

# **SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI**



## **THREE /FOUR-YEAR DEGREE OF BACHELOR OF SCIENCE**

### **Bachelor of Science**

**SUBJECT: ENVIRONMENTAL SCIENCE**

**FACULTY: SCIENCE AND TECHNOLOGY**

**(Courses effective from Academic Year 2026-2027)  
Under Uniform NEP 2020**

## **SYLLABUS**

**Semester I and II**

**Semester III and IV**

**Semester V and VI**

SANT GADGE BABA AMRAVATI UNIVERSITY,  
AMRAVATI



THREE YEAR UNDERGRADUATE  
PROGRAMME B.Sc. ENVIRONMENTAL  
SCIENCE  
FACULTY: SCIENCE AND TECHNOLOGY  
(Courses effective from Academic Year 2023-24) SYLLABUS  
  
(REVISED-2026-27)

SANT GADGE BABA AMRAVATI UNIVERSITY,  
AMRAVATI

**CONTENT**

| Sr. No | CONTENT                                                              | Page No. |
|--------|----------------------------------------------------------------------|----------|
| 1      | Preamble:                                                            | 3        |
| 2      | Core Competencies                                                    | 3        |
| 3      | Graduate Attributes                                                  | 4        |
| 4      | Program Outcomes                                                     | 5        |
|        |                                                                      |          |
| 5      | Teaching and Learning Scheme: for the B.Sc. FIRST YEAR: SEMESTER –I  | 9        |
| 6      | Teaching and Learning Scheme: for the B.Sc. FIRST YEAR: SEMESTER –II | 10       |
|        |                                                                      |          |
| 7      | Examination and Assessment Process:                                  | 12       |
| 8      | Examination, Evaluation and Assessment Scheme                        | 12       |
| 9      | Continuous Assessment Tests (CAT)                                    | 13       |
| 10     | Conduction of the Examination:                                       | 13       |
|        |                                                                      |          |
| 11     | B.Sc. Semester I: Major-Fundamental of Environments Science          | 15       |
| 12     | Semester I: Major-Lab                                                | 17       |
| 13     | Question Paper template for External / Internal Practical            | 18       |
| 14     | Semester I: GE/OEC Theory 1 -                                        | 19       |
| 15     | Semester I : GE/OEC Theory 2                                         | 21       |
| 16     | Sem-I, Skill Enhancement Course (SEC) Lab - 3                        | 24       |
| 17     | Assessment Rubric for Internal Practical                             | 24       |
|        |                                                                      |          |
| 18     | B.Sc. I (Environmental Science), SEMESTER – II (NEP)                 | 26       |
| 19     | Sem II Major Theory III-                                             | 26       |
| 20     | Sem II Major Lab                                                     | 29       |
| 21     | Question Paper for External/ for Internal Practical                  | 30       |
| 22     | Semester II: GE/OEC Course-III                                       | 31       |
| 23     | Semester II: GE/OEC Course IV                                        | 33       |
| 24     | Semester II: Vocational Skill Course Activities (VSC)                | 35       |
| 25     | Question Paper                                                       | 36       |
| 26     | Semester-II : Skill Enhancement Course (SEC) Lab/Practical-VI        | 37       |
| 27     | Question Paper for Internal Practical                                | 38       |

THREE YEAR UNDERGRADUATE  
PROGRAMME B.Sc. ENVIRONMENTAL  
SCIENCE  
FACULTY: SCIENCE AND TECHNOLOGY  
Sant Gadge Baba Amravati University  
FACULTY: Science and Technology  
(Three Years- Six Semesters Bachelor's Degree Programme)

Preamble:

Welcome to the Undergraduate Program in Environmental Science, an immersive and comprehensive journey into the world of Earth Sciences. The syllabus has given due importance on the main streams of the body of knowledge on 'Environment' with due recognition of its wide spectrum. Adequate emphasis has been given on the new and emerging techniques and understanding of the subject under the changing regime and global context. Historically, environment and conservation have been an integral part of India's ethical and spiritual values from ancient times. The degradation of our environment such as deforestation, pollution, the spread of wasteland etc. led to the need for placing environment education in curricula. In order to address the environmental challenges induced by anthropogenic activities, capacity building in Environmental Science is the need of the hour. There is a need for developing knowledgeable workforce in the areas such as climate change, pollution, waste management, sanitation, conservation of biological diversity, management of biological resources, forest and wildlife conservation, and sustainable development.

Doing this programme will enable the students to play decisive roles in addressing the environmental and sustainability concerns in India and across the world. It will help the learners to restore, protect, and sustain the environment and appreciate the interdependence between the components of the environment. The programme will give valuable insights to the learners with the necessary means and capacities to engage in fruitful assessment of environmental conditions, propose sustainable solutions and contribute to the formulation of suitable policies for environmental planning and sustainable development. The program will also help in shaping the students' overall personalities to take on the challenges of an emerging competitive society. It has incremental learning experiences that will enhance the abilities of students who come from diverse backgrounds. It will also provide opportunities to develop individual potentialities and to produce a pool of better professionals each year.

These major courses are supplemented with specialized vocational skill enhancement courses which are designed to equip the gap between academic learning and vocational expertise. Students immensely meticulously get acquainted with waste water treatment, field and lab skill for environmental analysis seamlessly connecting these skills to practical vocational applications like pollution monitoring, management, and entrepreneurship.

In addition to the core and vocational curricula, this program offers elective courses in critical and interesting areas like smart cities and sustainability, Environment and Green Marketing, Climate Change and its Implication, Health Safety and Environment. A unique feature of this program is the course on "Human Ecology", which integrates the study of the interactions between human and non-human nature in different cultures. Human Ecology combines the ideas and methods from several disciplines, including anthropology, sociology, biology, economic history and archeology. Our multidisciplinary approach enables us to comprehensively address issues of environmental justice and sustainability, offering students a unique perspective on the man, environment, biodiversity and pollution.

The graduates are not just academically proficient; they are also equipped with practical skills, an ethical mindset, and the capability to innovate and adapt in the dynamic field of Environmental science. They emerge as individuals who are ready to contribute in modern environmental concept like how to conserve biodiversity, acquiring skills to assist the concerned individuals in identifying and solving environmental problems. Capable to suggest the pathways to attain harmony with nature.

This program is an invitation to commence on a voyage of innovation, learning, and development in the appealing and interesting world of Environmental science. Preparing students to become Environmentalists for keeping the pace between sustainable development and man who will shape the future of nation and contribute positively to society and the environment.

Core Competencies:

Environmental competence is multidisciplinary, integrated and sociocultural in nature. Environmental competence structure is an integration of abilities, attitudes and creativity experience, and at the same time, "a specific combination of various abilities of the subject of activities that forms the basis of professional behavior aimed at solving environmental problems".

Based on the guidelines provided by the University Grants Commission under the National Education Policy 2020, the Graduate Attributes for the Discipline of Environmental Science for the Undergraduate Program at Sant Gadge Baba Amravati University can be defined as follows:

- Understanding Environment and Man relationship.
- Understanding the need of Environmental Monitoring.
- Understanding the importance of “3 Rs”.
- Understanding the application of technology and management tools in Environmental Conservation.
- Understanding Ecosystem Grasping the interconnectedness of life, tracing energy and nutrient flow, and understanding ecological relationships.

Supplementary Educational Attainment

- Analytical skills: Environmental scientists often use scientific methods and data analysis in their research. They base their conclusions on careful analysis of scientific data. They must consider all possible methods, interactions and solutions in their analyses.
- Critical-thinking skills: Environmental scientists must draw logical conclusions from observations, laboratory experiments, and other methods of research. They base their findings on sound observation and careful evaluation of data.
- Interpersonal skills: Environmental scientists typically work on teams with scientists, engineers, and technicians. Team members must be able to work together effectively to achieve their goals.
- Problem-solving skills: Environmental scientists try to find the best possible solution to problems that affect environment and cultures. They must be able to identify and anticipate problems to prevent losses for their employers, safeguard workers’ health, and mitigate environmental and cultural impacts.
- Experimental Proficiency: Demonstrating expertise in experimental techniques and methods within Environmental science.
- Speaking skills: Environmental scientists must be able to explain their findings to clients, professionals, or community members who do not have expertise in their area. They often give presentations to colleagues, managers, policymakers, and the general public.
- Writing skills: Environmental scientists write technical papers, reports and articles that explain their methods, findings, and recommendations.
- Integration of Digital Tools: Acquiring digital skills and amalgamating fundamental concepts with modern technological tools.
- Self-directed Learning: Acquiring knowledge and skills for higher studies, competitive examinations, and employment readiness.
- Ethical and Psychological Development: Strengthening ethical and moral principles, coupled with psychological resilience.

Curriculum Framework

Multidisciplinary and Holistic Education: Offering a comprehensive, in-depth, and focused curriculum that is student-centric and outcome-based.

Innovation and Curiosity: Promoting experiential learning, hands-on training, field studies, and internships to foster innovation and curiosity.

Adaptation to Modern Technology: Keeping abreast with the latest developments in Environmental sciences and technology.

Career Readiness: Equipping students with knowledge, competencies, and professional skills for the job market.

These attributes are designed to create well-rounded, skilled, and knowledgeable graduates who are ready to contribute effectively in their chosen careers and as responsible citizens.

Graduate Attributes

Graduates Attributes (GAs) are composed of independently measurable outcomes that signify the capabilities and potentials of the graduate to attain accomplishment and perform in adequate manner at appropriate situations.

The Graduate Attributes of B.Sc. Environmental Science are given as below:

GA1. Erudition of Acquaintance: Gain in-depth knowledge and understandings of discipline or professional area across boundaries of nations with an aptitude to identify, access, analyze and synthesize existing and new knowledge, and integrate them for the enrichment of knowledge.

GA2. Analytical Thinking: Critically to address multifaceted scientific issues and environmental phenomenon; pertain independent decision for synchronizing information to formulate innovative and intellectual advances towards focused research over wider theoretical and practical domains. GA3. Problem Solving: Address and solve scientific vis-a-vis environmental problems via rational and original thinking; keep updates of different solution avenues and select appropriate options considering public health, cultural, and societal factors.

GA4. Application of Modern Tools: Select, learn and apply appropriate techniques, resources, sophisticated instruments, models for explaining different environmental consequences and mitigation activities with a thorough understanding of drawbacks.

GA5. Mutual and Multidisciplinary Competence: Develop sound knowledge and perception about group dynamics, recognize role of individuals in a group, take initiatives and leadership in collaborative-multidisciplinary and trans-disciplinary scientific research, demonstrate a capacity for self-management and teamwork, timely decision-making through openness and flexibility, constructive arguments and rational analysis for achieving common goals and objectives; motivate group members to address environmental issues with a scientific outlook and mitigation approach. GA6. Communication Skill: Communicate scientific/technological knowhow and new learning to the scientific community and the society at large with strong conviction and confidence so that humanity benefit from the knowledge and technological development. This can be achieved through sound technical proficiency of graphics, software, writing skill, in-depth subject Environmental Science specifics knowledge, by maintaining appropriate standards, by the ability to render as well as receive comprehensible instructions.

GA7. Life-long Learning: Distinguish the importance and possess the ability to prepare and engage in the life-long learning process; also have the ability to transfer the acquired skills in other domains of science; which can be achieved through enthusiasm and commitment to improving knowledge and competence in a continuous manner.

GA8. Ethical values and Social Responsibility: Attain strong academic integrity, professional code of conduct, ethics of experimental research and scientific writings, contemplation of the impact of research findings on conventional practices, and a clear sense of responsibility towards societal needs and reaching the targets for attaining inclusive and sustainable development.

GA9: Entrepreneurial and Business Skills: Develop skills in commercialization of ecofriendly product, running of environmental consultancy entrepreneurship, in the areas of environmental impact assessment and audit preparing students for business ventures in Environmental Science.

GA10: Research Attitude: Encourage a strong foundation in research for students and motivate them towards IPR.

GA11. Futuristic attitude: Ability to recognize and address current environmental scenarios, scientific and technological progress, lifestyle change, and biophysical evolutions with a futuristic view; practicing intuitiveness and interest towards scientific prediction via application of basic knowledge of science especially with regard to India's SDGs in terms of economic welfare, social equity and proactive long-term environment management.

Minor Courses on Smart city and Sustainability cultivate an interdisciplinary and holistic approach to understanding and addressing complex issues that affect the environment, society, and economy. Students will learn how to integrate knowledge and methods from different disciplines, such as biology, geology, economics, sociology, and political science, to develop innovative and sustainable solutions to environmental and social problems.

The structure of the Vocational Skill Courses and Skill Enhancement Courses in Environmental science program is strategically designed to provide students with a comprehensive skill set that aligns directly with viable vocational pathways. For example, Waste water treatment plant its design and operation. This knowledge is then extended and applied in the course "Environmental laboratory techniques," enabling students to grasp the business aspects. Basic analysis of parameters can provide students excellent vocational opportunity in areas of environmental quality analysis. Another very huge door can be open for students from application of remote sensing and GIS with its application in Environmental Conservation.

The various aspects integrated in this program definitely build up and boost up the ideas of students so that it will become lead into the new era of eco marketing and also raise the Environmental Economics, Modeling, Tourism, Forest Carbon Specialist, Wildlife Film-Maker, Urban Planner and Product Manager-Environmental Health and Safety. This alignment of skills with vocational outcomes is key to providing students with a clear and achievable career path of post-graduation.

#### Program Outcomes

This program attempts to create pro-environment attitude and a behavioral pattern in student community and society that attaches importance and priority to create sustainable life style and

awareness on various environmental issues. This course is expected to inculcate a critical thinking on various dimensions of environment through knowledge, skill, critical thinking and problem-solving. It is an interdisciplinary academic field that integrates physical and biological sciences, (including but not limited to Ecology, Physics, Chemistry, Biology, Soil Science, Geology, Atmospheric Science and Geography) to the study of the environment, and the solution of environmental problems. Environmental science provides an integrated, quantitative, and interdisciplinary approach to the study of environmental systems.

- **Disciplinary knowledge** Enable students to develop a comprehensive understanding of various facets of life forms, ecological processes, and the impacts on them by humans during the Anthropocene era.
- **Critical thinking** Build capabilities to identify relevant environmental issues, analyze the various underlying causes, evaluate the practices and policies, and develop framework to make informed decisions.
- **Moral and ethical awareness/reasoning** Develop empathy for all life forms, appreciation for the various ecological linkages within the web of life, awareness and responsibility towards environmental protection and nature preservation.

Think critically and develop appropriate strategies (scientific, social, economic, administrative, and legal) for environmental protection, conservation of biodiversity, environmental equity, and sustainable development.

- **Demonstrate values and show compassionate attitudes** towards complex environmental economic-social challenges, and participate at national and international levels in solving current environmental problems and preventing the future ones.

- **Adopt sustainability as a practice** in life, society, and industry.

**Integrity and Adaptability:** Graduate will Catch up with daily activities to interweave life in an integrated manner. An integrated mindset helps things accomplish at an improved level. Working without boundaries and being flexible is one of the most important skills.

**Technological Competency:** Graduates will be familiar with modern technologies and tools relevant to environmental science including air, water, soil, microbial and analytical software.

**Creativity and Teamwork:** Graduates will become creative, creativity is not a skill, it's a necessity. Creativity comes from within. Inclination towards anything makes you explore it more and get into it to a level where you attain expertise. Teamwork and collaboration go together hand in hand. Teamwork is an exceptional skill that makes graduate unique. Indulge with team more and more and examine their qualities to make teamwork stronger.

**Branding, Marketing, and Networking Skills:** Graduate can get platform to enhance the skills which are essential for scaling the business and boosting opportunities. These skills enable entrepreneurs to promote and sell products or services. Branding creates a unique and memorable image of a product, service, or organization, and marketing promotes them to target consumers. Networking builds relationships and allows individuals to connect with potential customers, partners, suppliers, or colleagues.

**Innovation and Problem-Solving Skills:** Graduates will have the ability to apply creative and critical thinking to innovate and solve problems in the field of Environmental science.

**Employability Potential:** The students passing B.Sc. Degree in the subject Environmental Science have the opportunity of job and services in the field of Teaching, Researches, Projects, Effluent Treatment Plants of various Industries/Companies/Factories, Municipal Councils/Corporations, Central Pollution Control Board, State Pollution Control Boards, National Research Institutes/Organizations/Laboratories, NEERI, EIA, GIS, Environmental Monitoring Projects, Environmental Consultants, Different Laboratories, NGO's, Forest Department, Water Purification and Treatment Plants and Various Sectors related to the field of Environment.

This program will definitely boost an ability to identify, critically analyze, formulate and solve environmental problems using basic principles of nature conservation. Get acquainted with environmental and social impacts of any developmental activity. An ability to design and conduct experiments, interpret data, and provide well informed conclusions. Communicate effectively socio-economic problems related to environment by appropriate documentations and presentations.

THREE YEAR UNDERGRADUATE PROGRAMME  
B.Sc. ENVIRONMENTAL SCIENCE under FACULTY: SCIENCE AND TECHNOLOGY  
Board of Studies in Botany (Including Environmental Science and Seed Technology)

|                                                                                                                                                                                     |                                                                                                |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| 1. Agnihotri Dr. Adarsh Kumar,<br>Principal Scientific Officer, Bio-<br>processing & Herbal Division, Mahatma<br>Gandhi Institute for Rural<br>Industrialization, Maganwadi, Wardha | Shri Pundlik Maharaj Mahavidyalaya,<br>Nandura Rly                                             |
| 2. Dagwal Dr M. J.<br>Radhabai Sarada<br>Mahavidyalaya,<br>Anjangaon Surji                                                                                                          | 8. Kadu Dr. Suruchi R.,<br>Brijlal Biyani Science College, Amravati.                           |
| 3. DeosthaleDr. S. M.<br>B. B. Arts & N.B. Commerce & B.P.<br>Science College, Digras                                                                                               | 9. Khedkar Dr. Dinesh<br>Shri Shivaji Science College, Amravati                                |
| 4. Dongarwar, Dr. Nitin<br>M. Department of<br>Botany, Rashtrasant Tukdoji Maharaj<br>Nagpur University,<br>Nagpur                                                                  | 10. Khodke Dr. Suchita Pravin<br>Vinayak Vidnyan<br>Mahavidyalaya, Nandgaon<br>Kh.             |
| 5. Dr. Dipak K.<br>Koche,<br>Shri. Shivaji College of Arts,<br>Commerce & Science, Akola                                                                                            | 11. Maggirawar Dr. Rekha<br>Shri Shivaji Science College, Amravati                             |
| 6. Gawande Dr. P. A.<br>Dept. of Botany, Sant Gadge Baba<br>Amravati University. , Amravati                                                                                         | 12. Mangle Dr. Vijay<br>Art, Commerce and Science College,<br>Chikhaldara                      |
|                                                                                                                                                                                     | 13. Nathar Dr. Sou. V. N.<br>Dept. of Botany, Sant Gadge Baba Amravati<br>University, Amravati |
|                                                                                                                                                                                     | 14. Shahejad,Dr.M.A.<br>SPM Gilani Arts Commerce College,<br>Ghatanji, District -Yavatmal      |
|                                                                                                                                                                                     | 15. Wankhede Dr. Tushar Bhimrao<br>J. D. Patil Sangaludkar                                     |

THREE YEAR UNDERGRADUATE PROGRAMME  
B.Sc. ENVIRONMENTAL SCIENCE under FACULTY: SCIENCE AND TECHNOLOGY  
Sub- Committees Constituted by BoS (Botany Including Environmental Science and Seed  
Technology) for Curriculum Development in ENVIRONMENTAL SCIENCE for Semester I and II

|                                                                                                                                                                   |                                                                                                                                                                              |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Dr. V.S. Mangle<br>Professor & Head<br>Department of Environmental Science<br>Arts, Science and Commerce College,<br>Chikhaldara, Dist.-Amravati                  | Dr. S.P. Ingole, Associate<br>Professor & Head<br>Department of Environmental Science Shri<br>Shivaji Science College, Amravati                                              |
| Dr. V.U. Narnaware Meshram Professor<br>& Head<br>Department of Environmental Science Narsamma's<br>Arts , Commerce and Science College, Kiran<br>Nagar, Amravati | Prof. V. Bute<br>Assistant Professor<br>Department of Environmental Science Shri<br>Shivaji Science College, Amravati                                                        |
| Dr. S.K. Tippat,<br>Assistant Professor<br>Department of Environmental Science Narsamm's<br>Arts , Commerce and Science College, Kiran<br>Nagar, Amravati         | Dr. R. B. Barabde Associate<br>Professor<br>Department of Environmental Science<br>Shri Dnyaneshwar Maskuji Burungale Science and<br>Arts College, Shegaon Distt. - Buldhana |
| Dr. K.J. Gawai Associate<br>Professor<br>Department of Environmental Science Shri<br>Shivaji Science College, Amravati                                            | Prof. G. D. Muratkar<br>Assistant Professor<br>Department of Environmental Science<br>Arts, Science and Commerce College,<br>Chikhaldara, Dist.-Amravati                     |
| Dr. D.L. Bhade,<br>Associate Professor & Head<br>Shri Dnyaneshwar Maskuji Burungale Science and<br>Arts College, Shegaon Distt. - Buldhana                        |                                                                                                                                                                              |

THREE YEAR UNDERGRADUATE PROGRAMME  
B.Sc. ENVIRONMENTAL SCIENCE under FACULTY: SCIENCE AND TECHNOLOGY  
Sub- Committees Constituted by BoS (Botany Including Environmental Science and Seed Technology) for Curriculum Development in ENVIRONMENTAL SCIENCE for Semester I and II  
Paper wise contribution of faculties in preparation of B.Sc. I Semester I & II Syllabus of Environmental Science (NEP)

| B.Sc. I Semester -I                                                                                               | B.Sc. I Semester -II                                                                                                                                                                                                                                                                                   |
|-------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Fundamentals of Environmental Science. Dr. S.P. Ingole, Shri Shivaji Science College, Amravati.                   | Environment and Ecology<br>V. D. Bute<br>Shri Shivaji Science College, Amravati                                                                                                                                                                                                                        |
| Fundamentals of Environmental Science Major Lab-1<br>Dr. S.P. Ingole, Shri Shivaji Science College, Amravati      | Environment and Ecology Major Lab-2<br>V.D. Bute<br>Shri Shivaji Science College, Amravati                                                                                                                                                                                                             |
| Energy and Environment Dr. V.S. Mangle<br>Arts, Science and Commerce College, Chikhaldara, Dist.-Amravati         | Solid Waste Management<br>V.D. Bute<br>Shri Shivaji Science College, Amravati                                                                                                                                                                                                                          |
| Sustainable Development Dr. S.P. Ingole, Shri Shivaji Science College, Amravati.                                  | Water and Water Resources <ul style="list-style-type: none"><li>• Dr. V.S. Mangle<br/>Arts, Science and Commerce College, Chikhaldara, Dist.-Amravati.</li><li>• Dr. S.P. Ingole,<br/>Shri Shivaji Science College, Amravati.</li><li>• V.D. Bute<br/>Shri Shivaji Science College, Amravati</li></ul> |
| SEC- Energy and Sustainability Dr. V.S. Mangle<br>Arts, Science and Commerce College, Chikhaldara, Dist.-Amravati | Skills on Solid Waste Management.<br>Dr. V.S. Mangle<br>Arts, Science and Commerce College, Chikhaldara, Dist.-Amravati                                                                                                                                                                                |

Sant Gadge Baba Amravati University, Amravati FACULTY:

SCIENCE AND TECHNOLOGY

Teaching and Learning Scheme: for the Degree of Bachelor of Environmental Science and # as minor FIRSTYEAR: SEMESTER – I

| Mode of Teaching                                           | Vertical No. | The Vertical           | Type of Course  | Course Code | Course Name                             | Credits | Workload (Hrs/Week) | Vertical Workload (Hrs/Week) |
|------------------------------------------------------------|--------------|------------------------|-----------------|-------------|-----------------------------------------|---------|---------------------|------------------------------|
| Classroom Teaching / Lab Work (Practical)/ Outdoor / Field | a.           | Major/ Minor           | Theory1         | 114200      | Fundamentals of Environmental Science   | 2       | 2                   | 6                            |
|                                                            |              |                        | Lab/Practical-1 | 114201      | Environmental Science Major Lab-1       | 2       | 4                   |                              |
|                                                            | b.           | Minor/ Major           | Theory          | --          | --                                      | -       | -                   |                              |
|                                                            |              |                        | Lab/Practical   | -           | -                                       | -       | -                   |                              |
|                                                            | c.           | Generic/ Open Elective | Theory-1        | 114261      | Energy and Environment                  | 2       | 2                   | 4                            |
|                                                            |              |                        | Theory-2        | 114262      | Sustainable Development                 | 2       | 2                   |                              |
|                                                            | d.           | VSC                    | -               |             | -                                       | -       | -                   | 4                            |
|                                                            |              | SEC                    | Lab/Practical-3 | 114271      | Activities on Energy and sustainability | 2       | 4                   |                              |
|                                                            | e.           | AEC - English          | Theory          |             | Refer University basket                 | 1       | 1                   | 6                            |
|                                                            |              | AEC –MIL               | Theory          |             | Refer University basket                 | 1       | 1                   |                              |
|                                                            |              | IKS-Generic            | Theory          |             | Refer University basket                 | 2       | 2                   |                              |
|                                                            |              | VEC                    | Theory          |             | Refer University basket                 | 2       | 2                   |                              |
|                                                            | f.           | CC                     | Outdoor         |             | Separate SOP will be released           | 2       | 4                   | 4                            |
|                                                            |              | TOTAL                  |                 |             |                                         | 18      | 24                  | 24                           |

# Here mention the Minor Subject Opted by Student

Sant Gadge Baba Amravati University, Amravati FACULTY:  
SCIENCE AND TECHNOLOGY

Teaching and Learning Scheme: for the Degree of Bachelor of Environmental Science as Major and \$ as Minor FIRST  
YEAR: SEMESTER – II

| Mode of Teaching                                           | Vertical No. | The Vertical           | Type of Course  | Course Code | Course Name                                                    | Credits | Workload (Hrs/Week) | Vertical Workload (Hrs/Week) |
|------------------------------------------------------------|--------------|------------------------|-----------------|-------------|----------------------------------------------------------------|---------|---------------------|------------------------------|
| Classroom Teaching / Lab Work (Practical)/ Outdoor / Field | a.           | Major/ Minor           | Theory2         | 114202      | Environment and Ecology                                        | 2       | 2                   | 6                            |
|                                                            |              |                        | Lab/Practical-2 | 114203      | Major Lab/ Pr- Environment and Ecology                         | 2       | 4                   |                              |
|                                                            | b.           | Minor/ Major           | Theory          | -           | -                                                              | -       | -                   | -                            |
|                                                            |              |                        | Lab/Practical-5 | -           | -                                                              | -       | -                   |                              |
|                                                            | c.           | Generic/ Open Elective | Theory3         | 114263      | <b>Solid Waste Management</b>                                  | 2       | 2                   | 4                            |
|                                                            |              |                        | Theory4         | 114264      | Water and Water Resources                                      | 2       | 2                   |                              |
|                                                            | d.           | VSC                    | Lab/Practical-5 | 114272      | <b>Hands-on Techniques in Ecology and Biodiversity Studies</b> | 2       | 4                   | 8                            |
|                                                            |              | SEC                    | Lab/Practical-6 | 114273      | Basics of Solid Waste Management.                              | 2       | 4                   |                              |
|                                                            | e.           | AEC - English          | Theory          |             | Refer University basket                                        | 1       | 1                   | 4                            |
|                                                            |              | AEC –MIL               | Theory          |             | Refer University basket                                        | 1       | 1                   |                              |
|                                                            |              | VEC                    | Theory          |             | Refer University basket                                        | 2       | 2                   |                              |
|                                                            | f.           | CC                     | Outdoor         |             | Separate SOP will be released                                  | 2       | 4                   | 4                            |
|                                                            |              | TOTAL                  |                 |             |                                                                | 18      | 26                  | 26                           |

# Here mention the Minor Subject Opted by Student

Notes:

- a. The strength of the batch of the Practical for UG Classes shall be 16 with an addition of 10% with the permission of Hon'ble V Minor/ Major ice Chancellor. However, for Music Discipline the batch size shall be of 7 students. The number of the students required to constitute a batch or calculate the workload shall be in accordance with the relevant Government Resolution in force at the time, applicable to specific time, region, course type, mode of instruction, and other pertinent factors.
- b. 1 Credit shall mean 1 Hour Teaching per Week per Semester (Total 15 Hrs/ Semester), the duration of 1 Teaching Period will be 60 Minutes. For Practical 1 Credit shall mean 2 Hour Teaching per Week per Semester (Total 30 Hrs/ Semester).
- c. For Examination and Evaluation of Theory Courses, 40 % Marks shall be assigned to Internal Examination and 60% Marks shall be assigned to end-semester external university examination.
- d. Co-curricular Courses: Health and wellness, Yoga Education, Sports and Fitness, Cultural Activities, NSS/NCC, Fine/Applied/Visual/Performing Arts During Semester I, II, III, IV, V and VI. These courses may be taught by Physical Education Director or may be assigned to Language Teacher by the Principal of HEI based on the expertise of the concerned.
- e. Value Education Courses to be selected from the Basket of Courses provided by the University. These courses may be assigned to the Language Teacher by the Principal of HEI based on the expertise of the concerned.
- f. Generic / Open Elective Courses (GE/OE): Courses to be selected from the Basket of Courses provided by the University
- g. Abbreviations: Department Specific Core: DSC, Department Specific Elective: DSE, FSC: Faculty Specific Core, FSE: Faculty Specific Elective, Indian Knowledge System: IKS, Inter Faculty Specific Core: IFSC, Inter Faculty Specific Elective: IFSE, Theory : Th, Practical/Practicum: Pr, Environment Studies: ES, Pre-requisite Course mandatory if applicable: Prq, Laboratory: Lab (Practical), Generic/ Open Electives: OE; Vocational Skill and Skill Enhancement Courses: VSEC; Vocational Skill Courses: VSC; Skill Enhancement Courses: SEC; Ability Enhancement Courses: AEC; Value Education Courses: VEC; OJT: On Job Training: Internship/ Apprenticeship; Field projects: FP; Community Engagement and Service: CES; Co-curricular Courses: CC; RM: Research Methodology; Research Project: RP; MIL: Modern Indian Language

Examination and Assessment Process:

- i. The basic principle of the Credit framework is that Credits are a function of the successful completion of a program of study/ vocational education/ training and assessment. No Credit can be earned by the student unless the student is assessed for the achievement of the desired competencies and outcome of a program.
- ii. Exit options are provided with Certificate, Diploma and Basic Bachelor’s degrees to the students at the end of the second, fourth and sixth semesters of a Four Years Multidisciplinary Degree Programme. Students will receive a Bachelor’s degree with Honors/ Research on successfully completing of all eight semesters of the UG Program either at a stretch or with opted exits and re-entries.
- iii. For the smooth success of four-year degree programme with multiple entry and exit systems, the examination mode should be based on the combination of innovative trends in formative (informal and formal tests administered during the learning process) and summative (evaluation of students learning at the end of an instructional unit) examination modes in line with the UGC Report on ‘Evaluation Reforms in Higher Educational Institutions (2019).

Examination, Evaluation and Assessment Scheme

The total marks for each Course shall be based on Continuous Assessment and Semester End Examination.

Each theory course of Major, Minor, GE/OE, AEC, IKS, VEC as mentioned in Teaching Learning Scheme prepared by the Board of Studies shall be evaluated as per the scheme as mentioned in the following table -

Table: Examination, Evaluation and Assessment Scheme

| Vertical No. | The Vertical                   | Mode of Examination, Evaluation & Assessment | Theory                                                                                                                                                                                                                                                                     |            |            |            | Theory (Total) |            | Practical  |            |            |            | Practical (Total) |            |
|--------------|--------------------------------|----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|------------|------------|----------------|------------|------------|------------|------------|------------|-------------------|------------|
|              |                                |                                              | External                                                                                                                                                                                                                                                                   |            | Internal   |            |                |            | External   |            | Internal   |            |                   |            |
|              |                                |                                              | Max. Marks                                                                                                                                                                                                                                                                 | Min. Marks | Max. Marks | Min. Marks | Max. Marks     | Min. Marks | Max. Marks | Min. Marks | Max. Marks | Min. Marks | Max. Marks        | Min. Marks |
| a            | Major                          | External & Internal                          | 30                                                                                                                                                                                                                                                                         | 9          | 20         | 6          | 50             | 20         | 25         | 10         | 25         | 10         | 50                | 20         |
| b            | Minor                          |                                              | 30                                                                                                                                                                                                                                                                         | 9          | 20         | 6          | 50             | 20         | --         | --         | --         | --         | --                | --         |
| c            | Generic/ Open Elective         |                                              | 30                                                                                                                                                                                                                                                                         | 9          | 20         | 6          | 50             | 20         | --         | --         | --         | --         | --                | --         |
| d            | VSC                            | Internal                                     | --                                                                                                                                                                                                                                                                         | --         | 50         | 20         | 50             | 20         | --         | --         | 50         | 20         | 50                | 20         |
|              | SEC                            | Internal                                     | --                                                                                                                                                                                                                                                                         | --         | 50         | 20         | 50             | 20         | --         | --         | 50         | 20         | 50                | 20         |
| e            | AEC (Eng. & One MIL Composite) | External & Internal                          | 30                                                                                                                                                                                                                                                                         | 9          | 20         | 6          | 50             | 20         | --         | --         | --         | --         | --                | --         |
|              | IKS (Generic)                  | External & Internal                          | 30                                                                                                                                                                                                                                                                         | 9          | 20         | 6          | 50             | 20         | --         | --         | --         | --         | --                | --         |
|              | VEC                            | External & Internal                          | 30                                                                                                                                                                                                                                                                         | 9          | 20         | 6          | 50             | 20         | --         | --         | --         | --         | --                | --         |
| f            | Internship/ Apprenticeship     | Internal                                     | Assessment of these verticals shall be based on various activities/practices. It shall be evaluated by giving maximum marks of 50 per 2 Credit Course with separate activity weightages/levels. A detailed SOP for this assessment process shall be prescribed separately. |            |            |            |                |            |            |            |            |            |                   |            |
|              | FP/CEP                         |                                              |                                                                                                                                                                                                                                                                            |            |            |            |                |            |            |            |            |            |                   |            |
|              | CC                             |                                              |                                                                                                                                                                                                                                                                            |            |            |            |                |            |            |            |            |            |                   |            |

## Continuous Assessment Tests (CAT)

For internal assessment, the Continuous Assessment Tests (CAT) shall be conducted as under-

- i. Three CAT each of 8 / 10 Marks (Theory) as applicable and 10 Marks (Practical).
  - First on completion of 25% Syllabus of the course or on completion of 25 teaching days,
  - Second on completion of 50% Syllabus of the course or on completion of 50 teaching days,
  - Third on completion of 75% Syllabus of the course or on completion of 75 teaching days.
- ii. Each concurrent assessment (CAT-I, II & III) will be mapped to relevant Course Learning Outcome.
- iii. Total Performance in CAT (i.e. 40 %) shall be based on the best two out of three in CAT examinations
- iv. Internal assessment shall be carried out by the respective course teacher by choosing variety of assessment tools/methods such as class test, record book, seminar, case study, field work, mini project work, quiz or any innovative method, which may be deemed to be appropriate for AIW2 assessing the relevant course outcome.

## Conduction of the Examination:

As per the scheme of teaching, learning, examination and evaluation, theory/practical examinations of Semester-I, II, III, IV, V, VI, VII and VIII shall be conducted by the University (except for Internal Examinations as applicable) at the end of each semester.

The theory/practical examinations of all the Semesters shall be held as per the following Schedule –

| Sr. No. | Name of the Examination      | End Sem Examination | Supplementary Examination* |
|---------|------------------------------|---------------------|----------------------------|
| 1       | Semester-I, III, V and VII   | Winter              | Summer                     |
| 2       | Semester-II, IV, VI and VIII | Summer              | Winter                     |

\* The University may evolve mechanism for conducting repeat end semester examination. Such repeat examinations shall have to be conducted within one month of the regular even semester examination and on demand examination.

1. The practical examination of all semesters shall be conducted by the University at the end of each semester. The HEI shall conduct the Practical examination of odd semesters as per the schedule announced by the University. However, the appointment of the External and Internal Examiners shall be done by the Head or Principal of respective HEI to conduct external examination of the odd semester and the same should be communicated to the University before commencement of the practical examination. The University shall conduct the external practical examination of all even semester by appointing external and internal examiners.
2. The examinations specified above shall be held twice in a year at such places and on such dates as may be prescribed by the University.
3. An applicant to an examination specified above, shall pursue a regular course of study in courses prescribed for the examination concerned for not less than one semester in a particular semester in a College/Institute/University department.
4. Provided that the student shall be eligible to appear for examination if -
  - a. He/she complies with the provisions of the Ordinance pertaining to the Examination in general from time to time.
  - b. He/she has prosecuted a regular course of study in a university department/college affiliated to the University.
  - c. He/she has in the opinion of the Principal shown satisfactory progress in his/her studies.
5. The provisions of Ordinance No. 6 and Ordinance No. 9 shall be *mutatis-mutandis* applicable to every collegiate/non-collegiate student.
6. The fees for each theory examination and practical examination conducted by the university shall be as prescribed by the University, from time to time.

THREE YEAR UNDERGRADUATE PROGRAMME  
B.Sc. Environmental Science  
FACULTY: SCIENCE AND  
TECHNOLOGY SEMESTER – I

| Vertical | Type of Course  | Course Code | Course Name                             |
|----------|-----------------|-------------|-----------------------------------------|
| Major    | Major Theory1   | 114200      | Fundamental of Environment              |
|          | Lab/Practical-1 | 114201      | Major Lab/Pr-2                          |
| Minor    | Minor Theory1   | -           | -                                       |
|          | Lab/Practical-2 | -           | -                                       |
| GOEC     | G/OEC Theory1   | 114261      | Energy and Environment                  |
| GOEC     | G/OEC Theory2   | 114262      | Sustainable Development                 |
| SEC      | Lab/Practical-3 | 114271      | Activities on Energy and sustainability |

Sant Gadge Baba Amravati University, Amravati FACULTY:  
SCIENCE AND TECHNOLOGY  
Teaching and Learning Scheme: for the Degree of Bachelor of Environmental Science Syllabus for  
Major Courses  
**Major Th- 1 Fundamental of Environments Science**

| Level | Semester | Course Code | Course Name                                     | Credits | Teaching Hours | Exam Duration | Max Marks         |
|-------|----------|-------------|-------------------------------------------------|---------|----------------|---------------|-------------------|
| 4.5   | I        | 114200      | Major Th- 1 Fundamental of Environments Science | 2       | 30             | 2 Hrs         | Ext-30<br>Int- 20 |

|                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                         |                              |                                                                                                                                               |  |
|------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|--|
| Course Objectives:                                                                                                     | 1. Explain the structure and composition of different components of environment including atmosphere, hydrosphere, biosphere and lithosphere.<br>2. Describe the process of rock and soil formation and understand its significance in environment.<br>3. Classify geological hazards into different categories based on their types, causes, effects and prevention.<br>4. Identify and recognized the carrier scope in the field of environmental science. |                         |                              |                                                                                                                                               |  |
| Course Outcomes:                                                                                                       | CO-1: Understand the components of environment CO-2:<br>Describe the concept of Earth Geology<br>CO-3: Evaluate characteristics of geological hazards<br>CO-4: Understand the Carrier scope in Environmental Science.                                                                                                                                                                                                                                        |                         |                              |                                                                                                                                               |  |
| Unit System                                                                                                            | Contents                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Workload Allotted (Hrs) | Weighta ge of Marks Allotted | Incorporation of Pedagogies                                                                                                                   |  |
| Unit I                                                                                                                 | Physical Environment                                                                                                                                                                                                                                                                                                                                                                                                                                         | 8                       | 8                            | Chalk and talk, FW, Visits, use of ICT charts, models, problem based learning and collaborative learning. Theory, Self-study and Case studies |  |
|                                                                                                                        | 1.1: Concept of Earth System Science.                                                                                                                                                                                                                                                                                                                                                                                                                        |                         |                              |                                                                                                                                               |  |
|                                                                                                                        | 1.2: Components of Environment:<br>1.2.: Atmosphere - Definition, Structure and Composition.                                                                                                                                                                                                                                                                                                                                                                 |                         |                              |                                                                                                                                               |  |
|                                                                                                                        | 1.2: Hydrosphere – Definition, Distribution of Water and Hydrological Cycle                                                                                                                                                                                                                                                                                                                                                                                  |                         |                              |                                                                                                                                               |  |
|                                                                                                                        | 1.3: Biosphere - Definition, Boundaries of Biosphere                                                                                                                                                                                                                                                                                                                                                                                                         |                         |                              |                                                                                                                                               |  |
| 1.4: Lithosphere - Definition, Internal Structure of Earth.                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                         |                              |                                                                                                                                               |  |
| Unit II                                                                                                                | Environmental Geology                                                                                                                                                                                                                                                                                                                                                                                                                                        | 7                       | 7                            |                                                                                                                                               |  |
|                                                                                                                        | 2.1: Rocks - Types and their formation.                                                                                                                                                                                                                                                                                                                                                                                                                      |                         |                              |                                                                                                                                               |  |
|                                                                                                                        | 2.2: Soil - Definition, Composition, Formation, Soil Profile and Physical, Chemical and Biological Properties of Soil.                                                                                                                                                                                                                                                                                                                                       |                         |                              |                                                                                                                                               |  |
| 2.3: Environmental Geosciences: Concept of Plate Tectonics- Major Plates and their Boundaries.                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                         |                              |                                                                                                                                               |  |
| Unit III                                                                                                               | Geological hazards                                                                                                                                                                                                                                                                                                                                                                                                                                           | 8                       | 8                            |                                                                                                                                               |  |
|                                                                                                                        | 3.1: Geological hazards- Definition and Introduction, Types, Causes, Effects and Prevention - Earth Quakes and Floods.                                                                                                                                                                                                                                                                                                                                       |                         |                              |                                                                                                                                               |  |
|                                                                                                                        | 3.2: Geological hazards- Definition and Introduction, Types, Causes, Effects and Prevention of Volcano’s and Desertification.                                                                                                                                                                                                                                                                                                                                |                         |                              |                                                                                                                                               |  |
|                                                                                                                        | 3.3: Geological hazards- Definition and Introduction, Types, Causes, Effects and Prevention - Cyclones and Landslides.                                                                                                                                                                                                                                                                                                                                       |                         |                              |                                                                                                                                               |  |
| 3.4: Geological hazards- Definition and Introduction, Types, Causes, Effects and Prevention - Forest Fire and Tsunami. |                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                         |                              |                                                                                                                                               |  |
| Unit IV                                                                                                                | Weather and Climate                                                                                                                                                                                                                                                                                                                                                                                                                                          | 7                       | 7                            |                                                                                                                                               |  |
|                                                                                                                        | 4.1: Clouds - Definition, Formation and Types                                                                                                                                                                                                                                                                                                                                                                                                                |                         |                              |                                                                                                                                               |  |
|                                                                                                                        | 4.2: Precipitation- Types (Orographic, Convectional, Cyclonic) and Forms of precipitation (Rain, Drizzle, Sleet, Hail, Snow)                                                                                                                                                                                                                                                                                                                                 |                         |                              |                                                                                                                                               |  |

|                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |  |  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|
|                                                                                                                                                                                                                                                                                                                                                                                    | 4.3: Monsoon – Introduction and Meaning, Monsoon System of India: Southwest Monsoon and Northeast Monsoon                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |  |  |
|                                                                                                                                                                                                                                                                                                                                                                                    | 4.2: El-Nino and La-Nina - Concept and Mechanism                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |  |  |
| <p>References:</p> <p>Physical geography by Savendra Singh Physical<br/>Geology by P.K. Mukherji Environmental<br/>Geography by Savendra Singh<br/>Climatology: Atmosphere By- K. Siddharth (Kitab Mahal) Reference<br/>Books<br/>Engineering and general Geology by Parbin Singh<br/>Engineering and general Geology by Parbin Singh<br/>Environmental Geology by K.S. Waldia</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |  |  |
| Model Questions:                                                                                                                                                                                                                                                                                                                                                                   | <p>Short Type (At least 8):</p> <ol style="list-style-type: none"><li>1. Draw a well labelled diagram of hydrological cycle</li><li>2. What are the Metamorphic Rocks give its example.</li><li>3. Comment on types of igneous Rocks.</li><li>4. What is composition of atmosphere?</li><li>5. Explain characteristics of Tsunami.</li><li>6. Well labelled diagram for soil profile.</li><li>7. Causes of earthquake</li><li>8. What are rocks? Describe Igneous rocks</li></ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |  |  |  |
|                                                                                                                                                                                                                                                                                                                                                                                    | <p>Long Type (At least 4):</p> <ol style="list-style-type: none"><li>1. What are cyclones? Describe its causes, types and effect</li><li>2. Describe with diagram hydrological cycle</li><li>3. What is Soil? Give its composition. Describe the mechanism of soil formation</li><li>4. What are Volcanoes? Describe the causes, types and effects of volcanos.</li></ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |  |  |
|                                                                                                                                                                                                                                                                                                                                                                                    | <p>MCQs for Internal Assessment (At least 8)</p> <ol style="list-style-type: none"><li>1. The opening of dome of volcano is called as _____<br/>a- Mouth, b-cone, c- vent d- mountain.</li><li>2. Lower most layer of atmosphere is _____<br/>a. troposphere, b- stratosphere, c- ionosphere, d- mesosphere</li><li>3. The tropospheric lapse rate is _____<br/>(a) 4.5 °C/km (b) 6.5 °C/km (c) 5.5 °C/km</li><li>4. The rocks formed from cooling of Lava are called _____<br/>a. metamorphic, b-igneous, c- sedimentary, d- secondary.</li><li>5. Tropical savannah is dominated by:<br/>(a) Conifers (b) Grasses (c) Mosses (d) Ferns</li><li>6. The gaseous envelope present around the earth is<br/>(a) Hydrosphere (b) Atmosphere (c) Ozone</li><li>7. Typhoons and hurricanes are the examples of<br/>(a) Volcanoes (b) Floods (c) Cyclones</li><li>8. The stratosphere is characterized by presence of _____ gas.<br/>a.- Carbon oxide, b- ozone, c- nitrogen, d- hydrogen.</li></ol> |  |  |  |

Rubric for Internal Assessment for Theory Paper

| SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI      |                                        |                                     |               |
|----------------------------------------------------|----------------------------------------|-------------------------------------|---------------|
| Internal Assessment                                |                                        |                                     |               |
| B.Sc. I (Environmental Science) SEMESTER – I (NEP) |                                        |                                     |               |
| Paper: Maj/Theo-1                                  | Course Code: 114200                    | Fundamental of Environments Science | Max Marks: 20 |
| S.N.                                               | Assessment Criteria                    |                                     | Marks         |
| 1.                                                 | Attendance                             |                                     | 5             |
| 2.                                                 | Class Assignments                      |                                     | 5             |
| 3.                                                 | MCQ                                    |                                     | 5             |
| 4.                                                 | Participation in Activity/ Field visit |                                     | 2             |
| 5.                                                 | Overall Performance                    |                                     | 3             |

**Major Lab/Practical-1.**

| Level | Semester | Course Code | Course Name            | Credits | Teaching Hours | Exam Duration | Max Marks        |
|-------|----------|-------------|------------------------|---------|----------------|---------------|------------------|
| 4.5   | I        | 114201      | Major Lab/Practical-1. | 2       | 60             | 4 Hrs         | Ext-25<br>Int-25 |

|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                           |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|
| Course Objectives: | 1. Recall fundamental term, concept and methods related to water analysis.<br>2. Describe the analytical method for water and soil analysis.<br>3. Explain the parameters related to meteorology and understand its significance in the weather condition.<br>4. Identify the different rock and mineral types and understand how they are important in environment.                                                                                                |                                                                                           |
| Course Outcomes:   | CO-1. Determine the quality of water and evaluate degree of pollution. CO-2. Evaluate quality of Soil and its properties.<br>CO-3. Demonstrate experiments on meteorology.<br>CO-4. Handle, standardize and maintain the basic instruments such as pH meter, conductivity meter and meteorological equipment's.<br>CO-5. Identify types of rocks and minerals.                                                                                                      |                                                                                           |
|                    | A) Experiments on water analysis                                                                                                                                                                                                                                                                                                                                                                                                                                    | Incorporation of Pedagogies                                                               |
|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                           |
| 1.                 | Measurement of pH                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Sampling, Analysis, Field work comparative study, Assignment, project work.               |
| 2.                 | Measurement of electrical conductivity                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                           |
| 3.                 | Determination of dissolved Oxygen                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                           |
| 4.                 | Determination of free CO2                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                           |
| 5                  | Determination of turbidity                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                           |
|                    | B) Experiments on Soil and rocks and minerals                                                                                                                                                                                                                                                                                                                                                                                                                       | Experiential learning, group learning, Inquiry based learning and Expeditionary learning. |
| 1.                 | Determination of soil temperature                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                           |
| 2.                 | Determination of soil moisture                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                           |
| 3.                 | Determination of soil texture                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                           |
| 4.                 | Determination of soil electrical conductivity                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                           |
| 5.                 | Determination of soil pH                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                           |
| 6.                 | Determination of soil organic content                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                           |
| 7.                 | To study the properties of rocks and minerals (Streak, luster, texture, hardness, color etc.).                                                                                                                                                                                                                                                                                                                                                                      |                                                                                           |
|                    | C) Experiments on meteorology                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                           |
| 1.                 | Measurement of humidity and relative humidity                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                           |
| 2.                 | Measurement of light intensity                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                           |
| 3.                 | Monitoring wind speed and direction                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                           |
| 4.                 | Monitoring wind speed and direction                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                           |
| 5.                 | Measurement of rain fall                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                           |
|                    | D) Practical Based Activity                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                           |
| 1.                 | Field Studies of Geological site                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                           |
| 2.                 | Collection of different Rock and Soil Samples                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                           |
| 3.                 | Experiential Learning at Local Water Sites (Sampling and Analysis)                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                           |
| 4.                 | Case Studies on Geological Hazards                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                           |
| 5.                 | Visit to Geological Museum                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                           |
| 6.                 | Visit to Weather Station                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                           |
| References:        | Physical and chemical methods in soil analysis by Dipak Sarkar and Abhijit Haldar Method of soil analysis by Uttam Kumar and V. N. Mishra<br>Soil and water analysis: A practical manual by Dr. Rama Kant Singh, Dr. Pankaj Kumar Yadav Metrology and Measurements by Dr. G. K. Vijayaghavan<br>Fundamentals of Dimensional Metrology 5 <sup>th</sup> Edition by Connie L. Dotson Mechanical Measurement and Metrology by Prof. M. K. Vora, Prof. Kartik D. Pipalia |                                                                                           |

Question Paper template for External Practical Corse

| SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI<br>EXTERNAL PRACTICAL EXAMINATION<br>B.Sc. I (Environmental Science), SEMESTER – I (NEP) |                                    |                                                        |                     |                |
|----------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|--------------------------------------------------------|---------------------|----------------|
| Sem I    Major<br>Lab/Practical-1                                                                                                      | Course Code:<br>114200             | Major Lab/ Pr-1 Fundamental of<br>Environments Science | Max<br>Marks:<br>25 | Time: 4<br>Hrs |
| EXTERNAL                                                                                                                               |                                    |                                                        |                     |                |
| Question No.                                                                                                                           | Exercise                           |                                                        | Marks               |                |
| 1.                                                                                                                                     | Experiment based on water analysis |                                                        | 5                   |                |
| 2.                                                                                                                                     | Experiments on Soil analysis       |                                                        | 5                   |                |
| 3.                                                                                                                                     | Experiments on rocks and minerals  |                                                        | 5                   |                |
| 4.                                                                                                                                     | Experiments on meteorology         |                                                        | 5                   |                |
| 5.                                                                                                                                     | Viva Voce                          |                                                        | 5                   |                |

Question Paper template for Internal Practical Course

| SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI<br>PRACTICAL EXAMINATION<br>B.Sc. I (Environmental Science), SEMESTER – I (NEP) |                                        |       |
|-------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|-------|
| INTERNAL                                                                                                                      |                                        |       |
| S. No.                                                                                                                        | Assessment Criteria                    | Marks |
| 1.                                                                                                                            | Record/ Assignments                    | 7     |
| 2.                                                                                                                            | Attendance                             | 6     |
| 3.                                                                                                                            | Participation in Activity/ Field visit | 6     |
| 5.                                                                                                                            | Student Overall Performance            | 6     |
| Total                                                                                                                         |                                        | 25    |

**Theory 1 (GE/OE) Energy and Environment**

| Level | Semester | Course Code | Course Name                                | Credits | Teaching Hours/week | Exam Duration | Max Marks |
|-------|----------|-------------|--------------------------------------------|---------|---------------------|---------------|-----------|
| 4.5   | I        | 114261      | Theory 1 (GE/OE)<br>Energy and Environment | 2       | 1                   | 2 Hrs         | 30 + 20   |

|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                         |                             |                                                                                                                                                                                                 |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course Objectives: | 1. Learn types and availability of Energy resources & interaction of energy utilization with environment.<br>2. Explain types & availability of energy resources.<br>3. Describes renewable energy resources.<br>4. Identify impact of energy utilization on environment.<br>Adapt strategies to conserve energy.                                                                                                                                                 |                         |                             |                                                                                                                                                                                                 |
| Course Outcomes:   | CO-1: Identifies weather energy resource is renewable or nonrenewable. CO-2: Demonstrates the non-conventional energy resources.<br>CO-3: Identifies impact of utilization of energy on environment.<br>CO-4: Compare availability, utility and implications of renewable and nonrenewable energy resources. CO-5: Critique the effectiveness of different conservation strategies for energy.<br>CO-6: Justifies utility of energy resource among the its types. |                         |                             |                                                                                                                                                                                                 |
| Unit System        | Contents                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Workload Allotted (Hrs) | Weightage of Marks Allotted | Incorporation of Pedagogies                                                                                                                                                                     |
| Unit I             | Energy Recourses                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 8                       | 8                           | 1. Use of Charts, diagrams , ppt's of various energy resources.<br>2. Demonstration of working models of energy conversion.<br>3. Organize experiential learning through visit to power plants. |
|                    | 1.1: Energy: Forms and Importance                                                                                                                                                                                                                                                                                                                                                                                                                                 |                         |                             |                                                                                                                                                                                                 |
|                    | 1.2: Ddistribution and Availability of Energy Resources                                                                                                                                                                                                                                                                                                                                                                                                           |                         |                             |                                                                                                                                                                                                 |
|                    | 1.3: Global Energy Resources, Renewable and Non-renewable Resources.                                                                                                                                                                                                                                                                                                                                                                                              |                         |                             |                                                                                                                                                                                                 |
|                    | 1.4: Nonrenewable Energy Resources: Classification, Physico-Chemical Characteristics and Energy Content of: Fossil Fuels, Coal, Petroleum and Natural Gas.                                                                                                                                                                                                                                                                                                        |                         |                             |                                                                                                                                                                                                 |
| Unit II            | Renewable Energy Sources                                                                                                                                                                                                                                                                                                                                                                                                                                          | 7                       | 7                           |                                                                                                                                                                                                 |
|                    | 2.1: Principle and Generation of Solar Energy (photo-Voltaic)                                                                                                                                                                                                                                                                                                                                                                                                     |                         |                             |                                                                                                                                                                                                 |
|                    | 2.2: Solar Water Heating System & Solar Ponds                                                                                                                                                                                                                                                                                                                                                                                                                     |                         |                             |                                                                                                                                                                                                 |
|                    | 2.3: Wind Energy, Geothermal Energy, Tidal Energy, OTEC                                                                                                                                                                                                                                                                                                                                                                                                           |                         |                             |                                                                                                                                                                                                 |
|                    | 2.4: Energy from Biomass, Biofuels                                                                                                                                                                                                                                                                                                                                                                                                                                |                         |                             |                                                                                                                                                                                                 |
|                    | 2.5: Advantages and Disadvantages                                                                                                                                                                                                                                                                                                                                                                                                                                 |                         |                             |                                                                                                                                                                                                 |
| Unit III           | Energy, Environment and Society                                                                                                                                                                                                                                                                                                                                                                                                                                   | 8                       | 8                           |                                                                                                                                                                                                 |
|                    | 3.1: Energy Production as Driver of Environmental Change; Nature, Scope and Analysis of Local and Global Impacts of Energy Use on the Environment                                                                                                                                                                                                                                                                                                                 |                         |                             |                                                                                                                                                                                                 |
|                    | 3.2: Eenergy Over-Consumption and its Impact on the Environment, Economy, and Global Change                                                                                                                                                                                                                                                                                                                                                                       |                         |                             |                                                                                                                                                                                                 |
|                    | 3.3: Energy Production and its Impact on the Environment                                                                                                                                                                                                                                                                                                                                                                                                          |                         |                             |                                                                                                                                                                                                 |
|                    | 3.4: Ssocial Inequalities Related to Energy Production, Distribution, and Use; Energy Conservation.                                                                                                                                                                                                                                                                                                                                                               |                         |                             |                                                                                                                                                                                                 |
| Unit IV            | Future Aspects of Energy Use and Energy Conservation                                                                                                                                                                                                                                                                                                                                                                                                              | 7                       | 7                           |                                                                                                                                                                                                 |
|                    | 4.1: Current and Future Energy use Patterns in the World and in India                                                                                                                                                                                                                                                                                                                                                                                             |                         |                             |                                                                                                                                                                                                 |
|                    | 4.2. Evolution of Energy Use Over Time; Alternative Sources as Energy                                                                                                                                                                                                                                                                                                                                                                                             |                         |                             |                                                                                                                                                                                                 |
|                    | 4.3: Need for Energy Efficiency; Energy Conservation and Sustainability                                                                                                                                                                                                                                                                                                                                                                                           |                         |                             |                                                                                                                                                                                                 |
|                    | 4.4: Acation Strategies for Sustainable Energy Management from a Future Perspective                                                                                                                                                                                                                                                                                                                                                                               |                         |                             |                                                                                                                                                                                                 |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| References: | <p>Study Materials in the form of - Reference Books, Text Books, Research Articles, Digital Resources like Weblinks, E-Contents, Educational Software, Databases, etc.</p> <ol style="list-style-type: none"> <li>1. Hand book of energy and environment, Bani P. Banarji, Oxford .</li> <li>2. Energy and Environment: A study Energy Management, K.C. Gupta, Rekhta Books.</li> <li>3. Energy and Environment in India, Johannes Urpelainen, Columbia University Press.</li> <li>4. Environment, Energy and Climate Change, Nawneet Vibhaw, E-book Lexis Knowledge</li> <li>5. TERI Energy &amp; Environment Data Diary and Yearbook (TEDDY) 2018-19</li> <li>6. Earth And Planetary Science, Indian Academy Of Science, Bangalore Indian Academy Of Science.</li> <li>7. BIORESOURCES AND ENVIRONMENT, TRIPATHI S, NEW DELHI CAMPUS.</li> <li>8. L Agriculture And Water Management. Narasaiah M, New Delhi Discovery.</li> <li>9. Water Resource Management, Rao Nageswara K , New Delhi New Century Publishing.</li> <li>10. Physico Chemical Examination Of Water Sewage, Maniraska, Meerut Pragati.</li> </ol> |
|             | <p>Short Type (At least 8):</p> <ol style="list-style-type: none"> <li>1. Define Energy and its unit.</li> <li>2. Explain renewable energy resources</li> <li>3. Explain photovoltaics.</li> <li>4. Describe adverse effects of non- renewable energy resources on environment.</li> <li>5. Which are the fuels for future, explain.</li> <li>6. Explain advantages of solar energy resource.</li> <li>7. Describe principle involved in OTEC</li> <li>8. Why non- conventional energy are said to be ecofriendly?</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|             | <p>Long Type (At least 4):</p> <ol style="list-style-type: none"> <li>1. Discuss strategies to conserve energy.</li> <li>2. Discuss energy use pattern in India.</li> <li>3. Explain advantages and limitations of renewable and nonrenewable energy resources.</li> <li>4. Discuss fuels of future.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|             | <p>MCQs for Internal Assessment (At least 8)</p> <ol style="list-style-type: none"> <li>1. -----technology is used to convert solar energy into electric.<br/>a- magneto-hydro-dynamics, b-photovoltaics, c- thermodynamics, d- geothermal.</li> <li>2. -----is non-renewable energy resource.<br/>a- coal, b- solar, c- wind, d- tidal.</li> <li>3. The term OTEC is related with-----<br/>a- wind, b- solar, c- ocean, d- land.</li> <li>4. In India, maximum electricity is generated by -----power.<br/>a- hydro, b- nuclear, c- thermal, d- solar.</li> <li>5. -----is not a fossil fuel.<br/>a- coal, b- petroleum, c- nuclear, d- natural gas.</li> <li>6. Geothermal energy is nothing but energy-----.<br/>a- sun, b- water, c- wind, d-interior of earth.</li> <li>7. Gasohol is fuel with blending of -----in to gasoline or petrol.<br/>a- spirit, b- ethanol, c- acetone, d- diesel.</li> <li>8. Prime source of energy to earth is ----- .<br/>A- moon, b- sun, c- coal, d- wood.</li> </ol>                                                                                                            |

## Rubric for Internal Assessment for Theory Paper

| SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI      |                                        |                        |               |
|----------------------------------------------------|----------------------------------------|------------------------|---------------|
| Internal Assessment                                |                                        |                        |               |
| B.Sc. I (Environmental Science) SEMESTER – I (NEP) |                                        |                        |               |
| Paper:<br>GOEC-1                                   | Course Code: 114261                    | Energy and Environment | Max Marks: 20 |
| S.N.                                               | Assessment Criteria                    |                        | Marks         |
| 1.                                                 | Attendance                             |                        | 5             |
| 2.                                                 | Class Assignments                      |                        | 5             |
| 3.                                                 | Unit Test                              |                        | 5             |
| 4.                                                 | Participation in Activity/ Field visit |                        | 2             |
| 5.                                                 | Overall Performance                    |                        | 3             |

## Semester I: GE/OE-2

| Level | Semester | Course Code | Course Name                           | Credits | Teaching Hours/week | Exam Duration | Max Marks |
|-------|----------|-------------|---------------------------------------|---------|---------------------|---------------|-----------|
| 4.5   | I        | 114262      | Th- 2 (GE/OE) Sustainable Development | 2       | 1                   | 2 Hrs         | 30 + 20   |

|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                         |                             |                                                                                                                                                                                                                                 |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course Objectives: | 1. Understand the concept of Environmental Sustainability and act for it.<br>2. Describes the origin of concept of sustainable development.<br>3. Explains sustainability & carrying capacity.<br>4. Reviews global scenario of Sustainable development.<br>5. Focuses on agro sustainability and major issues in rural and urban areas.                                                                                                                                                                                                                                                                                                      |                         |                             |                                                                                                                                                                                                                                 |
| Course Outcomes:   | CO-1: Define sustainability and identify major sustainability challenges.<br>CO-2: Understand of the carrying capacity of ecosystems as related to providing for human needs. CO-3: Uunderstand their social responsibility as future professionals and citizens.<br>CO-4: Analyze power, structures of inequality, and social systems that govern individual and communal life.<br>CO-5: Recognize the global implications of their actions.<br>CO-6: Identify, act on, and evaluate their professional and personal actions with the knowledge and appreciation of interconnections among economic, environmental, and social perspectives. |                         |                             |                                                                                                                                                                                                                                 |
| Unit System        | Contents                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Workload Allotted (Hrs) | Weightage of Marks Allotted | Incorporation of Pedagogies                                                                                                                                                                                                     |
| Unit I             | Fundamentals Of Sustainable Development                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 8                       | 8                           | 1. Use of Charts, diagrams , ppt's of examples of sustainability.<br>2. Engage student in group discussion and assignments.<br>3. Organize experiential learning through visit to aspects related to sustainability in society. |
|                    | 1.1: The Conflicts Between Environment and Development                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                         |                             |                                                                                                                                                                                                                                 |
|                    | 1.2: The definition and Genesis of the Term Sustainable Development. The need for Sustainable Development                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                         |                             |                                                                                                                                                                                                                                 |
|                    | 1.3 Salient Features of Brundtland's Commission                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                         |                             |                                                                                                                                                                                                                                 |
|                    | 1.4: The role of World Commission on Environment and Development in Conceiving the Concept of Sustainable Development                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                         |                             |                                                                                                                                                                                                                                 |
| Unit II            | The Arts and Science of Sustainability                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 7                       | 7                           |                                                                                                                                                                                                                                 |
|                    | 2.1: Concept of Sustainability                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                         |                             |                                                                                                                                                                                                                                 |
|                    | 2.2: Development and Conflicts Among Weak and Strong Sustainability Concepts                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                         |                             |                                                                                                                                                                                                                                 |
|                    | 2.3: Development of Concept of Carrying Capacity of the Earth and Ecological Footprints                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                         |                             |                                                                                                                                                                                                                                 |
|                    | 2.4: Sustainability Index                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                         |                             |                                                                                                                                                                                                                                 |
| Unit III           | Global Efforts for Sustainable Development                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 8                       | 8                           |                                                                                                                                                                                                                                 |
|                    | 3.1:Rio Summit and Sustainable Development, Twenty-seven (27) Principles of Sustainable Development                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                         |                             |                                                                                                                                                                                                                                 |
|                    | 3.2:Role of International Chamber of Commerce (ICC) in Promotion of Sustainable Development, Business Charter                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                         |                             |                                                                                                                                                                                                                                 |
|                    | 3.3: Role of UNDP, UNFAO, WMF, in Promotion of Sustainable Development                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                         |                             |                                                                                                                                                                                                                                 |
|                    | 3.4:Sustainable Development Goals (2016 -2030)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                         |                             |                                                                                                                                                                                                                                 |
| Unit IV            | Sustainable Rural and Urban Development                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 7                       | 7                           |                                                                                                                                                                                                                                 |
|                    | 4.1:The problems of Rural Area: Availability of Water, Basic Infrastructural Facilities, Literacy Rate                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                         |                             |                                                                                                                                                                                                                                 |
|                    | 4.2:The problems of Urban Area: Urban Sprawls, Slums, Urban Heat Islands. Sustainable Urban Planning. Urban Waste Disposal and Ways of Recycling                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                         |                             |                                                                                                                                                                                                                                 |

|                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |  |  |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|
|                  | 4.3: Concept of Sustainable Agriculture: Green Revolution and its Environmental Impacts, Concept of Green Farming, Drip irrigation, No Tillage Agriculture, Integrated Pest Management                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |  |  |
| References:      | <ol style="list-style-type: none"> <li>1. Dash, M. C. (2013). <i>Concepts of Environmental Management for Sustainable Development</i>. IK International Pvt Ltd.</li> <li>2. Verma, M. K. (Ed.). (2021). <i>Environment, Development and Sustainability in India: Perspectives, Issues and Alternatives</i>. Springer Nature.</li> <li>3. Banerjee, S., &amp; Chakrabarti, A. (2013). Development and Sustainability. <i>India in a global perspective</i>.</li> <li>4. Kulik, R. M. (2023, December 18). <i>sustainable development</i>. <i>Encyclopedia Britannica</i>. <a href="https://www.britannica.com/topic/sustainable-development">https://www.britannica.com/topic/sustainable-development</a></li> <li>5. Baker, S. (2015). <i>Sustainable development</i>. Routledge.</li> <li>6. Tracey, S., &amp; Anne, B. (2008). <i>OECD insights sustainable development linking economy, society, environment: Linking economy, society, environment</i>. OECD Publishing.</li> <li>7. Banerjee, A., Jhariya, M. K., Meena, R. S., &amp; Yadav, D. K. (2021). Ecological footprints in agroecosystem: an overview. <i>Agroecological footprints management for sustainable food system</i>, 1-23.</li> <li>8. Kumar, S., Chatterjee, U., &amp; David Raj, A. (2023). Ecological Footprints in Changing Climate: An Overview. <i>Ecological Footprints of Climate Change: Adaptive Approaches and Sustainability</i>, 3-30.</li> <li>9. Jhariya, M. K., Banerjee, A., Meena, R. S., &amp; Yadav, D. K. (Eds.). (2019). <i>Sustainable agriculture, forest and environmental management</i>. Springer.</li> <li>10. Harwood, R. R. (2020). A history of sustainable agriculture. In <i>Sustainable agricultural systems</i> (pp. 3-19). CRC Press.</li> <li>11. Gupta, K. H. (2016). <i>Sustainable Development Law: The Law for the Future</i>. Partridge Publishing.</li> <li>12. Roy, S. K. (2016). The Principle of Sustainable Development, Human Rights, and Good Governance. <i>Brawijaya Law J</i>, 3(2), 209.</li> <li>13. Bauddh, K., Kumar, S., Singh, R. P., &amp; Korstad, J. (Eds.). (2020). <i>Ecological and practical applications for sustainable agriculture</i>. Springer Singapore.</li> <li>14. Roychowdhury, R., Choudhury, S., Hasanuzzaman, M., &amp; Srivastava, S. (Eds.). (2020). <i>Sustainable agriculture in the era of climate change</i>.</li> <li>15. Gupta, N., Pradhan, S., Jain, A., &amp; Patel, N. (2021). <i>Sustainable Agriculture in India 2021</i>. CEEW Report, 122p. <a href="https://www.ceew.in/sites/default/files/CEEWFOU-Sustainable-Agriculture-in-India-2021-20Apr21.pdf">https://www.ceew.in/sites/default/files/CEEWFOU-Sustainable-Agriculture-in-India-2021-20Apr21.pdf</a>.</li> <li>16. Reddy, G. O., Patil, N. G., &amp; Chaturvedi, A. (Eds.). (2017). <i>Sustainable management of land resources: An Indian perspective</i>. CRC Press.</li> <li>17. Desai, B. K., &amp; Pujari, B. T. (2014). <i>Sustainable agriculture: a vision for future</i>. New India Publishing.</li> <li>18. Sharma, P., &amp; Rajput, S. (Eds.). (2017). <i>Sustainable smart cities in India: Challenges and future perspectives</i>. Springer.</li> <li>19. Kashyap, P., &amp; Raut, S. (2005). <i>The Rural Marketing Book (Text &amp; Practice)(With Cd)</i>. Dreamtech Press.</li> <li>20. Kumar, S., &amp; Managi, S. (2009). <i>The economics of sustainable development: the case of India</i> (Vol. 32). Springer Science &amp; Business Media.</li> </ol> |  |  |  |
| Model Questions: | <p>Short Type (At least 8):</p> <ol style="list-style-type: none"> <li>1. Define the concept of sustainable development</li> <li>2. Explain the conflicts between Environment and development.</li> <li>3. Explain the need for sustainable development.</li> <li>4. Explain the Concept of Green farming</li> <li>5. Summarize the Twenty-seven Principles of sustainable development.</li> <li>6. What are the Sustainable Development Goals (2016 -2030)?</li> <li>7. Discuss the problems of rural and urban areas.</li> <li>8. What are the Goals and Elements of sustainable agriculture?</li> </ol> <p>Long Type (At least 4):</p> <ol style="list-style-type: none"> <li>1. describe the Salient features of Brundtland's Commission.</li> <li>2. Describe the concept of carrying capacity of the earth and ecological footprints.</li> <li>3. Describe the role of World Commission on Environment and Development in conceiving the concept of sustainable development.</li> <li>4. Discuss the problems of rural and urban areas.</li> </ol> <p>MCQs for Internal Assessment (At least 8)</p> <ol style="list-style-type: none"> <li>1. The first principles Sustainable Development was laid in _____.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |  |  |

- a) Kyoto conference   b) Basel Convention   c) Montreal Protocol   d) Stockholm conference
2. Which one of the following will not negatively affect sustainability?
  - a) Population control                      b) Global Warming
  - c) Overuse of natural resources        d) Corruption
3. Carrying capacity applies to:
  - a) Soil   b) Water   b) Humans   d) Air
4. Which one of the following is not Sustainable Development goals?
  - a) No poverty   b) Space research   c) Climate action   d) Life on land
5. What are (is) the major problem (s) in rural area?
  - a) Poverty   b) Insufficient rural connectivity   c) Inadequate basic amenities   d) All of above
6. \_\_\_\_ is micro irrigation system.
  - a) Sprinkler irrigation   b) Drip irrigation   c) Center pivot irrigation                      d) Manual irrigation
7. The growth of agricultural ecosystems in a self-sufficient and sustainable way is called:
  - a) Preculture       b) Polyculture       c) permaculture       d) Puericulture
8. What are (is) the impact (s) of urban heat island?
  - a) More Energy Demand   b) Good Air Quality   c) ReducedGHG   d) Good Water Quality

### Rubric for Internal Assessment for Theory Paper

| <p style="text-align: center;">SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI</p> <p style="text-align: center;"><b>Internal Assessment</b></p> <p style="text-align: center;">B.Sc. I (Environmental Science) SEMESTER – I (NEP)</p> |                                        |                         |               |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|-------------------------|---------------|
| Paper:<br>GE/OE-2                                                                                                                                                                                                                    | Course Code: 114262                    | Sustainable Development | Max Marks: 20 |
| <b>S.N.</b>                                                                                                                                                                                                                          | <b>Assessment Criteria</b>             |                         | <b>Marks</b>  |
| <b>6.</b>                                                                                                                                                                                                                            | Attendance                             |                         | 5             |
| <b>7.</b>                                                                                                                                                                                                                            | Class Assignments                      |                         | 5             |
| <b>8.</b>                                                                                                                                                                                                                            | Unit Test                              |                         | 5             |
| <b>9.</b>                                                                                                                                                                                                                            | Participation in Activity/ Field visit |                         | 2             |
| <b>10.</b>                                                                                                                                                                                                                           | Overall Performance                    |                         | 3             |

SEC Lab - Activities on Energy and sustainability.

| Level                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Semester | Course Code                                                                                                                                                                                                                                                                                                                                                                   | Course Name                                        | Credits | Teaching Hours | Exam Duration                                                                                                                                                                                    | Max Marks |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|---------|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| 4.5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | I        | 114271                                                                                                                                                                                                                                                                                                                                                                        | SEC Lab - Activities on Energy and sustainability. | 2       | 60             | 4 Hrs                                                                                                                                                                                            | 50        |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |          | 1. To understand types of Energy Resources.<br>2. To know availability of Energy Resources.<br>3. Aware of concept of Sustainability and Sustainable development.                                                                                                                                                                                                             |                                                    |         |                |                                                                                                                                                                                                  |           |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |          | After completion of the course student should be able to- CO 1: Classify the type of Energy resource. CO 2: Identifies the importance of nonconventional energy resources. CO 3: Understand the concept of sustainability and carrying capacity. CO 4: Determines the carrying capacity of particular area. CO 5: Explains concept and importance of sustainable development. |                                                    |         |                |                                                                                                                                                                                                  |           |
| Experiment/ Activity                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |          | Content                                                                                                                                                                                                                                                                                                                                                                       |                                                    |         |                | Incorporation of Pedagogies                                                                                                                                                                      |           |
| 1- Demonstration of Solar Water Heater<br>2- Demonstration of Solar Photovoltaic.<br>3- Demonstration of Wind Energy.<br>4- Find calorific Value of different fuels.<br>5- Study of local /Rural fuels.<br>6- Study of solar cooker.<br>7- Study of Local / rural types of Chulhas.<br>Field Visit- Study of local Solar Electric/ Heating systems/ Wind Mill.<br>Case Study : Determination of carrying Capacity of particular area ( Field/ Hill station/Road Traffic/ Water Resource etc.) |          |                                                                                                                                                                                                                                                                                                                                                                               |                                                    |         |                | Lab Reports: Students prepare detailed lab reports on their findings.<br><br>Discussion Sessions: Group discussions.<br>Group Projects: Assign group projects on Survey mentioned on activities. |           |

Assessment Rubric for Internal Practical

|                                                                                                                                          |                                |                     |                                                    |               |             |
|------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|---------------------|----------------------------------------------------|---------------|-------------|
| SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI<br>INTERNAL PRACTICAL EXAMINATION –<br>B.Sc. I (Environmental Science), SEMESTER – I (NEP) |                                |                     |                                                    |               |             |
| Sem I                                                                                                                                    | SEC-1                          | Course Code: 114271 | SEC Lab - Activities on Energy and sustainability. | Max Marks: 50 | Time: 4 Hrs |
| EXTERNAL                                                                                                                                 |                                |                     |                                                    |               |             |
| Question No.                                                                                                                             | Activity/Exercise / Experiment |                     |                                                    | Marks         |             |
| 1.                                                                                                                                       | Exercise-1                     |                     |                                                    | 10            |             |
| 2                                                                                                                                        | Exercise-2                     |                     |                                                    | 05            |             |
| 3                                                                                                                                        | Exercise-3                     |                     |                                                    | 10            |             |
| 4                                                                                                                                        | Group Project                  |                     |                                                    | 15            |             |
| 5.                                                                                                                                       | Viva Voce                      |                     |                                                    | 10            |             |

THREE YEAR UNDERGRADUATE PROGRAMME  
B.Sc. Environmental Science  
FACULTY: SCIENCE AND  
TECHNOLOGY SEMESTER –II

| Vertical | Type of Course   | Course Code | Course Name                                                        |
|----------|------------------|-------------|--------------------------------------------------------------------|
| Major    | Major Theory-2   | 114202      | Environment and Ecology                                            |
|          | Lab/Practical-2  | 114203      | Major Lab-2                                                        |
| GE/OEC   | GE/OE Theory-3   | 114263      | Basics of Solid Waste Management                                   |
| GE/OEC   | GE/OE Theory-4   | 114264      | Water and Water Resources                                          |
| VSC      | Lab/ Practical-5 | 114272      | <b>VSC-Hands-on Techniques in Ecology and Biodiversity Studies</b> |
| SEC      | Lab/Practical-6  | 114271      | Solid Waste Management                                             |

## Semester II Major Theory

| Level | Semester | Course Code | Course Name             | Credits | Teaching Hours | Exam Duration | Max Marks         |
|-------|----------|-------------|-------------------------|---------|----------------|---------------|-------------------|
| 4.5   | II       | 114202      | Environment and Ecology | 2       | 30             | 2 Hrs         | Ext-30<br>Int- 20 |

| Course Objectives: | 1. Impart knowledge on different ecological concept and displines of ecology.<br>2. To develop competency in understanding the ecological principles governing the biosphere.<br>3. Explain the structure and function of Population Ecology.<br>4. Demonstrate the ability to carry out ecological analysis in field conditions/laboratories and make appropriate judgements.                                                                                                                      |                         |                             |                                                                                                                                               |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| Course Outcomes:   | CO-1: Analyse natural processes and resources that sustain life and govern economy. CO-2: Understand fundamental Concept in Ecology.<br>CO-3: Analyze characteristics of Ecology<br>CO-4: Understand fundamental Concepts in Population Ecology.<br>CO-5: Demonstrate an entry level competence in understanding the ecological dynamics and their influence on humans and anthropogenic endeavors<br>CO-6: Get the opportunities of employment in the sector of Ecology and ecological monitoring. |                         |                             |                                                                                                                                               |
| Unit System        | Contents                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Workload Allotted (Hrs) | Weightage of Marks Allotted | Incorporation of Pedagogies                                                                                                                   |
| Unit I             | <b>Introduction to Ecology</b><br>1.1: Definition, Principles and Scope of Ecology.<br>Types of Ecology,<br>1.2: Biogeochemical Cycles- Definition and Types.:<br>Gaseous as Carbon, Oxygen, and Nitrogen<br>1.3: Sedimentary Cycle as Phosphorous and Sulfur<br>1.4: Inter-specific relationship: - Positive-<br>Mutualism and Commensalism, Negative –<br>Parasitism and Predation                                                                                                                | 8                       | 8                           | Chalk and talk, FW, Visits, use of ICT charts, models, problem based learning and collaborative learning. Theory, Self-study and Case studies |
| Unit II            | <b>Population &amp; Community Ecology</b><br>2.1: Definition and characteristic as Natalty, Mortality and Age Structure<br>2.2: Dispersion, Size and Density, Biotic Potential<br><b>Community Ecology:</b><br>2.3: Definition, structure, Characters used in community study: Analytical- i)Qualitative Characters as sociability, vitality and abundance; ii )Quantitative Characteristic as Frequency, Density and Abundance<br>2.4 Methods for Community Study: Quadrante method                | 7                       | 7                           |                                                                                                                                               |
| Unit III           | <b>3. Ecosystem I</b><br>3.1: Ecosystem: - Definition, components and structure<br>3.2: Food chain and Food web<br>3.3: Ecological pyramids- Definition & Types<br>3.4: Types of Ecosystems: Terrestrial: forest, grassland; Aquatic: marine and fresh water.                                                                                                                                                                                                                                       | 8                       | 8                           |                                                                                                                                               |

|         |                                                                                                                                                                                                                                                                                                      |   |   |  |
|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|--|
| Unit IV | <b>4. Ecosystem II</b><br>4.1: Energy flow in ecosystem: Y- shaped Energy flow Model<br>4.2: Productivity in ecosystem- Concept types and Measurement (Light & Dark Bottle)<br>4.3: Ecological succession: Concept, types, general mechanism and significance<br>4.4: Xerosere – Definition & Stages | 7 | 7 |  |
|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|--|

|                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| References:      | <p>‘Elements of Ecology’ Sharma P.D. Rastogi Publication<br/>A Textbook of Plant Ecology’ Ambashta R.S. &amp; Ambashta N.K (1999) CBS Publ. &amp; Distributers, New Delhi</p> <ol style="list-style-type: none"> <li>1. Text Book of Ecology and Environment. G.D. Muratkar, Dr.V.A. Meshram D.L. Bhade, Mr.R.B. BarabdeDnyanpath Publication, Amravati.</li> <li>2. Principles of Environmental Biology-P.K.G. Nair, Himalaya Publ.</li> <li>3. Ecology and Environment- P.D. Sharma , Rastogi Publ.</li> <li>4. Plant Ecology and Soil Science- R.S. Shukla, P.S. Chandel, S Chand&amp; company.</li> <li>6. Communities and Ecosystem- Witalkar.</li> <li>7. Manual of Field Ecology- R. Mishra.</li> <li>8. Concept of Ecology- E.J. Koromondy, Principal Hall.</li> <li>9. Modern Concept of Ecology- H.D. Kumar.</li> <li>10. Text book of Plant Ecology- R.S. Ambusth.</li> <li>11. Elements of Ecology- Brijgopal and Bharadwaj.</li> <li>12. Elements of Ecology- P.L. Kochar.</li> <li>13. Environmental Biology- K.C. Agrawal.</li> <li>14. A Text book of Ecology and Environment by P.C. Joshi and Namita Joshi, Himalaya</li> <li>15. Environment &amp; Ecology by- Vaishali Anand, Mc Graw Hill</li> <li>16. Environmental Ecology and Natural Resources by Awdhutwar and Kute 4</li> <li>17. Fundamental of Ecology and Environment by – Pranav Kumar</li> <li>18. Environment and Ecology by – K. K. Agrawal</li> <li>19. Environment, Ecology, Bio-diversity, Climate Change and Dister Management by – Ravi, Agrahari (Mc Graw Hill)</li> </ol> <p>Reference Books:</p> <ol style="list-style-type: none"> <li>1. Fundamentals of Ecology by E.P. Odum.</li> <li>2. Fundamentals of Ecology- M.C. Dash, Tata McGraw Hill Pub.</li> <li>3. Environmental Science - Van Cunningham, Tata McGraw Hill Pub.</li> <li>4. Ecology by Weiver and Climents Weblink to Equivalent MOOC on SWAYAM relevant:</li> </ol> <ol style="list-style-type: none"> <li>1. Ecology and Environment By Prof. Abhijit P Deshpande, Prof. Ravi Krishna R   IIT Madras <a href="https://onlinecourses.nptel.ac.in/noc22_ge20/preview">https://onlinecourses.nptel.ac.in/noc22_ge20/preview</a></li> <li>2. Environment Natural resources and Sustainable Development By Prabhakar Rao Jandhyala   University of Hyderabad <a href="https://onlinecourses.swayam2.ac.in/aic19_ge05/preview">https://onlinecourses.swayam2.ac.in/aic19_ge05/preview</a></li> <li>3. Environment and Development By Prof. NgamjahaoKipgen   IIT Guwahati <a href="https://onlinecourses.nptel.ac.in/noc22_hs126/preview">https://onlinecourses.nptel.ac.in/noc22_hs126/preview</a></li> <li>4. Environmental &amp; Resource Economics By Prof. Sabuj Kumar Mandal   IIT Madras <a href="https://onlinecourses.nptel.ac.in/noc22_hs71/preview">https://onlinecourses.nptel.ac.in/noc22_hs71/preview</a> Weblink to Equivalent Virtual Lab if relevant: 1. <a href="https://vlab.amrita.edu/?sub=2&amp;brch=294">https://vlab.amrita.edu/?sub=2&amp;brch=294</a> 2. <a href="https://ccnsb06-iiith.vlabs.ac.in/List%20of%20experiments.htm">https://ccnsb06-iiith.vlabs.ac.in/List%20of%20experiments.htm</a></li> </ol> |
| Model Questions: | <p>Short Type (At least 8), Long Type (At least 4) and MCQs for Internal Assessment (At least 8) wherever applicable as the need of curriculum.</p> <p>Short Type (At least 8):</p> <ol style="list-style-type: none"> <li>1. Define Ecology</li> <li>2. Draw a well labelled diagram for Oxygen cycle.</li> <li>3. Explain concept of Dispersal of Population</li> <li>4. Compare between Parasitism and Predation.</li> <li>5. Discuss the impact of climate change on gaseous cycle.</li> </ol> <p>Long Type (At least 4):</p> <ol style="list-style-type: none"> <li>1. Compare the Characteristics between Analytical and synthetic.</li> <li>2. Discuss in detail the Methods for Community Study- Quadrate with example</li> <li>3. Explain Principles and Scope of Ecology.</li> <li>4. : Differentiate between types of Inter-specific Relationship with suitable example.</li> </ol> <p>MCQs for Internal Assessment (At least 8)</p> <ol style="list-style-type: none"> <li>1. Birth rate is expressed as the number of live births per ----- --.<br/>(a) 1000, (b) 100, (c) 10 (d) 10000</li> <li>2. Sulphur is an example of-----cycle.<br/>(a) hydrological, (b) gaseous, (c) sediment (d) creb.</li> <li>3-----is not a Biogeochemical cycle.<br/>(a)Oxygen (b) Nitrogen (c) Phosphorous (d) Ozone</li> <li>4. Food web consist of -----<br/>(a) a portion of food chain (b) producers, consumers and decomposers (c) interlocking food chain (d)a set of similar consumers.</li> <li>5. The largest reservoir of nitrogen on our planet is -----<br/>(a) ocean (b) atmosphere (c) biosphere (d) soil.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

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|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <p>6. In aquatic ecosystem phytoplankton can be considered as-----<br/>(a) producer (b) consumer (c) macroconsumer (d) saprophytic organisms.</p> <p>7. The collection of individuals which belongs to the same species when live together in a region is known as _____<br/>a) Keystone species (b) Community (c) Guild (d) Population</p> <p>8. Name the term which defines the study of the characteristics and parameters of the population.<br/>a) Demography (b) Population ecology (c) Population density<br/>d) Mortality.</p> |
|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

| Rubric for Internal Assessment for Theory Paper    |                                        |                         |               |
|----------------------------------------------------|----------------------------------------|-------------------------|---------------|
| SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI      |                                        |                         |               |
| Internal Assessment                                |                                        |                         |               |
| B.Sc. I (Environmental Science) SEMESTER –II (NEP) |                                        |                         |               |
| Paper:<br>Maj/Theo-3                               | Course Code: 114202                    | Environment and Ecology | Max Marks: 20 |
| S.N.                                               | Assessment Criteria                    |                         | Marks         |
| 1.                                                 | Attendance                             |                         | 5             |
| 2.                                                 | Class Assignments                      |                         | 5             |
| 3.                                                 | Unit Test - MCQ                        |                         | 5             |
| 4.                                                 | Participation in Activity/ Field visit |                         | 2             |
| 5.                                                 | Overall Performance                    |                         | 3             |

**Major Lab/Practical-Environment & Ecology**

| Level | Semester | Course Code | Course Name                               | Credits | Teaching Hours | Exam Duration | Max Marks        |
|-------|----------|-------------|-------------------------------------------|---------|----------------|---------------|------------------|
| 4.5   | II       | 114203      | Major Lab/Practical-Environment & Ecology | 2       | 60             | 4 Hrs         | Ext-25<br>Int-25 |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course Objectives:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1. To create appreciation on diversity of life on earth.<br>2. To understand the distribution of biotic and abiotic factors of living things in environment.<br>3. To acquire in depth knowledge of pollution impact on components of ecosystem.<br>4. To equip the students with basic techniques in sampling and analysis.                                                                                                                                      |
| Course Outcomes:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | CO 1: Understand different levels of biological diversity through systematic approach towards study of ecology, ecosystem and biodiversity.<br>CO 2: Students can acquaint with the various case studies related to adverse impact on environment.<br>CO 3: Students are able to measure primary productivity can be Ecologist. CO-4.<br>Demonstrates the methodology for ecological community study.<br>CO-5. Determines ecological community in specific areas. |
| <b>A. Community Ecology</b><br>1. Fixation of minimum size of Quadrates<br>2. Fixation of minimum number of Quadrates<br>3. Determination of Frequency<br>4. Determination of Density and Abundance<br>5. Determination of Dominance<br>6. Importance Value Index (IVI)<br><b>B. Aquatic Ecology (Lake and Pond Ecosystems)</b><br>1. Study of Biotic & Abiotic Characteristics of a Lake Ecosystem. (pH, Temperature, Light Penetration, primary and secondary consumers)<br>2. Identification of Eutrophication Characteristics<br>3. To determine the primary productivity by light and dark bottle method.<br><b>C. Terrestrial Ecology (Forest and Grassland Ecosystems)</b><br>1. Determination of abiotic factors in terrestrial ecosystems. (Temperature, Moisture & Wind Speed)<br>2. Ground mapping with prismatic compass.<br>3. Estimation of population size by quadrat method.<br>4. Estimation of patterns of distribution of species in a community<br>5. Estimation of canopy cover using spherical densiometer.<br>6. Studies of lichen community in different habitats. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| References:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Study Materials in the form of - Reference Books, Text Books, Research Articles, Digital Resources like Weblinks, E- Contents, Educational Software, Databases, etc.                                                                                                                                                                                                                                                                                              |

### Rubric for Internal Assessment for Practical

| SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI<br><b>Internal Assessment</b><br>B.Sc. I (Environmental Science) SEMESTER –II (NEP)<br>Lab/Practical-4 |                                        |               |
|------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|---------------|
| Course Code: 114203                                                                                                                                  | Environment and Ecology                | Max Marks: 25 |
| Sr. No.                                                                                                                                              | Assessment Criteria                    | Marks         |
| 1                                                                                                                                                    | Attendance                             | 5             |
| 2                                                                                                                                                    | Record / Assignments                   | 5             |
| 3                                                                                                                                                    | Participation in Activity/ Field visit | 5             |
| 4                                                                                                                                                    | Reports on field visit                 | 5             |
| 5                                                                                                                                                    | Students' overall performance          | 5             |

### Rubric for External Assessment for Practical

| SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI<br><b>External Assessment</b><br>B.Sc. I (Environmental Science) SEMESTER –II (NEP)<br>Lab/Practical-4 |                                          |                             |
|------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|-----------------------------|
| Course Code: 114203                                                                                                                                  | Environment and Ecology                  | Max Marks: 25, Time: 4Hours |
| Sr. No.                                                                                                                                              | Assessment Criteria                      | Marks                       |
| 1                                                                                                                                                    | Practical Based on Community Ecology     | 08                          |
| 2                                                                                                                                                    | Practical Based on Aquatic Ecosystem     | 05                          |
| 3                                                                                                                                                    | Practical Based on Terrestrial Ecosystem | 07                          |
| 4                                                                                                                                                    | Viva Voce                                | 05                          |

## Semester II: GE/OEC Th-3

| Level | Semester | Course Code | Course Name                             | Credits | Teaching Hours/week | Exam Duration | Max Marks |
|-------|----------|-------------|-----------------------------------------|---------|---------------------|---------------|-----------|
| 4.5   | II       | 114263      | Theory 3 (GE/OE) Solid Waste Management | 2       | 1                   | 2 Hrs         | 30+20     |

|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                         |                             |                                                                                                                                                                                                                                                  |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course Objectives: | 1.Describes types, composition, and ways of treatment and disposal of solid waste.<br>2. Explain types & composition of wastes.<br>3. Describes ways of management of waste.<br>4. Explain ways treatment to solid waste.<br>5. Explain ways treatment, disposal and issues related to solid waste.                                                                                                                                                                                                                                 |                         |                             |                                                                                                                                                                                                                                                  |
| Course Outcomes:   | CO-1: Impart knowledge about the kind of solid waste generated at various location. CO-2: Develop the skill of segregate the solid waste according to type and composition<br>CO-3: Create awareness among the people to minimize the solid waste generation through the activities reduce, reuse and recycle.<br>CO-4: Provide knowledge associated to the techniques used to estimate quantity of waste generation CO-5: Understand the factor influencing solid waste generation rate.<br>CO-6: Achieve sustainable development. |                         |                             |                                                                                                                                                                                                                                                  |
| Unit System        | Contents                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Workload Allotted (Hrs) | Weightage of Marks Allotted | Incorporation of Pedagogies                                                                                                                                                                                                                      |
| Unit I             | Sources of solid waste                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 8                       | 8                           | 1. Use of Charts, diagrams, ppt's of examples of solid waste management.<br>2. Engage student in group discussion and assignments.<br>3. Organize experiential learning through visit to aspects related to Solid Waste Management I local area. |
|                    | 1.1 Sources of Solid waste, Types of Solid Waste                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                         |                             |                                                                                                                                                                                                                                                  |
|                    | 1.2: MSW, Agro-waste, Biomedical Waste, E-waste, Construction and Demolition Waste                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                         |                             |                                                                                                                                                                                                                                                  |
|                    | 1.3: Physical and Chemical composition of municipal solid waste, plastic waste                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                         |                             |                                                                                                                                                                                                                                                  |
|                    | 1.4: A global concern harmful effects of plastics. Plastic waste Generation in India, Plastic Waste Management                                                                                                                                                                                                                                                                                                                                                                                                                      |                         |                             |                                                                                                                                                                                                                                                  |
| Unit II            | Management techniques                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 7                       | 7                           |                                                                                                                                                                                                                                                  |
|                    | 2.1: Collection: Collection of Solid Waste                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                         |                             |                                                                                                                                                                                                                                                  |
|                    | 2.2: Services and Systems, Equipment, Transportation: Need of Transfer Operation, Transfer Station, Transport means and methods, route optimization                                                                                                                                                                                                                                                                                                                                                                                 |                         |                             |                                                                                                                                                                                                                                                  |
|                    | 2.3: Solid Waste Management 2000 rules with, 2016 Amendments.                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                         |                             |                                                                                                                                                                                                                                                  |
|                    | 2.4: Purpose of Processing, Volume Reduction by Incineration, Process Description, Mechanical Volume Reduction (compaction), Mechanical Size Reduction (Shredding), Component Separation (Manual and Mechanical Methods)                                                                                                                                                                                                                                                                                                            |                         |                             |                                                                                                                                                                                                                                                  |
| Unit III           | Treatment and disposal methods I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 8                       | 8                           |                                                                                                                                                                                                                                                  |
|                    | 3.1: Composting Aerobic and Anaerobic Method Mechanical Composting, Vermi Composting,                                                                                                                                                                                                                                                                                                                                                                                                                                               |                         |                             |                                                                                                                                                                                                                                                  |
|                    | 3.2: Sanitary Land Filling                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                         |                             |                                                                                                                                                                                                                                                  |
|                    | 3.3 Definition, Advantages and Disadvantages, Site Selection, Methods                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                         |                             |                                                                                                                                                                                                                                                  |
|                    | 3.4: landfill- Gas and Leachate Movement, Control of Gas and Leachate Movement                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                         |                             |                                                                                                                                                                                                                                                  |
| Unit IV            | Treatment and disposal methods II                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 7                       | 7                           |                                                                                                                                                                                                                                                  |
|                    | 4.1 Sources, Collection, Treatment and Disposal                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                         |                             |                                                                                                                                                                                                                                                  |
|                    | 4.2: Incineration Types of Incinerations, Pyrolysis, Energy Recovery Technique from Solid Waste Management                                                                                                                                                                                                                                                                                                                                                                                                                          |                         |                             |                                                                                                                                                                                                                                                  |
|                    | 4.3: Hazardous Waste, Problems Associated with Solid Waste                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                         |                             |                                                                                                                                                                                                                                                  |
|                    | 4.4: Role of Governments and Public in Relation to Issue of Solid Waste                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                         |                             |                                                                                                                                                                                                                                                  |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |  |  |
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|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |  |  |
| References: | <ol style="list-style-type: none"><li>1. Zero Waste: Management Practices for Environmental Sustainability by Ashok K. Rathoure</li><li>2. Sustainable Solid Waste Management by Ni-Bin Chang<br/>ISBN: 1118964543</li><li>3. Management of Municipal Solid Waste books.› books, T. V. Ramachandra · 2006</li><li>4. Municipal Solid Waste Management in Developing book.<br/>Sunil Kumar · 2016</li><li>5. Sustainable Resource Recovery and Zero Waste Approaches books<br/>Mohammad Taherzadeh, Kim Bolton, Jonathan Wong · 2019</li><li>6. Sustainable Solid Waste Management books. jonathan w c wong Rao y surampall iAmmaiyappan</li><li>7. Food Waste to Valuable Resources: Applications and Management books<br/>Rajesh Banu, Gopalakrishnan Kumar</li><li>8. Solid Waste Management: Principles and Practice books.,RameshaChandrappa, Diganta Bhusan Das · 2012</li><li>9. Waste Management: Concepts, Methodologies, Tools, and Management Association, Information Resources · 2019</li><li>10. Effective Waste Management and Circular Economy: Sadhan Kumar Ghosh, Sasmita Samanta, Harish Hirani · 2022</li></ol>                           |  |  |  |
|             | <b>Short Type</b> <ol style="list-style-type: none"><li>1. What is zero waste?</li><li>2. Write types of solid waste.</li><li>3. Explain sanitary land filling.</li><li>4. Write about what is hazardous waste.</li><li>5. What is aerobic composting?</li><li>6. What is manual and mechanical method of separation of waste?</li><li>7. Define solid waste.</li><li>8. Explain gas and leachate movement in solid waste disposal.</li></ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |  |  |
|             | <b>Long Type (At least 4):</b> <ol style="list-style-type: none"><li>1. Discuss sources and types of solid waste.</li><li>2. Discuss methods of size reduction of solid waste.</li><li>3. Discuss methods of incineration and pyrolysis of solid waste.</li><li>4. Discuss social and environmental issues related to solid waste management.</li></ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |  |  |
|             | <b>MCQs for Internal Assessment (At least 8)</b> <ol style="list-style-type: none"><li>1. Composting of solid waste is----- method.<br/>a- chemical, b- physical, c- microbial, d- heat treatment.</li><li>2. In MSW, ‘S’ stands for -----.<br/>a- substance, b- solid, c- solution, d- solvent.</li><li>3. Heat treatment is provided to solid waste under controlled conditions is -----.<br/>a- land filling, b- composting, c- incineration, d- open dumping.</li><li>4. In Pyrolysis, solid waste burnt under absence of-----.<br/>a- oxygen, b- carbon di oxide, c- hydrogen, d- nitrogen.</li><li>5. Best way of treatment of plastic waste is-----.<br/>a- burn, b- composting, c- recycle, d- open dumping.</li><li>6. Best way to treat biodegradable waste by ----- method.<br/>a- composting, b- pyrolysis, c- incineration, d- burning.</li><li>7. Management of domestic solid waste in cities is responsibility of-----.<br/>a- Zilla Parishad, Municipal Corporation, c- MIDC, d- Collector office.</li><li>8. Among the ‘3R’ , which is not proper way to control solid waste. a-<br/>Reduce, b-Regenerate, c- Reuse, d- Recycle.</li></ol> |  |  |  |

Rubric for Internal Assessment for Theory Paper

| SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI      |                                        |                        |               |
|----------------------------------------------------|----------------------------------------|------------------------|---------------|
| Internal Assessment                                |                                        |                        |               |
| B.Sc. I (Environmental Science) SEMESTER –II (NEP) |                                        |                        |               |
| Paper:<br>GOEC-3                                   | Course Code: 114263                    | Solid Waste Management | Max Marks: 20 |
| S.N.                                               | Assessment Criteria                    |                        | Marks         |
| 1                                                  | Attendance                             |                        | 5             |
| 2                                                  | Class Assignments                      |                        | 5             |
| 3                                                  | Unit Test                              |                        | 5             |
| 4                                                  | Participation in Activity/ Field visit |                        | 2             |
| 5                                                  | Overall Performance                    |                        | 3             |

## Semester II: GE/OEC Th-4

| Level | Semester | Course Code | Course Name                                 | Credits | Teaching Hours/week | Exam Duration | Max Marks |
|-------|----------|-------------|---------------------------------------------|---------|---------------------|---------------|-----------|
| 4.5   | II)      | 114264      | Theory 4 (GE/OEC) Water and Water Resources | 2       | 1                   | 2 Hrs         | 30+20     |

|                     |                                                                                                                                                                                                                                                                                                                                                                              |                         |                             |                                                                                                                                                                                                           |
|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course Objectives : | 1. Awareness of availability, quality, importance and conservation of water.<br>2. Describes water resource as whole.<br>3. Asses the quality of water.<br>4. Explain the availability & importance of fresh water.<br>5. Aware about marine water resource.                                                                                                                 |                         |                             |                                                                                                                                                                                                           |
| Course Outcomes :   | CO-1: Acquire knowledge of availability and demands of water. CO-2: Categorized quality of water.<br>CO-3: Understand process of renewal of water resources. CO-4: Investigate importance wetlands.<br>CO-5: Differentiate the freshwater & marine water resources. CO-6: Prioritize conservation of water.                                                                  |                         |                             |                                                                                                                                                                                                           |
| Unit System         | Contents                                                                                                                                                                                                                                                                                                                                                                     | Workload Allotted (Hrs) | Weightage of Marks Allotted | Incorporation of Pedagogies                                                                                                                                                                               |
| Unit I              | Water Resource                                                                                                                                                                                                                                                                                                                                                               | 8                       | 8                           | 1. Use of Charts, diagrams , ppt's of examples of water resources.<br>2. Engage student in group discussion and assignments.<br>3. Organize experiential learning through visit to local water resources. |
|                     | 1.1 Availability and Distribution of Water on Earth                                                                                                                                                                                                                                                                                                                          |                         |                             |                                                                                                                                                                                                           |
|                     | 1.2 Hydrological Cycle                                                                                                                                                                                                                                                                                                                                                       |                         |                             |                                                                                                                                                                                                           |
|                     | 1.3 Precipitation – Forms and Types                                                                                                                                                                                                                                                                                                                                          |                         |                             |                                                                                                                                                                                                           |
|                     | 1.4 Demand of Water- Domestic, Industrial & Irrigation                                                                                                                                                                                                                                                                                                                       |                         |                             |                                                                                                                                                                                                           |
| Unit II             | Parameter of water                                                                                                                                                                                                                                                                                                                                                           | 7                       | 7                           |                                                                                                                                                                                                           |
|                     | 2.1 Physical Parameter: Temperature, Color, Odor, Total Dissolved Solids and Total Suspended Solids, Electrical Conductivity                                                                                                                                                                                                                                                 |                         |                             |                                                                                                                                                                                                           |
|                     | 2.2 Chemical: Major Inorganic and Organic Constituents, Dissolved Gases, DO, Acidity and Alkalinity                                                                                                                                                                                                                                                                          |                         |                             |                                                                                                                                                                                                           |
|                     | 2.3 Biological: Phytoplankton, Phytoplankton, Zooplankton, Macro-invertebrates and Microbes                                                                                                                                                                                                                                                                                  |                         |                             |                                                                                                                                                                                                           |
|                     | 2.4 Conservation of Water Resources                                                                                                                                                                                                                                                                                                                                          |                         |                             |                                                                                                                                                                                                           |
| Unit III            | Freshwater:                                                                                                                                                                                                                                                                                                                                                                  | 8                       | 8                           |                                                                                                                                                                                                           |
|                     | 3.1: Surface and Subsurface Water, Ground Water                                                                                                                                                                                                                                                                                                                              |                         |                             |                                                                                                                                                                                                           |
|                     | 3.2: Water Shade, its Management, Rainwater Harvesting                                                                                                                                                                                                                                                                                                                       |                         |                             |                                                                                                                                                                                                           |
|                     | 3.3: Wetlands and their Management Definition of a Wetland; Types of Wetlands (fresh water and marine); Ecological Significance of Wetlands; Threats to Wetlands; Wetland Conservation                                                                                                                                                                                       |                         |                             |                                                                                                                                                                                                           |
|                     | 3.4: Surface and Ground Water Pollution- Sources and Control                                                                                                                                                                                                                                                                                                                 |                         |                             |                                                                                                                                                                                                           |
| Unit IV             | Marine /Saline Water                                                                                                                                                                                                                                                                                                                                                         | 7                       | 7                           |                                                                                                                                                                                                           |
|                     | 4.1 Distribution of Saline Water                                                                                                                                                                                                                                                                                                                                             |                         |                             |                                                                                                                                                                                                           |
|                     | 4.2 Physical Properties of Saline Water                                                                                                                                                                                                                                                                                                                                      |                         |                             |                                                                                                                                                                                                           |
|                     | 4.3 Marine Resources, Threat to Marine Resources                                                                                                                                                                                                                                                                                                                             |                         |                             |                                                                                                                                                                                                           |
|                     | 4.4 Marine Water Pollution- Sources and Control Measures                                                                                                                                                                                                                                                                                                                     |                         |                             |                                                                                                                                                                                                           |
| Reference s:        | Study Materials In The Form Of - Reference Books, Text Books, Research Articles, Digital Resources Like Weblinks, E- Contents, Educational Software, Databases, Etc.<br>1. S.S. Dara A Text Book Of Environmental Chemistry And Pollution Control, S. Chand, And Co. Ltd., New Delhi. (1995).<br>2. Physico Chemical Examination Of Water Sewage, Maniraska, Meerut Pragati. |                         |                             |                                                                                                                                                                                                           |

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                   | <ol style="list-style-type: none"> <li>Chemistry For Environmental Engineering And Science, Clair N Sawyer, 10 New Delhi Tata Mcgraw Hill.</li> <li>Water Soil, Saxena, New Delhi S Chand , New Delhi.</li> <li>Fundamentals Of Environmental Pollution , Kannan K, New Delhi S Chand , New Delh.</li> <li>Agriculture And Water Management, Narasaiah M L, New Delhi Discovery.</li> <li>Water Resource Management, Rao Nageswara K, New Delhi New Century Publishing.</li> <li>Physico Chemical Examination Of Water Sewage, Maniraska, Meerut Pragati.</li> <li>Oceanography, Lal D S, 4 Allahabad Sharda Pustak Bhawan.</li> <li>Water And Water Pollution, Abbasi S A , Karad Enviro Media.</li> <li>Environmental Science, Santra S C, New Delhi New Central.</li> <li>Environmental Issues In India , Trivedi Bhavana , New Delhi Discovery.</li> <li>Water : Friend And Foe , Discovery , Mumbai Shloka.</li> <li>Marine Biology, Prasad S N , New Delhi Cbs Publication.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Model Questions : | <p>Short Type (At least 8), Long Type (At least 4) and MCQs for Internal Assessment (At least 8) wherever applicable as the need of curriculum.</p> <p>Short Type (At least 8):</p> <ol style="list-style-type: none"> <li>Explain water resources are renewable resources.</li> <li>Describe distribution of fresh water on earth's surface.</li> <li>Which are the forms of precipitation?</li> <li>Which are the domestic demands of water?</li> <li>Which chemical impurities are presents in natural water other than H &amp;O ?</li> <li>Which are the characteristics of water table?</li> <li>What is aquifer?</li> <li>Give elemental composition of marine water.</li> </ol> <p>Long Type (At least 4):</p> <ol style="list-style-type: none"> <li>With the help of flow diagram explain hydrological cycle.</li> <li>Discuss physical and chemical properties of water.</li> <li>Discuss marine food and mineral resources.</li> <li>Discuss types of precipitation.</li> </ol> <p>MCQs for Internal Assessment (At least 8)</p> <ol style="list-style-type: none"> <li>Fresh water present on earth is-<br/>a- 1%, b-3 % c-5% D- 10 %.</li> <li>----- process is not involved in hydrological cycle<br/>a- evaporation, b- condensation, c- precipitation, d- sublimation.</li> <li>----- is not a form of precipitation.<br/>a- hail, b- snow, c- rain, d- meteorite.</li> <li>Color of natural water is -----<br/>a- blue, b- green, c- colorless, d- blue green.</li> <li>Major gas present in natural water is -----a-<br/>CO<sub>2</sub>, b- O<sub>2</sub>, CH<sub>4</sub>, d- H<sub>2</sub>S</li> <li>Free floating microscopic planta are called-----.<br/>a- zoo plankton, b- phytoplankton, c- insects, d- fish.</li> <li>Porus rock holds the water in the ground called-----a-<br/>aquifer, b- aquiclude, c- water table d- dyke.</li> <li>Salinity is important characteristics -----<br/>a- Fresh water, b- marine water, c- ground water, d- meteoritic water.</li> </ol> |

## Rubric for Internal Assessment for Theory Paper

| SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI      |                                        |                           |               |
|----------------------------------------------------|----------------------------------------|---------------------------|---------------|
| Internal Assessment                                |                                        |                           |               |
| B.Sc. I (Environmental Science) SEMESTER –II (NEP) |                                        |                           |               |
| Paper: GOEC-4                                      | Course Code: 114264                    | Water and Water Resources | Max Marks: 20 |
| S.N.                                               | Assessment Criteria                    |                           | Marks         |
| 1                                                  | Attendance                             |                           | 5             |
| 2                                                  | Class Assignments                      |                           | 5             |
| 3                                                  | Unit Test                              |                           | 5             |
| 4                                                  | Participation in Activity/ Field visit |                           | 2             |
| 5                                                  | Overall Performance                    |                           | 3             |

Semester-II, Course Category: Vocational Skill Course (VSC) Lab

| Level | Semester | Course Code | Course Name                                                           | Credits | Teaching Hours | Exam Duration | Max Marks |
|-------|----------|-------------|-----------------------------------------------------------------------|---------|----------------|---------------|-----------|
| 4.5   | II       | 114272      | VSC Lab - VSC-Hands-on Techniques in Ecology and Biodiversity Studies | 2       | 60             | 4 Hrs         | Int.-50   |

|                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                              |
|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course Objectives           | <ol style="list-style-type: none"><li>1. To provide practical knowledge of ecological laboratory and field techniques.</li><li>2. To develop skills in sampling, preservation, and identification of ecological specimens.</li><li>3. To train students in ecological data collection, analysis, and interpretation.</li><li>4. To familiarize learners with environmental monitoring instruments and methods.</li><li>5. To enhance employability in environmental laboratories, biodiversity surveys, and ecological research.</li></ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                              |
| Course Outcomes             | After completion of the course student should –<br>CO-1: Perform basic ecological sampling and ecological laboratory analysis<br>CO-2: Use instruments for measuring environmental parameters such as pH, temperature, humidity, and dissolved oxygen.<br>CO-3: Identify flora, fauna, and microorganisms using standard ecological methods.<br>CO 4: Analyze ecological data using statistical and graphical techniques.<br>CO-5: Prepare ecological reports and conduct environmental monitoring studies independently                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                              |
| Unit                        | Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Incorporation of Pedagogies                                                                                                                                                                                                                                                                                  |
| Experiments/<br>Activities. | <b>Course Structure</b><br><br><b>Introduction to Ecological Laboratory Techniques</b> <ul style="list-style-type: none"><li>• Principles of ecology and ecosystem study</li><li>• Laboratory safety and handling of equipment</li><li>• Sampling techniques in ecology</li><li>• Collection, preservation, and labeling of specimens</li></ul> <b>Techniques for Soil, Water, and Air Analysis</b> <ul style="list-style-type: none"><li>• Soil sampling and analysis</li><li>• Water quality assessment techniques</li><li>• Air quality monitoring methods</li><li>• Measurement of physicochemical parameters</li></ul> <b>Biodiversity and Population Study Techniques</b> <ul style="list-style-type: none"><li>• Quadrat and transect methods</li><li>• Population density and frequency analysis</li><li>• Identification of flora and fauna</li><li>• Herbarium and museum techniques</li></ul> <b>Ecological Data Analysis and Reporting</b> <ul style="list-style-type: none"><li>• Ecological indices and calculations</li><li>• Use of charts, graphs, and statistical tools</li><li>• Preparation of ecological field reports</li><li>• Environmental Impact Assessment basics</li></ul> <b>Practical/Exercises</b><br><br><ol style="list-style-type: none"><li>1. Measurement of soil pH and moisture content</li><li>2. Determination of water quality parameters</li><li>3. Quadrat method for vegetation analysis</li><li>4. Preparation of herbarium sheets</li><li>5. Identification of plankton and microorganisms</li><li>6. Estimation of population density and abundance</li><li>7. Air quality monitoring using simple techniques</li><li>8. Calculation of biodiversity indices</li><li>9. Ecological data tabulation and graphical representation</li><li>10. Preparation of ecological survey reports</li></ol> | <ul style="list-style-type: none"><li>• Laboratory demonstrations</li><li>• Field visits and ecological surveys</li><li>• Hands-on training sessions</li><li>• Group projects and case studies</li><li>• ICT-based ecological data analysis</li><li>• Problem-solving and report-writing exercises</li></ul> |

|            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| References | <p>Text books:</p> <ol style="list-style-type: none"><li>1. Chemical and Biological Methods for Water Pollution Studies. R.K. Trivedi, and P.K. Goel, Enviro Media, Karad.</li><li>2. Ecology and Environment, P.D. Sharma, Rastogi Publications, Meerut.</li><li>3. Experimental Plant Ecology, Pratima Kapur &amp; Sudharani Govil.</li><li>4. Plankton Analysis, Training Manual , By United States. Federal Water Pollution Control Administration. Training Program · 1970</li><li>5. Guide Manual, Water and Waste Water Analysis, By India. Central Pollution Control Board. PR Division · 2012</li><li>6. Ecology and Environmental Biology. Anuradha Sen, Books and Allied Pvt. Ltd.</li><li>7. Environment and Ecology; Prabha Singh, Anup Singh, Piyush Malviya. Acme Learning Pvt Ltd.</li></ol> |
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INTERNAL THEORY EXAMINATION

PRACTICAL INTERNAL ASSESSMENT

| SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI<br>INTERNAL PRACTICAL EXAMINATION –<br>B.Sc. I (Environmental Science), SEMESTER – II (NEP) |                                  |                                                                |                      |
|-------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|----------------------------------------------------------------|----------------------|
| Sem II VSC<br>Lbb-5                                                                                                                       | Course Code:<br>114272           | VSC-Hands-on Techniques in<br>Ecology and Biodiversity Studies | Max Marks:<br>Int-50 |
| EXTERNAL                                                                                                                                  |                                  |                                                                |                      |
| Question No.                                                                                                                              | Assessment Criteria              | Marks                                                          |                      |
| 1.                                                                                                                                        | Attendance and Participation     | 10                                                             |                      |
| 2                                                                                                                                         | Laboratory Skills                | 10                                                             |                      |
| 3                                                                                                                                         | Field Work and Ecological Survey | 10                                                             |                      |
| 4                                                                                                                                         | End Assessment /Test/ Report     | 10                                                             |                      |
| 5                                                                                                                                         | Viva Voce                        | 10                                                             |                      |

SEC Lab- Basics of Solid Waste Management

| Level                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Semester | Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Course Name                               | Credits | Teaching Hours                                                                                                                                                                                                                                                                               | Exam Duration | Max Marks |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----------|
| 4.5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | II       | 114273                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | SEC Lab- Basics of Solid Waste Management | 2       | 60                                                                                                                                                                                                                                                                                           | 4 Hrs         | 50        |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |          | <ol style="list-style-type: none"><li>o introduce students to the basic concepts and types of solid waste.</li><li>To develop practical skills in waste segregation, collection, storage, and disposal.</li><li>To familiarize learners with recycling, composting, and waste treatment methods.</li><li>To create awareness regarding environmental and public health impacts of waste.</li><li>To train students in sustainable waste management practices and environmental responsibility.</li></ol> |                                           |         |                                                                                                                                                                                                                                                                                              |               |           |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |          | After completion of the course, students will be able to:<br><br>CO-1: Identify different categories and sources of solid waste.<br>CO-2: Perform waste segregation and handling using scientific methods.<br>CO-3: Apply basic techniques of composting, recycling, and waste minimization.<br>CO-4: Understand environmental regulations and safety measures in waste management.<br>CO-5: Participate effectively in community and institutional waste management programs.                           |                                           |         |                                                                                                                                                                                                                                                                                              |               |           |
| Experiment/ Activity                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                           |         | Incorporation of Pedagogies                                                                                                                                                                                                                                                                  |               |           |
| <b>Introduction to Solid Waste Management</b> <ul style="list-style-type: none"><li>Definition and concept of solid waste</li><li>Sources and types of solid waste</li><li>Characteristics of municipal, industrial, biomedical, and agricultural waste</li><li>Environmental and health impacts of improper waste disposal .</li></ul> <b>Waste Collection, Segregation, and Storage</b> <ul style="list-style-type: none"><li>Waste generation and collection systems</li><li>Segregation of biodegradable and non-biodegradable waste</li><li>Color coding and storage methods</li><li>Transportation and handling techniques</li><li></li></ul> <b>Waste Treatment and Disposal Methods</b> <ul style="list-style-type: none"><li>Composting and vermicomposting</li><li>Recycling and reuse techniques</li><li>Incineration and sanitary landfill methods</li><li>Waste-to-energy concepts .</li></ul> <b>Sustainable Waste Management Practices</b> <ul style="list-style-type: none"><li>3Rs: Reduce, Reuse, Recycle</li><li>Plastic waste management</li><li>E-waste and hazardous waste basics</li><li>Government policies and Swachh Bharat Mission initiatives</li><li></li></ul> <b>Practicals/Exercises</b> <ol style="list-style-type: none"><li>Identification and classification of different solid wastes</li><li>Demonstration of waste segregation methods</li><li>Preparation of compost from biodegradable waste</li><li>Visit to waste management or recycling facility</li><li>Estimation of household or campus waste generation</li><li>Preparation of vermicompost unit</li><li>Survey on community waste disposal practices</li><li>Demonstration of recycling and reuse activities</li><li>Preparation of awareness posters/charts on waste management</li><li>Case study report on municipal solid waste management</li></ol> |          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                           |         | <ul style="list-style-type: none"><li>Classroom lectures and demonstrations</li><li>Field visits and community surveys</li><li>Hands-on practical training</li><li>Group discussions and case studies</li><li>ICT-enabled teaching-learning methods</li><li>Project-based learning</li></ul> |               |           |

| SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI<br>INTERNAL ASSESSMENT FOR SEC<br>B.Sc. I (Environmental Science), SEMESTER – II (NEP) |                                                       |                             |
|--------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|-----------------------------|
| <b>Code-114273</b>                                                                                                                   | <b>SEC Lab- Basics of Solid Waste Management</b>      | <b>Marks: 50 (Internal)</b> |
| S. No.                                                                                                                               | Assessment Criteria                                   | Marks                       |
| 1.                                                                                                                                   | Attendance                                            | 10                          |
| 2.                                                                                                                                   | Continuous Assessment Tests/ Group Projects.          | 10                          |
| 3.                                                                                                                                   | Active participation in activities Field Visit Report | 10                          |
| 4.                                                                                                                                   | Submission of practical record                        | 10                          |
| 5                                                                                                                                    | Internal examiner viva-voce                           | 10                          |

**SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI**



**THREE YEAR GRADUATE PROGRAMME B.Sc. ENVIRONMENTAL SCIENCE**

**Semester III and IV**

**FACULTY: SCIENCE AND TECHNOLOGY**

**(Courses effective from Academic Year 2025-26) Under NEP 2020  
SYLLABUS**

# TABLE OF CONTENT

| Sr. No | Content                                                       | Page No. |
|--------|---------------------------------------------------------------|----------|
| 1      | TLE Scheme for Second Year: Semester-III                      | 4        |
| 2      | TLE Scheme for Second Year: Semester-IV                       | 5        |
| 3      | Examination and Assessment Process:                           | 6        |
| 4      | Examination, Evaluation and Assessment Scheme                 | 6        |
| 5      | Continuous Assessment Tests (CAT)                             | 7        |
| 6      | Conduction of the Examination                                 | 8        |
| 7      | SEMESTER – III                                                | 09       |
| 8      | Major Theory: Dynamics of Biodiversity                        | 10       |
| 9      | Assessment Rubric: Internal for Theory Course-Major           | 12       |
| 10     | Major Theory: Environmental Chemistry                         | 13       |
| 11     | Assessment Rubric: Internal for Theory Course- Major          | 15       |
| 12     | Major Lab/Practical: Biodiversity and Environmental Chemistry | 16       |
| 13     | Assessment Rubric: Major Lab/Practical                        | 17       |
| 14     | IKS Theory: Environmental Conservation in Ancient India       | 18       |
| 15     | Assessment Rubric: Internal for Theory Course-IKS             | 21       |
| 16     | Minor Theory: Fundamentals of Environmental Chemistry         | 22       |
| 17     | Assessment Rubric: Internal for Theory Course-Minor           | 24       |
| 18     | Minor Lab/ Practical                                          | 25       |
| 19     | Assessment Rubric: Lab Course-Minor                           | 26       |
| 20     | G/OE Theory: Ecotourism and Environmental Ethics.             | 27       |
| 21     | VSC: Skill for Conservation Biologist                         | 30       |
| 22     | Assessment Rubric: Lab Course-VSC                             | 31       |
| 23     | FP/CES                                                        | 32       |
| 24     | SEMESTER – III                                                | 37       |
| 25     | Major Theory: Environmental Pollution-1                       | 38       |
| 26     | Assessment Rubric: Internal for Theory Course-Major           | 40       |
| 27     | Major Theory: Environmental Pollution-2                       | 41       |
| 28     | Assessment Rubric: Internal for Theory Course- Major          | 43       |
| 29     | Major Lab/Practical: Environmental Pollution-1&2              | 44       |
| 30     | Assessment Rubric: Major Lab/Practical                        | 45       |
| 31     | Minor Theory: General Approach of Environmental Pollution.    | 46       |

|    |                                                                          |    |
|----|--------------------------------------------------------------------------|----|
| 32 | Minor Lab work: General Approach of Environmental Pollution.             | 48 |
| 33 | Assessment Rubric: Internal for Theory Course-Minor                      | 49 |
| 34 | G/OE Theory: Global environmental issues                                 | 50 |
| 35 | VSC: Skills for Environmental Lab Technician: Water Sampling & Analysis. | 53 |
| 36 | Assessment Rubric: Lab Course-VSC                                        | 54 |
| 37 | SEC: Field and Lab skills for Environmental quality analysis.            | 55 |
| 38 | Assessment Rubric: Lab Course-SEC                                        | 56 |
| 39 | FP/CES                                                                   | 57 |

Sant Gadge Baba Amravati University, Amravati FACULTY: SCIENCE AND TECHNOLOGY Teaching and Learning Scheme: for the Degree of Bachelor of Environmental Science as Major and Minor SECOND YEAR:  
SEMESTER –III

| Mode of Teaching                                           | Vertical No. | The Vertical           | Type of Course   | Course Code | Course Name                                                       | Credits | Workload (Hrs/Week) | Vertical Workload (Hrs/Week) |
|------------------------------------------------------------|--------------|------------------------|------------------|-------------|-------------------------------------------------------------------|---------|---------------------|------------------------------|
| Classroom Teaching / Lab Work (Practical)/ Outdoor / Field | a.           | Major                  | Theory -1        | 114204      | Dynamics of Biodiversity                                          | 2       | 2                   | 8                            |
|                                                            |              |                        | Theory -2        | 114205      | Environmental Chemistry                                           | 2       | 2                   |                              |
|                                                            |              |                        | Lab/Practical-8  | 114206      | Major Lab- Techniques in Biodiversity and Environmental Chemistry | 2       | 4                   |                              |
|                                                            |              | IKS                    | Theory           | 114207      | Environmental Conservation in Ancient India                       | 2       | 2                   |                              |
|                                                            | b.           | Minor                  | Theory           | 114208      | Fundamentals of Environmental Chemistry                           | 2       | 2                   | 6                            |
|                                                            |              |                        | Lab/Practical-9  | 114209      | Minor Lab- Fundamentals of Environmental Chemistry                | 2       | 4                   |                              |
|                                                            | c.           | Generic/ Open Elective | Theory           | 114265      | Ecotourism and Environmental Ethics.                              | 2       | 2                   | 2                            |
|                                                            | d.           | VSC                    | Lab/Practical-10 | 114274      | Skills for Conservation Biologist                                 | 2       | 4                   | 4                            |
|                                                            | e.           | AEC - English          | Theory           |             | Refer University basket                                           | 1       | 1                   | 2                            |
|                                                            |              | AEC –MIL               | Theory           |             | Refer University basket                                           | 1       | 1                   |                              |
|                                                            | f.           | Project                | Project          | 114210      | FP/ Community Engagement Service in Environmental Science Phase-I | 2       | 4                   | 8                            |
|                                                            | g.           | CC                     | Outdoor          |             | Separate SOP will be released                                     | 2       | 4                   |                              |
|                                                            | Total        |                        |                  |             |                                                                   |         |                     | 30                           |

**Note:**

- VSC Should be Complementary to Major.
- SEC has to be selected from the Basket Provided by University, from the same Faculty/Discipline of the Major/Minor

**Sant Gadge Baba Amravati University, Amravati FACULTY: SCIENCE AND TECHNOLOGY Teaching and Learning Scheme:  
for the Degree of Bachelor of Environmental Science as Major and Minor SECOND YEAR: SEMESTER –IV**

| Mode of Teaching                                           | Vertical No. | The Vertical           | Type of Course    | Course Code   | Course Name                                                         | Credits | Workload (Hrs/Week) | Vertical Workload (Hrs/Week) |
|------------------------------------------------------------|--------------|------------------------|-------------------|---------------|---------------------------------------------------------------------|---------|---------------------|------------------------------|
| Classroom Teaching / Lab Work (Practical)/ Outdoor / Field | <u>a.</u>    | Major                  | Theory -3         | 114211        | Environmental Pollution-1                                           | 2       | 2                   | 8                            |
|                                                            |              |                        | Theory-4          | 114212        | Environmental Pollution-2                                           | 2       | 2                   |                              |
|                                                            |              |                        | <b>Theory - N</b> | <b>114217</b> | Global Environmental Change and Resilience                          |         |                     |                              |
|                                                            |              |                        | Lab/Practical-11  | 114213        | Lab/Practical based on Environmental pollution.                     | 2       | 4                   |                              |
|                                                            | <u>b.</u>    | Minor                  | Theory -9         | 114214        | General Approach of Environmental Pollution.                        | 2       | 2                   | 6                            |
|                                                            |              |                        | Lab/Practical-12  | 114215        | Lab work: General Approach of Environmental Pollution.              | 2       | 4                   |                              |
|                                                            | <u>c.</u>    | Generic/ Open Elective | Theory            | 114266        | Global environmental issues.                                        | 2       | 2                   | 2                            |
|                                                            | <u>d.</u>    | VSC                    | Lab/Practical-13  | 114275        | Skills for Environmental Lab Technician: Water Sampling & Analysis. | 2       | 4                   | 4                            |
|                                                            | <u>e.</u>    | AEC - English          | Theory            |               | Refer University basket                                             | 1       | 1                   | 2                            |
|                                                            |              | AEC –MIL               | Theory            |               | Refer University basket                                             | 1       | 1                   |                              |
|                                                            | <u>f</u>     | Project                | Project           | 114216        | FP/ Community Engagement Service Phase-II                           | 2       | 4                   | 8                            |
|                                                            | <u>g</u>     | CC                     | Outdoor           |               | Separate SOP will be released                                       | 2       | 4                   |                              |
|                                                            | <u>Total</u> |                        |                   |               |                                                                     |         |                     | 32                           |

**Note:**

- VSC Should be Complementary to Major.
- SEC has to be selected from the Basket Provided by University, from the same Faculty/Discipline of the Major/Minor

**Notes:**

- a.** The strength of the batch of the Practical for UG Classes shall be 16 with an addition of 10% with the permission of Hon'ble Vice Chancellor. The number of the students required to constitute a batch or calculate the workload shall be in accordance with the relevant Government Resolution in force at the time, applicable to specific time, region, course type, mode of instruction, and other pertinent factors.
- b.** 1 Credit shall mean 1 Hour Teaching per Week per Semester (Total 15 Hrs/ Semester), the duration of 1 Teaching Period will be 60 Minutes. For Practical 1 Credit shall mean 2 Hour Teaching per Week per Semester (Total 30 Hrs/ Semester).
- c.** For Examination and Evaluation of Theory Courses, 40 % Marks shall be assigned to Internal Examination and 60% Marks shall be assigned to end-semester external university examination.
- d.** Co-curricular Courses: Health and wellness, Yoga Education, Sports and Fitness, Cultural Activities, NSS/NCC, Fine/Applied/Visual/Performing Arts During Semester I, II, III, IV, V and VI. These courses may be taught by Physical Education Director or may be assigned to Language Teacher by the Principal of HEI based on the expertise of the concerned.
- e.** Value Education Courses to be selected from the Basket of Courses provided by the University. These courses may be assigned to the Language Teacher by the Principal of HEI based on the expertise of the concerned.
- f. Generic / Open Elective Courses (GE/OE):** Courses to be selected from the Basket of Courses provided by the University
- g. Abbreviations:** Department Specific Core: DSC, Department Specific Elective: DSE, FSC: Faculty Specific Core, FSE: Faculty Specific Elective, Indian Knowledge System: IKS, Inter Faculty Specific Core: IFSC, Inter Faculty Specific Elective: IFSE, Theory: Th, Practical/Practicum: Pr, Environment Studies: ES, Pre-requisite Course mandatory if applicable: Prq, Laboratory: Lab (Practical), Generic/ Open Electives: OE; Vocational Skill and Skill Enhancement Courses: VSEC; Vocational Skill Courses: VSC; Skill Enhancement Courses: SEC; Ability Enhancement Courses: AEC; Value Education Courses: VEC; OJT: On Job Training: Internship/ Apprenticeship; Field projects: FP; Community Engagement and Service: CES; Co-curricular Courses: CC; RM: Research Methodology; Research Project: RP; MIL: Modern Indian Language.

**EXAMINATION AND ASSESSMENT PROCESS**

- i. The basic principle of the Credit framework is that Credits are a function of the successful completion of a program of study/ vocational education/ training and assessment. No Credit can be earned by the student unless the student is assessed for the achievement of the desired competencies and outcome of a program.
- ii. Exit options are provided with Certificate, Diploma and Basic Bachelor's degrees to the students at the end of the second, fourth and sixth semesters of a Four Years Multidisciplinary Degree Programme. Students will receive a Bachelor's degree with Honors/ Research on successfully completing of all eight semesters of the UG Program either at a stretch or with opted exits and re-entries.
- iii. For the smooth success of four-year degree programme with multiple entry and exit systems, the examination mode should be based on the combination of innovative trends in formative (informal and formal tests administered during the learning process) and summative (evaluation of students learning at the end of an instructional unit) examination modes in line with the UGC Report on 'Evaluation Reforms in Higher Educational Institutions (2019).

**EXAMINATION, ASSESSMENT AND EVALUATION SCHEME**

The total marks for each Course shall be based on Continuous Assessment and Semester End Examination. Each theory course of Major, Minor, GE/OE, AEC, IKS, VEC as mentioned in **Teaching Learning Scheme** prepared by the Board of Studies shall be evaluated as per the scheme as mentioned in the following table.

| Vertical No. | The Vertical                   | Mode of Examination, Evaluation & Assessment | Theory                                                                                                                                                                                                                                                                  |           |           |           | Theory (Total) |           | Practical |           |           |            | Practical (Total) |            |
|--------------|--------------------------------|----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-----------|-----------|----------------|-----------|-----------|-----------|-----------|------------|-------------------|------------|
|              |                                |                                              | External                                                                                                                                                                                                                                                                |           | Internal  |           |                |           | External  |           | Internal  |            |                   |            |
|              |                                |                                              | Max Marks                                                                                                                                                                                                                                                               | Min Marks | Max Marks | Min Marks | Max Marks      | Min Marks | Max Marks | Min Marks | Max Marks | Min. Marks | Max Marks         | Min. Marks |
| a            | Major                          | External & Internal                          | 30                                                                                                                                                                                                                                                                      | 9         | 20        | 6         | 50             | 20        | 25        | 10        | 25        | 10         | 50                | 20         |
| b            | Minor                          |                                              | 30                                                                                                                                                                                                                                                                      | 9         | 20        | 6         | 50             | 20        | 25        | 10        | 25        | 10         | 50                | 20         |
| c            | Generic/ Open Elective         |                                              | 30                                                                                                                                                                                                                                                                      | 9         | 20        | 6         | 50             | 20        | --        | --        | --        | --         | --                | --         |
| d            | VSC                            | Internal                                     | --                                                                                                                                                                                                                                                                      | --        | --        | --        | --             | --        | --        | --        | 50        | 20         | 50                | 20         |
|              | SEC                            | Internal                                     | --                                                                                                                                                                                                                                                                      | --        | --        | --        | --             | --        | --        | --        | 50        | 20         | 50                | 20         |
| e            | AEC (Eng. & One MIL Composite) | External & Internal                          | 30                                                                                                                                                                                                                                                                      | 9         | 20        | 6         | 50             | 20        | --        | --        | --        | --         | --                | --         |
|              | IKS (Generic)                  | External & Internal                          | 30                                                                                                                                                                                                                                                                      | 9         | 20        | 6         | 50             | 20        | --        | --        | --        | --         | --                | --         |
|              | VEC                            | External & Internal                          | 30                                                                                                                                                                                                                                                                      | 9         | 20        | 6         | 50             | 20        | --        | --        | --        | --         | --                | --         |
| F            | FP/CEP                         | Internal                                     | --                                                                                                                                                                                                                                                                      | --        | --        | --        | --             | --        | --        | --        | 50        | 20         | 50                | 20         |
|              | Internship/ Apprenticeship     |                                              | Assessment of these verticals shall be based on various activities/practices. I shall be evaluated by giving maximum marks of 50 per 2 Credit Course with separate weightages/levels. A detailed SOP for this assessment process is prescribed for Phase I and Phase II |           |           |           |                |           |           |           |           |            |                   |            |
|              | CC                             |                                              |                                                                                                                                                                                                                                                                         |           |           |           |                |           |           |           |           |            |                   |            |

## CONTINUES ASSESSMENT TEST

For internal assessment, the Continuous Assessment Tests (CAT) shall be conducted as under-

- i. Three CAT each of 8 / 10 Marks (Theory) as applicable and 10 Marks (Practical).
  - First on completion of 25% Syllabus of the course or on completion of 25 teaching days,
  - Second on completion of 50% Syllabus of the course or on completion of 50 teaching days,
  - Third on completion of 75% Syllabus of the course or on completion of 75 teaching days.
- ii. Each concurrent assessment (CAT-I, II & III) will be mapped to relevant Course Learning Outcome.
- iii. Total Performance in CAT (i.e. 40 %) shall be based on the **best two out of three** in CAT examinations. Internal assessment shall be carried out by the respective course teacher by choosing variety of Assessment tools/methods such as class test, record book, seminar, case study, field work, mini project work, quiz or any innovative method, which may be deemed to be appropriate for assessing the relevant course outcome.

## CONDUCTION OF EXAMINATION

As per the scheme of teaching, learning, examination and evaluation, theory/practical examinations of Semester-I, II, III, IV, V, VI, VII and VIII shall be conducted by the University (except for Internal Examinations as applicable) at the end of each semester. The theory/practical examinations of all the Semesters shall be held as per the following Schedule –

| Sr. No. | Name of the Examination      | End Sem Examination | Supplementary Examination* |
|---------|------------------------------|---------------------|----------------------------|
| 1       | Semester-I, III, V and VII   | Winter              | Summer                     |
| 2       | Semester-II, IV, VI and VIII | Summer              | Winter                     |

\* The University may evolve mechanism for conducting repeat end semester examination. Such repeat examinations shall have to be conducted within one month of the regular even semester examination and on demand examination.

1. The practical examination of all semesters shall be conducted by the University at the end of each semester. The HEI shall conduct the Practical examination of odd semesters as per the schedule announced by the University. However, the appointment of the External and Internal Examiners shall be done by the Head or Principal of respective HEI to conduct external examination of the odd semester and the same should be communicated to the University before commencement of the practical examination. The University shall conduct the external practical examination of all even semester by appointing external and internal examiners.
2. The examinations specified above shall be held twice in a year at such places and on such dates as may be prescribed by the University.
3. An applicant to an examination specified above, shall pursue a regular course of study in courses prescribed for the examination concerned for not less than one semester in a particular semester in a College/Institute/University department.
4. Provided that the student shall be eligible to appear for examination if -
  - a. He/she complies with the provisions of the Ordinance pertaining to the Examination in general from time to time.
  - b. He/she has prosecuted a regular course of study in a university department/college affiliated to the University.
  - c. He/she has in the opinion of the principal shown satisfactory progress in his/her studies.
5. The provisions of Ordinance No. 6 and Ordinance No. 9 shall be *mutatis-mutandis* applicable to every collegiate/non-collegiate student.
6. The fees for each theory examination and practical examination conducted by the university shall be as prescribed by the University, from time to time.

**B.Sc. II SEMESTER-III**

| Types of Course       | Course Code | Course Name                                            |
|-----------------------|-------------|--------------------------------------------------------|
| Major Theory          | 114204      | Dynamics of Biodiversity                               |
| Major Theory          | 114205      | Environmental Chemistry                                |
| Major Lab / Practical | 114206      | Major Lab- Biodiversity and Environmental Chemistry    |
| IKS Theory            | 114207      | Environmental Conservation techniques in Ancient India |
| Minor Theory          | 114208      | Fundamentals of Environmental Chemistry                |
| Minor Lab/ Practical  | 114209      | Minor Lab- Fundamentals of Environmental Chemistry     |
| G/OE Theory           | 114265      | Ecotourism and Environmental Ethics.                   |
| VSC: Lab              | 114274      | Skills for Conservation Biologist                      |
| Project               | 100210      | FP/ Community Engagement Service                       |
| CC-Outdoor            | --          | Separate SOP will be released                          |

Sant Gadge Baba Amravati University, Amravati FACULTY:  
SCIENCE AND TECHNOLOGY  
Teaching and Learning Scheme: For the Degree of Bachelor of Environmental Science as Major and

**Major Course - Dynamics of Biodiversity**

| Level | Semester | Course Code | Course Name                               | Credits | Teaching Hours | Exam Duration | Max Marks             |
|-------|----------|-------------|-------------------------------------------|---------|----------------|---------------|-----------------------|
| 5.0   | III      | 114204      | Major Theory.<br>Dynamics of Biodiversity | 2       | 30             | 2 Hrs.        | 30 (Ext.)<br>20 (Int) |

| <b>Course Objectives:</b> | <ul style="list-style-type: none"> <li>To understand status of the planet's biological diversity</li> <li>To gain value of biodiversity and causes of its loss</li> <li>To know basic concepts and scientific principles of conservation and global patterns in biodiversity</li> <li>To know current efforts to conserve biodiversity on global, national and local scales;</li> <li>To study practical issues with local conservation.</li> </ul>                                                                                                                                                                                                                                                     |                          |                             |                                                                                                           |
|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|-----------------------------|-----------------------------------------------------------------------------------------------------------|
| <b>Course Outcomes:</b>   | <p>At the end of the course the students will-</p> <p>Co-1: Understand concept, status and significance of biodiversity with respect to different discipline.</p> <p>CO-2: Realize endemic as well as rare and endangered species and need of their Conservation.</p> <p>CO-3: Cite the scientific evidence for biodiversity change in the modern era and detail the contemporary causes of diversity loss,</p> <p>CO-4: Understand and convey the ecological, social, and economic impacts of diversity loss, and apply management principles and tools that are used to conserve diversity at levels from genes to landscapes.</p> <p>CO-5: Explain, Ex and In-situ conservation of biodiversity.</p> |                          |                             |                                                                                                           |
| Unit System               | Contents                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Workload Allotted (Hrs.) | Weightage of Marks Allotted | Incorporation of Pedagogies                                                                               |
| Unit I                    | <b>Biodiversity</b><br>1.1: Definition, Types/levels (species, ecosystem and genetic biodiversity);<br>1.2: Bio-geographic classification of India<br>1.3: Concept of Biodiversity "hot spots"; Eastern Himalaya and Western ghats as biodiversity hot spots.<br>1.4: Argo-biodiversity- Concept, threats and conservation.                                                                                                                                                                                                                                                                                                                                                                             | 8                        | 8                           | Chalk and talk, FW, Visits, use of ICT charts, models, problem based learning and collaborative learning. |
| Unit II                   | <b>2. Values of Biodiversity</b><br>2.1: Consumptive and productive use values: (Biodiversity as sources of food, fodder, timber and medicinal).<br>2.2: Social, Ethical, aesthetic values and ecosystem services.<br>2.3: Concept of Endangered species; India.<br>2.4: Concept of endemic species of India.                                                                                                                                                                                                                                                                                                                                                                                           | 7                        | 7                           | Theory, Self-study and Case studies                                                                       |

|          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |   |   |
|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|
| Unit III | <b>3. Threats to Biodiversity</b><br>3.1 : Causes of Biodiversity loss: Habitat loss and Destruction, Fragmentation, Transformation and Degradation.<br>3.2: Hunting and bio invasions of alien Species. Extinction: Types of Extinctions, Processes responsible for Species Extinction.<br>3.3: Pollution: Impacts of Pesticide pollution, Water pollution on biodiversity.<br>3.4.: Overexploitation: Impacts of Exploitation on Target and Non-target Ecosystems | 8 | 8 |
| Unit IV  | <b>4. Biodiversity Conservation</b><br>4.1: Strategies for conservation: In situ conservation: Protected areas, Wildlife sanctuaries.<br>4.2-National parks, and Biosphere reserves.<br>4.3: Ex situ conservation: Botanical Gardens, Seed banks, zoological park.<br>4.4: Biodiversity policy and legislation: Biodiversity Act 2002, Convention on biological Diversity (CBD).                                                                                    | 7 | 7 |

References:Text Books-

1. Primack, Richard B., and Anna Sher (2016). Introduction To Conservation Biology. Sinauer Associates, Incorporated, Publishers.
2. Berlatsky (2013) Biodiversity – Global Viewpoints. Gale Cengage Publishers. ISBN: 9780737769050.
3. Gary G. Mittelbach (2012) Community Ecology. Sinauer Associates, Inc.; 1 edition. ISBN: 978-0878935093.
4. Biodiversity Conservation: Present Scenario and Future Prospects Author(s): Dr. Amar Nath Singh Dr. Awadh Kishore Roy; walnut publication.
5. Biodiversity And Conservation: A Global Perspective 2024 by Akshay Laxman Patil
6. Biodiversity and Its Conservation Paperback by Parveen Garg; BR Publishing corporation.
7. Biodiversity with Practical Paperback 2022 by Dr. Kalyan Das; Mahaveer Publication,
8. Animal Diversity 1 - Non-Chordates 1 & Chordates; 2023by Dr. Tripurari Mishra (Author),
9. Biodiversity Conservation Perfect Paperback – 14 August 2023 by Omkar Verma, Ravi Shanker; New age international pub.
- 10 An Advanced Textbook on Biodiversity: Principles and Practice Paperback 2018 by K.V. Krishnamurthy Published by Oxford & IBH Publishing Co. Pvt. Ltd
- 11 Biodiversity and Ecosystem Conservation Hardcover 2003 by Ashish Dutta Publisher: Kalpaz

Reference Books

1. Jase Fitzgerald 2017. Biodiversity: An Introduction. Larsen and Keller Education. ISBN: 978-1635490428 [8]
2. Peter Stiling 2015. Ecology: Global Insights & Investigations 2nd Edition. McGraw-Hill international edition
3. Krishnamurthy KV (2003) an Advanced Textbook on Biodiversity – Principles and Practice, Oxford and IBH Publishing, New Delhi.
4. Singh J.S., Singh S.P. and Gupta S.R. (2014) Ecology, Environmental Science and Conservation. 4th Edition. S. Chand & Company Pvt. Ltd.
5. Primack, R. B. (2012). A Primer of Conservation Biology. Sinauer Associates is an imprint of Oxford University Press; 5 editions.
6. Anne E. Magurran, Brian J. McGill (2011) Biological Diversity: Frontiers in Measurement and Assessment. Oxford University Press. ISBN: 978-0199580675.
7. Groom, M. J., Meffe, G. R. and C. R. Carroll. 2006. Principles of Conservation Biology. Sinauer Associates, Inc., USA.

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| 8. Krishnamurthy, K. V. 2003. Textbook of Biodiversity. Science Publication.<br>9. Primack, R. 2006. Essentials of Conservation Biology. Sinauer Associates, Inc., USA.<br>10. Hamblen, C. 2004. Conservation. Cambridge University Press.<br>11. Van Dyke, F. 2008. Conservation Biology Foundations, Concepts, Applications 2nd Edition, Springer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Model Questions: Short Answer-</b><br>1. Define Biodiversity.<br>2. Explain species biodiversity.<br>3. Describe consumptive values of biodiversity.<br>4. Explain causes of habitat loss.<br>5. Describe characteristics of National Park.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Long Answer-</b><br>1. Discuss types of biodiversity with suitable examples.<br>2. Discuss causes of biodiversity loss.<br>3. Give account of Ex-situ conservation of biodiversity.<br>4. Discuss features of Biodiversity Act 2002.<br>5. Discuss the values of Biodiversity.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>MCQ-</b><br>1. -----diversity is not a type of biodiversity.<br>a. Species, b-ecosystem, c- genetic, d- community.<br>2. ----- is not an example of biodiversity habitat loss.<br>a. Destruction, b. Fragmentation, c. Transformation d. decomposition.<br>3. How many biogeographic does India have?<br>a. 5, b. 6, c. 8, d. 10<br>4. ----- is one of the most prevalent hotspots of biodiversity in India.<br>a. Himalayas, b. Western Ghats, c. Ganges, d. Melghat.<br>5. ----- is an example of an ex-situ conservation.<br>a. Sacred groves, b. Wildlife sanctuary, c. Seed bank, d. National Park.<br>6. ----- is an example of an ex-situ conservation.<br>a. Endemism, b. Species richness, c. Loss of diversity, d. Lesser interspecific competition.<br>7. ----- occurs when the death of the last individual in a species occurs.<br>Adaptation, b. Phylogenetic diversity, c. Speciation, extinction. |

#### Rubric for Internal Assessment for Theory Paper

| SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI<br><b>Internal Assessment</b><br>B.Sc. II (Environmental Science) SEMESTER – III(NEP) |                                                |               |
|-------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|---------------|
| Code:114204                                                                                                                         | <b>Major Theory-3 Dynamics of Biodiversity</b> | Max Marks: 20 |
| <b>S.N.</b>                                                                                                                         | <b>Assessment Criteria</b>                     | <b>Marks</b>  |
| <b>1.</b>                                                                                                                           | Test -MCQ                                      | 10            |
| <b>2.</b>                                                                                                                           | Assignment                                     | 5             |
| <b>3.</b>                                                                                                                           | Attendance                                     | 3             |
| <b>4.</b>                                                                                                                           | Students' overall performance                  | 2             |

### Major Course - Environmental Chemistry

| Level | Semester | Course Code | Course Name                                | Credits | Teaching Hours | Exam Duration | Max Marks             |
|-------|----------|-------------|--------------------------------------------|---------|----------------|---------------|-----------------------|
| 5.0   | III      | 114205      | Major, Theory-2<br>Environmental Chemistry | 2       | 30             | 2Hrs          | 30 (Ext.)<br>20 (Int) |

|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                   |                             |                                                                                                                                                                       |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course Objectives: | <ul style="list-style-type: none"> <li>To learn the fundamentals of Environmental chemistry.</li> <li>To understand principles and tenets of green chemistry, and how these relate to global human health and environmental issue.</li> <li>To aware about chemical reactions in atmosphere.</li> <li>To understand aspects of toxicology and its importance.</li> </ul>                                                                                                                                                                        |                   |                             |                                                                                                                                                                       |
| Course Outcomes:   | After the completion of this course student is able to - CO-1: Understand chemical components of atmosphere. CO-2: Criticize, the chemical reactions in atmosphere. CO-3: Demonstrates various properties of water. CO-4: Interpret aspects of Geo-environmental aspects. CO-5: Describes concept of environmental toxicology and understand toxicants and its way of entry in human body. CO-6: Explains need, importance and applications of green chemistry.                                                                                 |                   |                             |                                                                                                                                                                       |
| Unit System        | Contents                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Workload Allotted | Weightage of Marks Allotted | Incorporation of Pedagogies                                                                                                                                           |
| UNIT-I             | <b>1. Environmental and Atmospheric Chemistry</b><br>1.1- Introduction to Environmental Chemistry<br>1.2 Atmospheric chemistry: Ions and Radicles. Gaseous and particulate components of atmosphere.<br>1.3-Reactions in atmosphere:Chemical, Photochemical reactions.<br>1.4- Acid Rain (Dry and wet deposits), Ozone formation and depletion.                                                                                                                                                                                                 | 8                 | 8 Marks                     | A blend of theoretical knowledge and practical application, emphasizing real- world relevance and student engagement through active learning, case studies, and field |
| UNIT-II            | <b>2. Aquatic Chemistry</b><br>2.1 Properties of water- physical (Temperature, Specific heat capacity, density, viscosity, solubility of gases). Chemical Properties-Polarity, cohesion, adhesion and Surface tension<br>2.2 Water quality Parameters; Physical- TS, TDS, TSS, TVS, Conductivity, Temperature and turbidity.<br>2.3- Water quality Parameters; Chemical- pH, DO, Acidity, Alkalinity, Hardness, BOD, COD, Heavy Metals and biological parameters.<br>2.4-Water Quality Standards (Drinking-BIS and waste water standards-CPCB). | 7                 | 7 Marks                     |                                                                                                                                                                       |
| UNIT-III           | <b>3. Chemistry of Geosphere and Soil</b><br>3.1- Components and composition of geosphere (Crust, mantle and core).<br>3.2-Major mineral groups in earth's crust<br>3.3- Inorganic and organic components of soil. Mineral nutrients in soil (Major and minor).                                                                                                                                                                                                                                                                                 | 8                 | 8 Marks                     |                                                                                                                                                                       |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |   |         |                                                                                      |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---------|--------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 3.4- Acid – base and ion exchange reactions in soil.<br>Non-essential and toxic elements.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |   |         | experiences to foster a deeper understanding of environmental issues and solutions . |
| UNIT-IV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>4. Environmental Toxicology and Green Chemistry</b><br>4.1- Introduction of Environmental Toxicology, toxicant in environment (Heavy /toxic metals, dioxins, pesticides, food additives). Routes of exposure, Acute, sub-acute and Chronic Toxicity.<br>4.2- A. Green Chemistry: Definition and principles, biodegradable and bio-accumulative products in environment.<br>4.3 Green Technology: Successful green technologies (wind turbines and solar panels).<br>4.4 Application of Green Technologies: Green House Gas (GHG) emission reduction, carbon capture and storage technologies.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 7 | 7 Marks |                                                                                      |
| References                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>Study Materials in the form of - Reference Books, Text Books, Research Articles, Digital Resources like Weblinks, E- Contents, Educational Software, Databases, etc.</b><br>1. Rashmi Sanghai and Srivastava M.M. (2006): Green Chemistry; Environment Friendly Alternatives. Narosa Publishing House.<br>2. Krishnan Kanna, (1991): Fundamentals of Environmental Pollution. S Chand and Company Ltd. New Delhi.<br>3. Santra S.C. (2005): Environmental Science. New Central Book Agency (P) Ltd.<br>4. Morton Lippmann. (2000): Environmental Toxicants. Interscience, John Wiley & Sons Inc.<br><br><b>Websites</b><br>1. <a href="http://www.lanl.gov/greenchemistry/conf.html">http://www.lanl.gov/greenchemistry/conf.html</a> .<br>2. <a href="http://www.epa.gov/opptintr/greenchemistry/calender.html">http://www.epa.gov/opptintr/greenchemistry/calender.html</a> .<br>3. <a href="http://www.acs.org/education/greenchem/resources.html#conferences">http://www.acs.org/education/greenchem/resources.html#conferences</a> .<br>4. <a href="http://www.lanl.gov/greenchemistry/news.html#news">http://www.lanl.gov/greenchemistry/news.html#news</a> . |   |         |                                                                                      |
| <p style="text-align: center;">Model Questions</p> <p><b>Short Type (At least 8), Long Type (At least 4) and MCQs for Internal Assessment (At least 8) wherever applicable as the need of curriculum</b></p> <p><b>Short Type:</b></p> <ol style="list-style-type: none"><li>1. Define Environmental chemistry.</li><li>2. With the help of suitable example, explain Thermochemical Reaction in atmosphere.</li><li>3. Explain particulate components of atmosphere and their sources.</li><li>4. Explain mode of formation of Ozone in atmosphere with its chemical reaction.</li><li>5. Define acidity and alkalinity of water.</li><li>6. Define toxicant and toxicity.</li><li>7. Explain concept of green chemistry.</li><li>8. Define Biochemical oxygen Demand.</li></ol> <p><b>Long Questions:</b></p> <ol style="list-style-type: none"><li>1. What is acid rain? Explain mechanism of formation of acid rain.</li><li>2. With the help of suitable reaction explain Photochemical reaction in atmosphere.</li><li>3. Discuss Chemical Oxygen Demand with its significance and advantages.</li><li>4. Discuss composition of Atmosphere.</li><li>5. With the help of diagram, discuss structure of water molecule.</li></ol> <p><b>Multiple Choice Questions.</b></p> <ol style="list-style-type: none"><li>1. Major component of atmosphere is.....<br/>a- Oxygen, b- nitrogen, c- hydrogen, d- ozone.</li></ol> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |   |         |                                                                                      |

2. The key free radical presents in atmosphere, breaking down many pollutants is..... a- per oxy radicle) (2O), b- Alkoxy radical (RO), c- Nitric oxide radical (NO),  
d- hydroxyl radical (OH).
3. Specific Gravity of Water at is considered as .....gm/cm<sup>3</sup>.  
a-0.5, b- 1, c- 1.2, d- 2.
4. The unit of conductivity is..... a-  
Ohm, b- Simens, c- volt, d- watt.
5. In LC50, "C" stands for ----- --.  
a- Carbon, b- concentration, c- chemical, d- Celsius.
6. In Green Chemistry, 'Green' word expresses-----  
a- Color, b- green alert, c- environment friendly, d- photosynthesis.
7. Organic component of soil is called ----- --.  
a- Nutrients, b- soil atmosphere, c- humus, d-pedons.
8. In India, drinking water standard prescribed by-----.  
a- WHO, b- CPCB, c- BIS, d- ICMR.

#### Rubric for Internal Assessment for Theory Paper

| SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI<br><b>Internal Assessment</b><br>B.Sc. II (Environmental Science) SEMESTER – III(NEP) |                                              |               |
|-------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|---------------|
| Subject Code:<br>114205                                                                                                             | <b>Major Theory- Environmental Chemistry</b> | Max Marks: 20 |
| <b>S.N.</b>                                                                                                                         | Assessment Criteria                          | Marks         |
| <b>1.</b>                                                                                                                           | Test -MCQ                                    | 10            |
| <b>2.</b>                                                                                                                           | Assignment                                   | 5             |
| <b>3.</b>                                                                                                                           | Attendance                                   | 3             |
| <b>4.</b>                                                                                                                           | Students' overall performance                | 2             |

**Major Lab/Pract: Dynamics, of Biodiversity and Environmental Chemistry.**

| Level | Semester | Course Code | Course Name                                                           | Credit | Teaching Hrs | Exam. Duration | Mx Marks              |
|-------|----------|-------------|-----------------------------------------------------------------------|--------|--------------|----------------|-----------------------|
| 5.0   | III      | 114206      | Lab/Experiments: Dynamics of Biodiversity and Environmental Chemistry | 02     | 60           | 4 Hrs          | 25 (Ext.)<br>25 (Int) |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course Objectives:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <ul style="list-style-type: none"> <li>To know the properties and physico-chemical characteristics of water and soil.</li> <li>Study of methodology to determination of soil and water quality.</li> <li>To study ecological status of local area.</li> <li>Study of aquatic flora and faunal diversity of local water bodies.</li> </ul>                                                                                                                                                                                                  |
| Course Outcomes:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <p>After the completion of this course, student is able to-</p> <p>CO-1: Determine physico chemical properties of water.</p> <p>CO-2: Prepares biodiesel from used cooking oil.</p> <p>CO-3: Analyse soil for its quality parameters.</p> <p>CO-4: Estimates carbon stock in soil.</p> <p>CO-5: Acquainted with Ecological study of terrestrial and aquatic ecosystems.</p> <p>CO-6: Finds the productivity of aquatic ecosystem.</p> <p>CO-7: Aware about local bird species.</p> <p>CO-8: Conducts biodiversity awareness programme.</p> |
| Experiment/ Activity                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>Contents</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <p><b>A)-Experiment on Environmental Chemistry:</b></p> <ol style="list-style-type: none"> <li>To determine Total Solids (TS), Total Dissolved Solid (TDS) and Total Suspended Solids (TSS) of given water sample.</li> <li>To determine Total Hardness of given water sample.</li> <li>To determine Calcium and Magnesium of given water sample.</li> <li>To compare the chemical Characteristics (carbonate content, nitrate content, base deficiency and pH) of given soil sample by Rapid Test.</li> <li>To estimate Organic Carbon from different soil samples.</li> <li>To determine carbonate alkalinity and bicarbonate alkalinity.</li> <li>Preparation of biodiesel from Waste Cooking oil.</li> </ol> <p><b>B)- Exercise on Dynamics of Biodiversity:</b></p> <ol style="list-style-type: none"> <li>Study of local endemic area with respects its species composition and ecological status.</li> <li>Study of local biodiversity hot spot with respects its species composition, significance and ecological status.</li> <li>Determination of primary productivity as GPP and NPP using light and dark bottle technique.</li> <li>Identification and study of phytoplankton's diversity from local water bodies.</li> <li>Identification and study of zooplankton's diversity from local water bodies.</li> </ol> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>Practical on Global Environmental Issues</b></p> <ol style="list-style-type: none"> <li>Study of temperature, humidity, rainfall, and wind data using meteorological instruments.</li> <li>Preparation and interpretation of climate graphs using long-term weather records.</li> <li>Analysis of global temperature anomaly data related to climate change.</li> <li>Demonstration of greenhouse effect using laboratory models.</li> <li>Estimation of carbon dioxide concentration in ambient air samples.</li> <li>Study of heatwave trends and extreme weather events using secondary data.</li> <li>Case study analysis of floods, droughts, cyclones, and their environmental impacts.</li> <li>Demonstration of El-Niño and La-Niña effects using ocean-atmosphere interaction models.</li> <li>Study of ozone layer depletion using UV radiation and atmospheric data records.</li> <li>Determination of pH and acidity of rainwater samples for acid rain analysis.</li> <li>Comparative analysis of normal rainwater and acidified water on plant growth.</li> <li>Assessment of indoor and outdoor air pollution in selected areas.</li> </ol> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

13. Study of the effect of acidic water on shells/chalk to demonstrate ocean acidification impacts.
14. Survey of impacts of climate change on biodiversity and ecosystems in local areas.
15. Calculation of personal or institutional carbon footprint.
16. Preparation of a report on international environmental agreements such as the Kyoto Protocol and Paris Agreement.

#### Rubric for Internal Assessment for Practical

|                    |                                                                                                                                                  |                                                                        |               |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|---------------|
| I                  | SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI<br><b>Internal Assessment for Lab Work</b><br>B.Sc. II (Environmental Science) SEMESTER –III (NEP) |                                                                        |               |
| Course Code:114206 |                                                                                                                                                  | <b>Major Lab: Dynamics of Biodiversity and Environmental Chemistry</b> | Max Marks: 25 |
| <b>Sr. No.</b>     | <b>Assessment Criteria</b>                                                                                                                       | <b>Marks</b>                                                           |               |
| 1                  | Attendance                                                                                                                                       | 5                                                                      |               |
| 2                  | Record / Assignments                                                                                                                             | 8                                                                      |               |
| 3                  | Participation in Activity/ Field visit and its report                                                                                            | 7                                                                      |               |
| 4                  | Students' overall performance                                                                                                                    | 5                                                                      |               |

#### Rubric for External Assessment for Practical

|                     |                                                                                                                                                  |                             |  |
|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|--|
| E                   | SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI<br><b>External Assessment for Lab Work</b><br>B.Sc. II (Environmental Science) SEMESTER –III (NEP) |                             |  |
| Course Code: 114206 | Major Lab: Dynamics of Biodiversity and Environmental Chemistry                                                                                  | Max Marks: 25, Time: 4Hours |  |
| <b>Sr. No.</b>      | <b>Assessment Criteria</b>                                                                                                                       | <b>Marks</b>                |  |
| 1                   | Practical Based on Biodiversity (Major).                                                                                                         | 06                          |  |
| 2                   | Practical Based on Environmental Chemistry (Major)                                                                                               | 06                          |  |
| 3                   | Practical Based on Environmental Issues                                                                                                          | 06                          |  |
| 4                   | Viva Voce                                                                                                                                        | 07                          |  |

**IKS – Major Specific: Environmental Conservation in Ancient India**

| Level | Semester | Course Code | Course Name                                             | Credits | Teaching Hours | Exam Duration | Max Marks             |
|-------|----------|-------------|---------------------------------------------------------|---------|----------------|---------------|-----------------------|
| 5.0   | III      | 114207      | IKS Theory: Environmental Conservation in Ancient India | 2       | 30             | 2 Hrs         | 30 (Ext.)<br>20 (Int) |

|                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                         |                                    |                                    |
|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|------------------------------------|------------------------------------|
| <b>Course Objectives:</b> | <ul style="list-style-type: none"> <li>Introduce students to the ecological and environmental principles rooted in Indian Knowledge Systems.</li> <li>Understand traditional practices, cultural values, and texts related to environmental sustainability.</li> <li>Evaluate the relevance of indigenous knowledge in solving contemporary environmental issues.</li> <li>Understand Traditional Knowledge Systems – Introduce students to ancient Indian environmental conservation practices and their relevance in the modern context.</li> <li>Analyse Water Management Techniques – Examine ancient Indian water conservation methods such as stepwells, tanks, and irrigation systems like ghul and johads.</li> <li>Study Forest &amp; Wildlife Conservation – Learn about ancient Indian perspectives on afforestation, sacred groves, and wildlife protection.</li> <li>Understand Agricultural Practices – Investigate sustainable agricultural techniques, organic farming, and soil conservation methods used in ancient India.</li> <li>Examine Sacred &amp; Ethical Environmental Values – Discuss philosophical and religious principles advocating environmental preservation in Hinduism, Buddhism, and Jainism.</li> <li>Encourage Sustainable Practices – Inspire students to incorporate traditional environmental wisdom into modern conservation efforts for sustainable development.</li> </ul> |                                         |                                    |                                    |
| <b>Course Outcomes:</b>   | <p>By the end of the course, students will be able to:</p> <p>CO-1: Describe the environmental philosophy embedded in Indian traditions and texts.</p> <p>CO-2: Identify sustainable practices from ancient India and analyze their modern relevance.</p> <p>CO-3: Critically assess how traditional ecological knowledge can complement modern environmental science.</p> <p>CO-4: Apply IKS principles in local or global environmental problem-solving.</p> <p>CO-5: Assess traditional water management techniques, including stepwells, tanks, canals, and rainwater harvesting systems.</p> <p>CO-6: Explain the significance of sacred groves, protected forest areas, and wildlife conservation practices in ancient India.</p> <p>CO-7: Draw parallels between ancient conservation methods and contemporary environmental strategies, evaluating their relevance today.</p> <p>CO-8: Develop innovative conservation models by integrating ancient techniques with modern environmental solutions.</p> <p>CO-8: Engage in research projects, case studies, and field visits to heritage conservation sites to apply traditional environmental knowledge in practical contexts.</p>                                                                                                                                                                                                                            |                                         |                                    |                                    |
| <b>Unit System</b>        | <b>Contents</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>Workload Allotted (Hrs) per week</b> | <b>Weightage of Marks Allotted</b> | <b>Incorporation of Pedagogies</b> |
| Unit :1                   | <b>Introduction to Indian Knowledge Systems</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 8                                       | 8                                  | Chalk and talk, FW,                |

|         |                                                                                                                                                                                                                                                                                                                                                                   |   |   |                                                                                                                           |
|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---------------------------------------------------------------------------------------------------------------------------|
|         | 1.1 Definition and scope of IKS, Interdisciplinary Approach,<br>1.2: environmental sustainability in Indus Valley Civilization<br>1.3: Environmental conservation in Hinduism (Sacredness of life, Nature and the divine, Panch Mahabhutas<br>1.4: Core philosophical principles, ecosystem and environmental ethics in Jainism                                   |   |   | Visits, use of ICT charts, models, problem based learning and collaborative learning. Theory, Self-study and Case studies |
| Unit: 2 | <b>Environmental conservation in ancient and middle era.</b><br>2.1 : Interconnection and respect for life, ethical implication, compassion in Buddhism<br>2.2 : Emperor Ashoka's contribution to environmental conservation<br>2.3 : Environmental Protection by Bishnoi Community<br>2.4 : Environmental stewardship in the era of Chhatrapati Shivaji Maharaj. | 7 | 7 |                                                                                                                           |
| Unit: 3 | <b>Traditional Ecological Knowledge</b><br>3.1 : Sacred groves, forests, rivers, and biodiversity Conservation.<br>3.2 : Indigenous agricultural practices and water management<br>3.3 : Ecofriendly tools and medicinal plants<br>3.4 : Traditional rainwater harvesting (Johads, Tankas, Ahar-Pyne systems)                                                     | 8 | 8 |                                                                                                                           |
| Unit: 4 | <b>Modern Environmental Conservation Efforts and challenges</b><br>4.1 : Modern Era environmentalist (Sunderlal Bahuguna, Salim Ali, Rajendra Singh, Jadav Payeng, Kinkri Devi)<br>4.2 : Eco-centric vs Anthropocentric worldview.<br>4.3 : Integration of IKS with modern environmental science.<br>4.4 : Challenges in preserving and applying IKS              | 7 | 7 |                                                                                                                           |

**References:**

1. Dharampal – Collected Writings on Indian Science and Technology
2. J.C. Kalita & K.K. Baruah – Traditional Knowledge System and Environmental Sustainability
3. Kapil Kapoor – Text and Interpretation: The Indian Tradition
4. Agarwal, D.P. – The Archaeology of India
5. Guha, Ramachandra – Environmentalism: A Global History
6. Sharma, Anupam – Ancient Indian Environmental History and Conservation Practices
7. Singh, G.P. – Environmental Ethics in Ancient India
8. Thapar, Romila – Early India: From the Origins to AD 1300
9. Chapple, Christopher Key – Hinduism and Ecology: The Intersection of Earth, Sky, and Water
10. K.L. Seshagiri Rao – The Four Faces of Hinduism and the Environment
11. Chapple, Christopher Key – Buddhist Ethics and Environmental Concerns
12. Harris, Ian – Buddhism and Ecology
13. Kaza, Stephanie – Green Buddhism: Practice and Compassionate Action in Uncertain Times
14. Swearer, Donald K. – Buddhism and Ecology: The Interconnection of Dharma and Deeds
15. Jaini, Padmanabh – Ecology and Jainism: Environmental Ethics and Non-Violence
16. Chapple, Christopher Key – Jainism and Ecology: Nonviolence in the Web of Life
17. Dundas, Paul – The Jains
18. Sangave, Vilas A. – Jainism and Ecology
19. Rankin, Aidan – Jainism and Environmental Philosophy: Karma and the Web of Life

20. Thapar, Romila – Ashoka and the Decline of the Mauryas
21. Singh, Upinder – A History of Ancient and Early Medieval India: From the Stone Age to the 12th Century
22. Keay, John – India: A History
23. Basham, A.L.- – The Wonder That Was India
24. Kulke, Hermann & Rothermund, Dietmar – A History of India.
25. N.A. Nikam & Richard McKeon -The Edicts of King Asoka: An English Rendering”
26. Environment in Ancient India” – R. Nath
27. Chhatrapati Shivaji Maharaj: Environmental Consciousness and Forest Management” – Maharashtra State Archives
28. Forests and Forts: Resource Conservation in Maratha Administration” – (Journal articles on Maratha- era policies)
29. The Bishnois: Protectors of Nature” – Krishan Singh Detha
30. Nanditha Krishna- Sacred Animals of India

*Short Questions:*

1. Define Indian Knowledge System.
2. What is the scope of IKS.
3. Which is the Pancha maha Bhutas?
4. What are the Sacred grooves?
5. Define sustainability.
6. What do you understand by Ahimsa?
7. What are the Johads?
8. What is Ahar-Pyne systems?
9. What is core philosophical principles?
10. What is interconnection for life?

*Long Questions:*

1. Explain scope of IKS.
2. Describe the role of Buddhism in environment.
3. Explain corelation in Panch Maha Bhutas and environment.
4. Discuss concept of Johads.
5. Discuss in detail Indigenous agricultural practices.

*MCQ:*

1. In Rajasthan are small, traditional, earthen check dams designed to capture and conserve rainwater are called-  
a- vahir, b- kuvva, c- johad, d- talav.
2. ----- is environment friendly thinking.  
a- Anthropocentric, b- Eco centric, c- human centric, d- artificial centric.
3. patches of forest protected and revered by local communities due to their religious or cultural significance, called-  
a- jungal, b- sacred grove, c- Ran, d- mangrove.
4. Inn Maharashtra patches of religious protected forest is called –  
a- Devrai, b- Law Kyntang, c- Kovilkadu, d- Sarnas.
5. ----- is a core principle in Hinduism, Jainism, and Buddhism, means non-violence and non-harming towards all living beings.  
a- Upvas, b- Ahimsa, c- Aastey, d- voilance.

**Rubric for Internal Assessment for Theory Paper**

| SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI<br><b>Internal Assessment</b><br>B.Sc. II (Environmental Science) SEMESTER – III(NEP) |                                                                 |               |
|-------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|---------------|
| Subject Code:<br>114207                                                                                                             | IKS Theory- <b>Environmental Conservation in Ancient India.</b> | Max Marks: 20 |
| <b>S.N.</b>                                                                                                                         | Assessment Criteria                                             | Marks         |
| <b>1.</b>                                                                                                                           | Test -MCQ                                                       | 10            |
| <b>2.</b>                                                                                                                           | Assignment                                                      | 5             |
| <b>3.</b>                                                                                                                           | Attendance                                                      | 3             |
| <b>4</b>                                                                                                                            | Students' overall performance                                   | 2             |

**Minor Theory: Fundamentals of Environmental Chemistry**

| Level | Semester | Course Code | Course Name                                           | Credits | Teaching Hours | Exam Duration | Max Marks             |
|-------|----------|-------------|-------------------------------------------------------|---------|----------------|---------------|-----------------------|
| 5.0   | III      | 114208      | Minor Theory: Fundamentals of Environmental Chemistry | 2       | 30             | 2Hrs          | 30 (Ext.)<br>20 (Int) |

|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                   |                             |                                                                                                                                               |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| Course Objectives: | <ul style="list-style-type: none"> <li>To learn the fundamentals of Environmental chemistry.</li> <li>To understand principles and tenets of green chemistry, and how these relate to global human health and environmental issue.</li> <li>To aware about chemical reactions in atmosphere.</li> <li>To understand aspects of toxicology and its importance.</li> </ul>                                                                                                                                    |                   |                             |                                                                                                                                               |
| Course Outcomes:   | After the completion of this course, student is able to - CO-1: Understand chemical components of atmosphere. CO-2: Criticize, the chemical reactions in atmosphere. CO-3: Demonstrates various properties of water. CO-4; Interpret aspects of Geo-environmental aspects. CO-5: Describes concept of environmental toxicology and understand toxicants and its way of entry in human body. CO-6: Explains need, importance and applications of green chemistry.                                            |                   |                             |                                                                                                                                               |
| Unit System        | <b>Contents</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Workload Allotted | Weightage of Marks Allotted | Incorporation of Pedagogies                                                                                                                   |
| UNIT-I             | <b>1. Environmental and Atmospheric Chemistry</b><br>1.1- Introduction to Environmental Chemistry<br>1.2 Atmospheric chemistry: Gaseous and particulate components of atmosphere.<br>1.3-Reactions in atmosphere: Chemical, Photochemical reactions.<br>1.4- Ozone formation and depletion.                                                                                                                                                                                                                 | 8Hrs              | 8 Marks                     | Chalk and talk, FW, Visits, use of ICT charts, models, problem based learning and collaborative learning. Theory, Self-study and Case studies |
| UNIT-II            | <b>2. Aquatic Chemistry</b><br><b>2.1</b> Properties of water- Physical Properties-State of Matter, Boiling & Freezing Points, Density, Surface Tension. / Chemical Properties-Polarity, Hydrogen Bonding, pH Level.<br><b>2.2</b> Water quality Parameters; Physical- TS, Conductivity, Temperature and turbidity, Colour Taste.<br><b>2.3-</b> Water quality Parameters; Chemical- pH, DO, Hardness, BOD, COD.<br><b>2.4-</b> Thermal Properties- High Specific Heat Capacity, High Heat of Vaporization. | 7 Hrs             | 7 Marks                     |                                                                                                                                               |
| UNIT-III           | <b>3. Chemistry of Geosphere and Soil</b><br>3.1- Components and composition of geosphere (Crust, mantle and core).<br>3.2- Inorganic and organic components of soil.<br>3.3- Mineral nutrients in soil (Major and minor).                                                                                                                                                                                                                                                                                  | 8Hrs              | 8 Marks                     |                                                                                                                                               |

|                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |       |         |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|---------|--|
|                                                                                                                                                                                                                                                                                                                                                                                                                                 | 3.4- Non-essential and toxic elements.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |       |         |  |
| UNIT-IV                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>4. Environmental Toxicology and Green Chemistry</b><br>4.1- Introduction of Environmental Toxicology, toxicant in environment.<br>4.2- Routes of exposure, Acute, sub-acute and Chronic Toxicity.<br>4.3- Introduction, evolution and Principles of Green Chemistry.<br>4.4- Need of Green chemistry.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 7 Hrs | 7 Marks |  |
| References                                                                                                                                                                                                                                                                                                                                                                                                                      | Study Materials in the form of - Reference Books, Text Books, Research Articles, Digital Resources like Weblinks, E- Contents, Educational Software, Databases, etc.<br>1. Rashmi Sanghai and Srivastava M.M. (2006): Green Chemistry; Environment Friendly Alternatives. Narosa Publishing House.<br>2. Krishnan Kanna, (1991): Fundamentals of Environmental Pollution. S Chand and Company Ltd. New Delhi.<br>3. Santra S.C. (2005): Environmental Science. New Central Book Agency (P) Ltd.<br>4. Morton Lippmann. (2000): Environmental Toxicants. Interscience, John Wiley & Sons Inc.<br>1. Daniel D. Chiras (1994), Environmental Science, 4th Ed.<br>2. Environmental Chemistry by W. Moore and J. Moore<br>3. Environmental chemistry by J.O.M. Bockariss<br>4. Environmental by BK Sharma<br>5. Environmental chemistry by SS Dara<br>6. Environmental chemistry by Mahajan<br>7. Environmental chemistry by A. K. De by A. K. De<br><b>Websites</b><br>1. <a href="http://www.lanl.gov/greenchemistry/conf.html">http://www.lanl.gov/greenchemistry/conf.html</a> .<br>2. <a href="http://www.epa.gov/opptintr/greenchemistry/calender.html">http://www.epa.gov/opptintr/greenchemistry/calender.html</a> .<br>3. <a href="http://www.acs.org/education/greenchem/resources.html#conferences">http://www.acs.org/education/greenchem/resources.html#conferences</a> .<br>4. <a href="http://www.lanl.gov/greenchemistry/news.html#news">http://www.lanl.gov/greenchemistry/news.html#news</a> . |       |         |  |
| Model Questions                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |       |         |  |
| <b>Short Type:</b><br>1. Define Environmental chemistry.<br>2. With the help of suitable example, explain Thermochemical Reaction in atmosphere.<br>3. Explain particulate components of atmosphere and their sources.<br>4. Explain mode of formation of Ozone in atmosphere with its chemical reaction.<br>5. Define toxicant and toxicity.<br>6. Explain concept of green chemistry.<br>7. Define Biochemical oxygen Demand. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |       |         |  |
| <b>Long Questions:</b><br>1. What is ozone depletion? Explain mechanism.<br>2. With the help of suitable reaction explain Photochemical reaction in atmosphere.<br>3. Discuss Chemical Oxygen Demand with its significance and advantages.<br>4. Discuss composition of Atmosphere.<br>5. With the help of diagram, discuss structure of water molecule.                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |       |         |  |
| <b>Multiple Choice Questions.</b><br>1. Major component of atmosphere is.....<br>b- Oxygen, b- nitrogen, c- hydrogen, d- ozone.<br>2. The key free radicle presents in atmosphere, breaking down many pollutants is.....                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |       |         |  |

- b- per oxy radicle) (2O), b- Alkoxy radical (RO), c- Nitric oxide radical (NO), d- hydroxyl radical (OH).
3. Specific Gravity of Water at is considered as .....gm/cm<sup>3</sup>.  
a-0.5, b- 1, c- 1.2, d- 2.
4. The unit of conductivity is.....  
b- Ohm, b- Simens, c- volt, d- watt.
5. In LC50, "C" stands for-----.  
b- Carbon, b- concentration, c- chemical, d- Celsius.
6. In Green Chemistry, 'Green' word expresses-----  
b- Color, b- green alert, c- environment friendly, d- photosynthesis.
7. Organic component of soil is called-----.  
b- Nutrients, b- soil atmosphere, c- humus, d-pedons.
8. In India, drinking water standard prescribed by -----.  
b- WHO, b- CPCB, c- BIS, d- ICMR.

**Rubric for Internal Assessment for Theory Paper**

| SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI<br><b>Internal Assessment</b><br>B.Sc. II (Environmental Science) SEMESTER – III(NEP) |                                                              |               |
|-------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|---------------|
| Subject Code:<br>114208                                                                                                             | Minor Theory- <b>Fundamentals of Environmental Chemistry</b> | Max Marks: 20 |
| <b>S.N.</b>                                                                                                                         | <b>Assessment Criteria</b>                                   | <b>Marks</b>  |
| 1.                                                                                                                                  | Test -MCQ                                                    | 10            |
| 2.                                                                                                                                  | Assignment                                                   | 5             |
| 3.                                                                                                                                  | Attendance                                                   | 3             |
| 4.                                                                                                                                  | Students' overall performance                                | 2             |

**Minor Lab/Experiments Fundamentals of Environmental Chemistry.**

| Level | Semester | Course Code | Course Name                                                    | Credits | Teaching Hours | Exam Duration | Max Marks |
|-------|----------|-------------|----------------------------------------------------------------|---------|----------------|---------------|-----------|
| 5.0   | III      | 114209      | Minor Lab/Experiments Fundamentals of Environmental Chemistry. | 02      | 60             | 4Hrs          | 25+25     |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                   |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Objectives:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <ul style="list-style-type: none"> <li>To know the properties and physico-chemical characteristics of water and soil.</li> <li>Study of methodology to determination of water quality.</li> <li>To demonstrate nonconventional energy resources.</li> <li>To know the properties of biomolecules.</li> </ul>                                                      |
| Course Outcomes:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | After the completion of this course, student is able to-<br>CO-1: Demonstrate non-conventional energy sources.<br>CO-2: Determines presences of bio-molecules in matter.<br>CO-3: Analyses - effects of temperature on properties of enzymes.<br>CO-4: Acquire the technique of paper chromatography.<br>CO-5: Understand the effect of toxic substance on human. |
| <b>Experiment/ Activity</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                   |
| <ol style="list-style-type: none"> <li>To determine pH of water sample.</li> <li>To determine Alkalinity of water sample.</li> <li>Determination of Dissolved Oxygen (DO) of water sample</li> <li>Determination of Total Dissolved Solids (TDS)</li> <li>Determination of and Turbidity of water.</li> <li>Estimation of residual chlorine by titration method.</li> <li>Study the effects of temperature on activity of enzyme.</li> <li>Qualitative estimation of carbohydrates from sample.</li> <li>Demonstration of immobilization of enzyme.</li> <li>To study the activity of amylase enzyme on starch.</li> <li>Demonstration of non-conventional energy sources by working models. (i) Solar cells, (ii) Solar cooker, (iii) Wind mills, (iv) Solar water Heaters</li> </ol> |                                                                                                                                                                                                                                                                                                                                                                   |

**Rubric for Internal Assessment for Practical**

|                     |                                                                                                                                                  |                                                                        |
|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|
| <b>I</b>            | SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI<br><b>Internal Assessment for Lab Work</b><br>B.Sc. II (Environmental Science) SEMESTER –III (NEP) |                                                                        |
| Course Code: 114209 |                                                                                                                                                  | <b>Minor: Fundamentals of Environmental Chemistry</b><br>Max Marks: 25 |
| <b>Sr. No.</b>      | <b>Assessment Criteria</b>                                                                                                                       | <b>Marks</b>                                                           |
| 1                   | Attendance                                                                                                                                       | 5                                                                      |
| 2                   | Record / Assignments                                                                                                                             | 8                                                                      |
| 3                   | Participation in Activity/ Field visit and its report                                                                                            | 7                                                                      |
| 4                   | Students' overall performance                                                                                                                    | 5                                                                      |

**Rubric for External Assessment for Practical**

|                        |                                                                                                                                                  |                                   |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|
| E                      | SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI<br><b>External Assessment for Lab Work</b><br>B.Sc. II (Environmental Science) SEMESTER –III (NEP) |                                   |
| Course Code:<br>114209 | Minor: Fundamentals of Environmental Chemistry                                                                                                   | Max Marks:<br>25, Time:<br>4Hours |
| <b>Sr. No.</b>         | <b>Assessment Criteria</b>                                                                                                                       | <b>Marks</b>                      |
| 1                      | Practical Based on Water Analysis.                                                                                                               | 07                                |
| 2                      | Practical Based on Biochemistry.                                                                                                                 | 07                                |
| 3                      | Practical Based on Demonstration of Non-conventional energy                                                                                      | 07                                |
| 4                      | Viva Voce                                                                                                                                        | 04                                |

**G/OEC Th- Ecotourism and Environmental Ethics**

| Level | Semester | Course Code | Course Name                                   | Credits | Teaching Hours | Exam Duration | Max Marks                   |
|-------|----------|-------------|-----------------------------------------------|---------|----------------|---------------|-----------------------------|
| 5.0   | III      | 114265      | G/OEC Th- Ecotourism and Environmental Ethics | 2       | 30             | 2 Hrs         | 30<br>(Ext.)<br>20<br>(Int) |

| Course Objective s: | <ul style="list-style-type: none"><li>● To understand the principles and practices of ecotourism.</li><li>● To explore the ethical dimensions of human-environment interactions.</li><li>● To analyse the impacts of tourism on natural and cultural environments.</li><li>● To evaluate strategies for sustainable ecotourism development.</li><li>● To foster critical thinking about environmental values and responsibilities</li></ul>                                                                                                                                                                                                                                                                |                         |                              |                                                                                                                                               |
|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| Course Outcomes :   | After the completion of this course, student is able to -<br><b>CO1:</b> Define and differentiate between ecotourism and traditional tourism, demonstrating and understanding of ecotourism principles.<br><b>CO2:</b> Explain key concepts in environmental ethics, including anthropocentrism, biocentrism, and the intrinsic value of nature.<br><b>CO3:</b> Identify and analyse the various ecological, socio-cultural, and economic impacts of ecotourism.<br><b>CO4:</b> Describe sustainable ecotourism practices, including community-based ecotourism and eco-certificate<br><b>CO5:</b> Develop strategies for mitigating the negative impacts of tourism on natural and cultural environments. |                         |                              |                                                                                                                                               |
| Unit System         | Contents                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Workload Allotted (Hrs) | Weighta ge of Marks Allotted | Incorporatio n of Pedagogies                                                                                                                  |
| Unit I              | <b>Foundations of Ecotourism</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 8                       | 8                            | Chalk and talk, FW, Visits, use of ICT charts, models, problem based learning and collaborative learning. Theory, Self-study and Case studies |
|                     | 1.1 Definitions and history of ecotourism.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                         |                              |                                                                                                                                               |
|                     | 1.2 Principles and characteristics of ecotourism.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                         |                              |                                                                                                                                               |
|                     | 1.3 Ecotourism vs. traditional tourism.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                         |                              |                                                                                                                                               |
|                     | 1.4 Ecotourism and sustainable development.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                         |                              |                                                                                                                                               |
| Unit II             | <b>Environmental Ethics and Values</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 7                       | 7                            |                                                                                                                                               |
|                     | 2.1 Introduction to environmental ethics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                         |                              |                                                                                                                                               |
|                     | 2.2 Anthropocentric vs. biocentric perspectives                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                         |                              |                                                                                                                                               |
|                     | 2.3 Ethical frameworks for environmental decision-making.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                         |                              |                                                                                                                                               |
|                     | 2.4 The concept of intrinsic value in nature                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                         |                              |                                                                                                                                               |
| Unit III            | <b>Impacts of Ecotourism</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 8                       | 8                            |                                                                                                                                               |
|                     | 3.1 Ecological impacts of tourism (positive and negative).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                         |                              |                                                                                                                                               |
|                     | 3.2 Socio-cultural impacts of tourism.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                         |                              |                                                                                                                                               |
|                     | 3.3 Economic impacts of ecotourism.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                         |                              |                                                                                                                                               |

|                                                                                                                                                                                           |                                                      |   |   |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|---|---|--|
|                                                                                                                                                                                           | 3.4 Monitoring and evaluation of ecotourism impacts. |   |   |  |
| Unit IV                                                                                                                                                                                   | <b>Sustainable Ecotourism Practices</b>              | 7 | 7 |  |
|                                                                                                                                                                                           | 4.1 Ecotourism planning and management               |   |   |  |
|                                                                                                                                                                                           | 4.2Community-based ecotourism                        |   |   |  |
|                                                                                                                                                                                           | 4.3 Responsible tourism practices.                   |   |   |  |
|                                                                                                                                                                                           | 4.4 Ecotourism certification and eco-labelling.      |   |   |  |
| References:                                                                                                                                                                               |                                                      |   |   |  |
| 1. "Ecotourism Development in India" by Seema Bhatt and Syed Liyakat Niranjan Dev                                                                                                         |                                                      |   |   |  |
| 2. "Environmental Ethics and India's Perspective on Environment" by Bhardwaj                                                                                                              |                                                      |   |   |  |
| 3. "Ecotourism and Sustainable Development: Who Owns Paradise?" by Martha Honey.                                                                                                          |                                                      |   |   |  |
| 4. "Ecotourism: Principles, Practices & Policies for Sustainability" by Wood. Megan Epler                                                                                                 |                                                      |   |   |  |
| 5. Ecotourism and Environmental Sustainability: Principles and Practice and Jennifer Hill e" by Tim Gale                                                                                  |                                                      |   |   |  |
| 6. "An Introduction to Environmental Ethics by Laxmikant Padhi.                                                                                                                           |                                                      |   |   |  |
| 7. "The Great Derangement: Climate Change and the Unthinkable" Am itav Ghosh                                                                                                              |                                                      |   |   |  |
| <b>Model Questions: Short Type (At least 8):</b>                                                                                                                                          |                                                      |   |   |  |
| 1. Define "ecotourism."                                                                                                                                                                   |                                                      |   |   |  |
| 2. What is the difference between anthropocentrism and biocentrism?                                                                                                                       |                                                      |   |   |  |
| 3. List three potential positive impacts of ecotourism.                                                                                                                                   |                                                      |   |   |  |
| 4. What is community-based ecotourism?                                                                                                                                                    |                                                      |   |   |  |
| 5. What is the importance of eco-labelling?                                                                                                                                               |                                                      |   |   |  |
| <b>Long Type (At least 4):</b>                                                                                                                                                            |                                                      |   |   |  |
| 1. Discuss the key principles of ecotourism and how they differ from those of traditional tourism.                                                                                        |                                                      |   |   |  |
| 2. Analyze the ethical implications of human interactions with wildlife in ecotourism settings.                                                                                           |                                                      |   |   |  |
| 3. Evaluate the effectiveness of community-based ecotourism in promoting sustainable development.                                                                                         |                                                      |   |   |  |
| 4. Describe the potential ecological and socio-cultural impacts of ecotourism and discuss strategies for mitigating negative impacts.                                                     |                                                      |   |   |  |
| 5. Explain the roles that environmental ethics play in creating sustainable ecotourism practices.                                                                                         |                                                      |   |   |  |
| <b>MCQs for Internal Assessment (At least 8)</b>                                                                                                                                          |                                                      |   |   |  |
| 1. Eco-labelling aims to:                                                                                                                                                                 |                                                      |   |   |  |
| a) Promote unsustainable tourism practices. b) Provide consumers with information about environmentally friendly products and services. c) Reduce consumer choice. d) Increase pollution. |                                                      |   |   |  |
| 2. Biocentrism places value on:                                                                                                                                                           |                                                      |   |   |  |
| a) Human economic development. b) All living organisms. c) Only charismatic megafauna. d) Non-living natural resources.                                                                   |                                                      |   |   |  |
| 3. A core goal of ecotourism is to achieve environmental -----                                                                                                                            |                                                      |   |   |  |
| a) conservation, b) degradation, c) pollution, d) contamination.                                                                                                                          |                                                      |   |   |  |
| 4. Environmental ethics explores the _____relationship between humans and nature.                                                                                                         |                                                      |   |   |  |
| 5. Successful ecotourism projects prioritize the involvement of–                                                                                                                          |                                                      |   |   |  |
| 6. 4.Ecotourism can be a tool for--- natural areas.                                                                                                                                       |                                                      |   |   |  |
| 7. 5. Ecotourism encourages _____ travel practices.                                                                                                                                       |                                                      |   |   |  |

**Important Considerations:**

- **Case Studies:** Incorporating real-world case studies is crucial for illustrating ecotourism concepts and ethical dilemmas.
- **Field Trips:** If possible, include field trips to local ecotourism destinations to provide practical experience.
- **Current Events:** Stay updated on current events related to ecotourism and environmental issues.
- **Local context:** When designing the syllabus, it is very important to make sure that local areas, and local environmental concerns are included in the syllabus.

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### VSC: Skills for Conservation Biologist

| Level | Semester | Course Code | Course Name                            | Credits | Teaching Hours | Exam Duration | Max Marks |
|-------|----------|-------------|----------------------------------------|---------|----------------|---------------|-----------|
| 5.0   | III      | 114274      | VSC: Skills for Conservation Biologist | 2       | 60             | 4 Hrs         | 50        |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course Objectives:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <ol style="list-style-type: none"> <li>1. To develop practical knowledge of biodiversity conservation and ecosystem management.</li> <li>2. To train students in wildlife monitoring, habitat assessment, and ecological survey techniques.</li> <li>3. To enhance skills in conservation planning, environmental monitoring, and sustainable resource management.</li> <li>4. To provide field and laboratory exposure related to flora, fauna, and ecosystem conservation.</li> <li>5. To create awareness about environmental laws, climate resilience, and community participation in conservation.</li> </ol>                                                                                                                                                                                                                  |
| Course Outcomes:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <p>After the completion of this work student is able to –</p> <p>CO-1: Identify and document biodiversity components in different ecosystems.</p> <p>CO-2: Conduct ecological surveys and wildlife monitoring using standard field techniques.</p> <p>CO-3: Apply conservation strategies for habitat restoration and species protection.</p> <p>CO-4: Use basic GIS, GPS, and environmental monitoring tools in conservation studies.</p> <p>CO-5: Analyse environmental issues and suggest sustainable management practices.</p> <p>CO-6: Work effectively with local communities and organizations for conservation programs.</p> <p>CO-7: Prepare field reports, biodiversity records, and conservation management plans.</p> <p>CO-8: Demonstrate professional and ethical responsibility toward environmental protection.</p> |
| Activities                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <p><b>A-Fundamentals of Conservation Biology</b></p> <p>Concept and scope of conservation biology</p> <p>Biodiversity and ecosystem services</p> <p>Threats to biodiversity</p> <p>Conservation ethics and sustainable development</p> <p><b>B- Wildlife and Habitat Conservation</b></p> <p>Wildlife identification and monitoring</p> <p>Habitat assessment techniques</p> <p>Protected areas and wildlife management</p> <p>Human–wildlife conflict management</p> <p><b>C- Environmental Monitoring and Restoration</b></p> <p>Ecological survey methods</p> <p>Water, soil, and air quality assessment</p> <p>Habitat restoration and afforestation</p> <p>Climate change and ecosystem resilience</p> <p><b>D-Applied Conservation Practices</b></p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| GIS and GPS applications in conservation<br>Environmental laws and policies<br>Community participation and eco-development<br>Field training and conservation project work                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |
| <b>Practical / Skill-Based Activities</b> <ol style="list-style-type: none"> <li>1. Biodiversity survey of local ecosystems</li> <li>2. Identification of flora and fauna using field guides</li> <li>3. Wildlife observation and habitat mapping</li> <li>4. Water and soil quality analysis</li> <li>5. Preparation of herbarium or species records</li> <li>6. GPS-based field mapping exercises</li> <li>7. Solid waste and pollution assessment</li> <li>8. Participation in plantation and restoration activities</li> <li>9. Awareness campaign on biodiversity conservation</li> <li>10. Preparation of conservation project reports</li> </ol> |  |

#### **Pedagogies:**

**Experiential Learning:** Field trips to forests, wetlands, farms, sanctuaries; conservation projects.

**Demonstration & Practice:** Demonstrating tools like quadrats, transects, monitoring apps; composting, nursery setup, etc.

**Problem-Based Learning (PBL):** How can this village protect its local wetland/forest?" Students explore real local conservation challenges.

**Peer Learning:** Group activities, student-led presentations on species or ecosystems, exchange of local knowledge.

**Storytelling & Indigenous Knowledge:** Integrate local conservation stories, folklore, and traditional practices.

**Blended Learning (where feasible):** Digital tools (e.g., videos, virtual biodiversity maps) to supplement field learning.

#### **Skills Developed**

**Fieldwork Skills:** Knowledge of field survey techniques, species identification, habitat assessment, and data collection.

**Policy and Advocacy:** Understanding of environmental laws, policy-making, and the ability to advocate for biodiversity protection.

**Community Engagement:** Working with local communities to promote conservation and sustainable practices.

**Environmental Education:** Educating others about the importance of biodiversity and ways to conserve it.

**Research and Monitoring:** The ability to analyse data and produce reports to inform conservation efforts.

**Project Management:** Overseeing conservation projects from planning through.

### Rubric for Internal Assessment for Theory Paper

|                                                      |                                                       |               |
|------------------------------------------------------|-------------------------------------------------------|---------------|
| SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI        |                                                       |               |
| <b>Internal Assessment</b>                           |                                                       |               |
| B.Sc. II (Environmental Science) SEMESTER – III(NEP) |                                                       |               |
| Subject<br>Code:114274                               | <b>VSC: Skill for Conservation Biologist</b>          | Max Marks: 50 |
| 1.                                                   | Test -MCQ                                             | 15            |
| 2.                                                   | Case Study                                            | 10            |
| 3.                                                   | Participation in Activity/ Field visit and its report | 10            |
| 4.                                                   | Field Report                                          | 10            |
| 5.                                                   | Overall Performance                                   | 05            |

### Field Project / Community Engagement Services in Environmental Science: Phase-I

| Level | Semester | Course Code | Course Name                                                                     | Credits | Teaching Hours | Exam Duration | Max Marks |
|-------|----------|-------------|---------------------------------------------------------------------------------|---------|----------------|---------------|-----------|
| 5.0   | III      | 114210      | Field Project / Community Engagement Services in Environmental Science: Phase-I | 2       | 60             | --            | Int-50    |

#### Course Objectives:

- To provide hands-on learning through field visits, surveys, and community engagement on key pollution issues.
- To build understanding of environmental pollutants, their sources, impacts, and relevant quality standards.
- To train students in sampling, data collection, and analysis of air, water, soil, and noise pollution, biodiversity using field tools.
- To promote student involvement in community outreach and education to raise awareness and support local pollution solutions.
- To foster environmental responsibility by guiding students to develop sustainable projects and evaluate relevant policies and management.

#### Course Outcomes:

Upon successful completion of this course, students will be able to:

- Understand and identify major air pollutants, noise sources, radiation types, soil contaminants, solid waste categories, and water pollutants, along with their standards and environmental impacts.
- Apply field methods to monitor and assess pollution levels across air, noise, radiation, soil, water, and solid waste in real community settings.
- Analyze and interpret data collected from field studies to evaluate pollution effects on health, ecosystems, and infrastructure.
- Understand importance and identify major threats to biodiversity and works for its conservation.
- Engage effectively with local communities to raise awareness about pollution issues and collaborate on practical mitigation strategies.
- Develop critical thinking skills by evaluating existing pollution control policies, regulations, and management practices within local governance frameworks.

#### Guidelines/ SoP for FP/CEP

For understanding key principles of CE, forms of CE, operational guidelines and implementation strategy please refer [https://www.ugc.gov.in/pdfnews/4187860\\_Revised-Final-Guidelines.pdf](https://www.ugc.gov.in/pdfnews/4187860_Revised-Final-Guidelines.pdf)

As per NEP 2020, students of B Sc. II of Semester III and IV need to perform a Field Project (FP) for TWO (2) credits i.e. 50 Marks.

The guidelines regarding the field project are as follows:

1. Students are required to complete a minimum of 60 hours of field engagement.
2. The project can be undertaken individually or in groups of up to four students, each guided by a departmental faculty mentor.
3. Topic Selection:
  - Select a relevant and locally applicable environmental issue (e.g., air pollution, water quality, plastic waste, biodiversity loss, noise pollution, etc.).
4. Team Formation:
  - Form a small group (2–5 students), ensuring equal participation in planning, fieldwork, and reporting.
5. Define Objectives:
  - Clearly frame the aim and specific objectives of the project.
  - Set achievable and measurable outcomes.
6. Literature Review:
  - Review books, journals, research papers, news articles, and government reports to understand the background of the selected issue.
7. Study Area Selection:
  - Choose a field site (urban/rural/industrial/residential area, school, village, water body, etc.) suitable for study and outreach.
8. Methodology Planning:
  - Decide tools, equipment, and techniques for data collection (e.g., surveys, sampling, interviews, measurements, observation).
  - Prepare data sheets or questionnaires if needed.
9. Stakeholder Identification:
  - Identify local authorities, NGOs, school heads, or community leaders who can support or participate in the project.
10. Permission and Coordination:
  - Take official permission from concerned institutions, government departments, or communities for field visits and interaction.
11. Work Plan and Timeline:
  - Prepare a detailed schedule of activities with assigned roles for each team member.
12. Preliminary Visit:
  - Conduct a short visit to the study area to understand the ground situation, availability of resources, and challenges.
13. Take photographs of the sites, pollution sources, and community engagement activities.
14. The report should be a minimum of six pages, excluding the cover page, certificates, acknowledgements, and similar sections. (For Phase 1 – 50%)
15. A poster or PowerPoint presentation is mandatory and will be assessed by a designated examiner.

#### **SUGGESTED FORMS OF COMMUNITY-ENGAGED PRACTICE IN ENVIRONMENTAL SCIENCE**

##### **• Environmental Awareness Campaigns**

Organize workshops, street plays, or information sessions on pollution types, causes, and prevention. Distribute pamphlets or posters in local languages highlighting environmental issues and solutions.

- **Surveys and Interviews**

Conduct structured surveys or informal interviews with residents, workers, and local authorities to assess pollution awareness and impacts.

Use questionnaires to collect data on community health, waste disposal habits, or water usage.

- **Community Clean-up Drives**

Plan and participate in cleaning local water bodies, streets, parks, or waste dumping sites. Involve local volunteers, schools, and NGOs for greater impact.

- **Monitoring and Sampling Activities**

Engage community members in simple environmental monitoring such as air quality measurement, water testing, or noise level monitoring using portable instruments.

Train locals on basic pollution detection methods.

- **Tree Plantation and Green Space Development**

Collaborate with community groups to plant trees and promote green spaces to improve air quality and reduce noise pollution.

- **Waste Management Workshops**

Educate communities on waste segregation, recycling, composting, and responsible disposal practices. Help set up or improve local waste management systems.

- **Advocacy and Policy Engagement**

Facilitate community discussions to gather feedback on local environmental policies. Support community members in communicating concerns to local governance bodies.

- **Participatory Mapping and Documentation**

Work with locals to map pollution hotspots or vulnerable areas using simple mapping tools or apps. Document pollution sources and their effects through photos and notes.

- **Environmental Education in Schools**

Conduct interactive sessions in nearby schools to raise awareness about pollution and sustainability among children.

- **Health Impact Assessments**

Collaborate with community health workers to understand and document pollution-related health issues.

- **Workshop on Biodiversity.**

To Organize awareness workshop on importance, types, threats, and conservation of biodiversity.

### **Examples of Environmental Science-Specific Field Project Topics**

1. Assessment of Air Quality in Urban Areas
2. Impact of Noise Pollution on Residential Areas

3. Radiation Levels in the Vicinity of Mobile Towers.
4. Soil Contamination Due to Pesticide Use in Agricultural Fields.
5. Water Quality Analysis of Local Rivers, Lakes, Water Bodies.
6. Solid Waste Management Practices in a Community
7. Effect of Industrial Effluents on Nearby Water Bodies.
8. Study of Plastic Pollution and Its Impact on Local Ecosystems.
9. Evaluation of Green Spaces and Their Role in Air Pollution Mitigation.
10. Community Awareness and Practices Regarding Environmental Pollution.
11. Assessment of Indoor Air Quality in Schools or Homes.
12. Monitoring Noise Levels during Festivals or Public Events.
13. Assessment of E-waste Disposal Practices in Urban Areas.
14. Evaluation of Rainwater Harvesting and Its Effectiveness in Pollution Control.
15. Assessment of local floral and faunal biodiversity.
16. Assessment of local soil biodiversity.
17. Study of threats to local biodiversity.

**Reference:**

1. *World Health Organization (WHO)*. Ambient (outdoor) air pollution. WHO, 2018.
2. *Central Pollution Control Board (CPCB), India*. National Ambient Air Quality Standards (NAAQS).
3. Kumar, P., et al. (2015). "The rise of low-cost sensing for managing air pollution in cities." *Environment International*, 75, 199-205.
4. *World Health Organization (WHO)*. Guidelines for Community Noise, 1999.
5. Basner, M., et al. (2014). "Auditory and non-auditory effects of noise on health." *The Lancet*, 383(9925), 1325-1332.
6. ICNIRP (International Commission on Non-Ionizing Radiation Protection) Guidelines, 2020.
7. Alloway, B.J. (2013). *Heavy Metals in Soils: Trace Metals and Metalloids in Soils and their Bioavailability*. Springer.
8. Pimentel, D. (2005). "Environmental and economic costs of pesticide use." *Bioscience*, 55(10), 893-898.
9. *Standard Methods for the Examination of Water and Wastewater*, APHA, 23rd Edition, 2017.
10. Wetzel, R.G. (2001). *Limnology: Lake and River Ecosystems*. Academic Press.
11. Tchobanoglous, G., et al. (2014). *Integrated Solid Waste Management: Engineering Principles and Management Issues*. McGraw-Hill.
12. CPCB Reports on Municipal Solid Waste Management, India.
13. Raju, N.J., et al. (2018). "Assessment of industrial effluent impact on water quality." *Environmental Monitoring and Assessment*.

14. UNEP (United Nations Environment Programme) Guidelines on Industrial Pollution Control.
15. Thompson, R.C., et al. (2009). "Plastics, the environment and human health: current consensus and future trends." *Philosophical Transactions of the Royal Society B*.
16. UNEP (2018). *Single-use Plastics: A Roadmap for Sustainability*.
17. Nowak, D.J., et al. (2014). "Tree and forest effects on air quality and human health in the United States." *Environmental Pollution*, 193, 119-129.
18. US EPA (2018). *Indoor Air Quality Tools for Schools*.
19. Basner, M., et al. (2014). *Auditory and non-auditory effects of noise on health*.
20. Widmer, R., et al. (2005). "Global perspectives on e-waste." *Environmental Impact Assessment Review*.
21. Fewkes, A. (2000). "Modelling the performance of rainwater harvesting systems." *Water Research*.
22. IS 15797:2008 Indian Standard on Rainwater Harvesting.

**Assessment Rubric for FP/CEP: Phase-I**

| <b>SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI PRACTICAL<br/>EXAMINATION<br/>B.Sc. II (Environmental Science), SEMESTER – III (NEP)</b> |                                                                           |                                                                                               |                             |
|-------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|-----------------------------|
| FP/CEP                                                                                                                                    | <b>Course Code:</b><br>114210                                             | Field Project / Community Engagement Services in<br>Environmental Science<br>: <b>Phase-I</b> | <b>Max<br/>Marks:</b><br>50 |
| <b>Q. No.</b>                                                                                                                             | <b>Exercise</b>                                                           |                                                                                               | <b>Marks</b>                |
| 1                                                                                                                                         | Topic Selection & Objectives                                              |                                                                                               | 10                          |
| 2                                                                                                                                         | Literature Review                                                         |                                                                                               | 08                          |
| 3                                                                                                                                         | Project Design & Methodology                                              |                                                                                               | 12                          |
| 4                                                                                                                                         | Teamwork & Roles                                                          |                                                                                               | 05                          |
| 5                                                                                                                                         | Time & Resource Planning                                                  |                                                                                               | 05                          |
| 6                                                                                                                                         | Report Writing: Structured report with all sections (50% Work of Phase I) |                                                                                               | 05                          |
| 7                                                                                                                                         | Presentation & Communication (50% Work of Phase I)                        |                                                                                               | 05                          |

**B.Sc. II SEMESTER-IV**

| Types of Course       | Course Code | Course Name                                                                      |
|-----------------------|-------------|----------------------------------------------------------------------------------|
| Major Theory          | 114211      | Environmental Pollution-1                                                        |
| Major Theory          | 114212      | Environmental Pollution-2                                                        |
| Major Theory          | 114217      | Global Environmental Change and Resilience                                       |
| Major Lab / Practical | 114213      | Lab/Practical based on Environmental pollution.                                  |
| Minor Theory          | 114214      | General Approach of Environmental Pollution.                                     |
| Minor Lab/ Practical  | 114215      | Lab work: General Approach of Environmental Pollution.                           |
| G/OE Theory           | 114266      | Global environmental issues.                                                     |
| VSC: Lab              | 114275      | Skill for Environmental Lab Technician: Water Sampling & Analysis.               |
| FP/CES                | 114216      | Field Project / Community Engagement Services in Environmental Science: Phase-II |
| CC Outdoor            | --          | Separate SOP will be released                                                    |

Sant Gadge Baba Amravati University, Amravati FACULTY:  
SCIENCE AND TECHNOLOGY  
Teaching and Learning Scheme: For the Degree of Bachelor of Environmental Science as Major and Minor

**SECOND YEAR: SEMESTER –IV**

MAJOR THEORY - : ENVIRONMENTAL POLLUTION-1

| Level | Semester | Course Code | Course Name                                | Credits | Teaching Hours | Exam Duration | Max Marks             |
|-------|----------|-------------|--------------------------------------------|---------|----------------|---------------|-----------------------|
| 5.0   | IV       | 114211      | Major Theory:<br>Environmental Pollution-1 | 2       | 30             | 2 Hrs         | 30 (Ext.)<br>20 (Int) |

| <b>Course Objectives:</b> | <ul style="list-style-type: none"> <li>To Improve air quality and mitigate the adverse effects of air pollution.</li> <li>To monitor and control sources that produce and cause noise.</li> <li>Implementation of radioactive waste management methods that ensure the protection of people and the environment.</li> <li>Identify and recognized the carrier scope in the field of environmental pollution.</li> </ul>                         |                         |                             |                                                                                                                                               |
|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course Outcomes:</b>   | <p>After the completion of this course, student is able to- CO-1: Understand concept of environmental pollution.</p> <p>CO-2: Acquire knowledge of sources of environmental pollution. CO-3: Explains types of Environmental Pollutions and air pollutants.</p> <p>CO-4: Apply knowledge to control pollution and suggest steps to protect natural resources</p> <p>CO-5: Identifies possible effects of specific pollutant on environment.</p> |                         |                             |                                                                                                                                               |
| Unit System               | Contents                                                                                                                                                                                                                                                                                                                                                                                                                                        | Workload Allotted (Hrs) | Weightage of Marks Allotted | Incorporation of Pedagogies                                                                                                                   |
| <b>Unit I</b>             | <b>1.Introduction to air pollution</b>                                                                                                                                                                                                                                                                                                                                                                                                          | 8                       | 8                           | Chalk and talk, FW, Visits, use of ICT charts, models, problem based learning and collaborative learning. Theory, Self-study and Case studies |
|                           | 1.1: Introduction: History, global status and Definition Sources of air pollution (Local and Global.) Ambient and Indoor air pollution                                                                                                                                                                                                                                                                                                          |                         |                             |                                                                                                                                               |
|                           | 1.2: Classification of air pollutants and major air pollutants (Natural contaminants, Aerosoles and gases and vapours). Primary, Secondary, Gaseous and Particulate.                                                                                                                                                                                                                                                                            |                         |                             |                                                                                                                                               |
|                           | 1.3: Meteorological factors influencing Air Pollution: wind, temperature, atmospheric stability and mixing height.                                                                                                                                                                                                                                                                                                                              |                         |                             |                                                                                                                                               |
|                           | 1.4: Plume behaviour: its types                                                                                                                                                                                                                                                                                                                                                                                                                 |                         |                             |                                                                                                                                               |
| <b>Unit II</b>            | <b>2. air pollutants Standards and effects of air pollution.</b>                                                                                                                                                                                                                                                                                                                                                                                | 7                       | 7                           |                                                                                                                                               |
|                           | 2.1: National Air Quality Index and its Criteria,                                                                                                                                                                                                                                                                                                                                                                                               |                         |                             |                                                                                                                                               |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                         |   |   |  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|---|---|--|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 2.2: Air Pollutant Standards: Ambient and Emissions                                                                     |   |   |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 2.3: Effects of air pollutants on plants and on human health and property.                                              |   |   |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 2.4: Case Study on Air Pollution (London smog and Bhopal Gas Tragedy).                                                  |   |   |  |
| Unit III                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 3. Noise pollution                                                                                                      | 8 | 8 |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 3.1: Definition, and sources of noise                                                                                   |   |   |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 3.2: Basic properties and types of Noise.                                                                               |   |   |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 3.3 Effects of Noise: Auditory and non- auditory effects on human being. Techniques of measurements of noise pollution. |   |   |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 3.4: Noise pollution standards, monitoring and control measures.                                                        |   |   |  |
| Unit IV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 4. Radiation pollution                                                                                                  | 7 | 7 |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 4.1: Introduction, Definition Pollution. Types and sources of radiation.                                                |   |   |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 4.2: Radioactive Fallout, Effects of radiation pollution                                                                |   |   |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 4.3: Major radioactive isotopes, nuclear fusion & fission reactions,                                                    |   |   |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 4.4: Applications of radioactive isotopes.                                                                              |   |   |  |
| <b>Reference Books-</b><br>1. Environmental Chemistry – A.K. De, Wiley Eastern ltd. New Delhi<br>2. Air Pollution by M.N. Rao and H.V.N. Rao. Tata McGraw Hill Publications Company New Delhi.<br>3. Environmental Pollution Control Engineering by C.S. Rao. New Age International Publishing.<br>4. Environmental Chemistry – V.P. Khudesia<br>5. Environmental Chemistry – B.K. Sharma<br>6. Environmental Chemistry – Kaur.<br>7. Industrial Chemistry – B. K. Sharma<br>8. Environmental Engineering – S.S.Deswal<br>9. Water supply & Sanitary Engineering – Rangawala<br>10. Environmental pollution control Engineering– C.S.Rao, Newage international publication<br>11. Environmental Engineering – S.S.Deswal<br>12. Water supply & Sanitary Engineering – Rangawala<br>13. Environmental pollution control Engineering– C.S.Rao, Newage international publication<br>14. Environmental Chemistry – Chhatwal Anand<br>15. Environmental Sciences, Daniel Botkin & Edward Keller, John Wiley & sons, New York<br>16. Environmental Sciences, Eldon D. Enger and Bradley F.Smith, WCB Publishers, |                                                                                                                         |   |   |  |
| <b>Model Questions:</b><br><b>Short Type (At least 8):</b><br>1. Explain sources of NO <sub>x</sub><br>2. Explain effects of Sox on human being<br>3. What is RSPM                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                         |   |   |  |

4. What are aerosols
5. What are noise pollution standards
6. Explain effects of noise pollution
7. What is radiation
8. What is radiation pollution.

**Long Type (At least 4):**

1. Give threefold classification of air pollutants with examples
2. Describe classification and sources of air pollutants
3. How to control noise pollution and give prescribed standards of noise
4. What is radioactive fallout explain in details.

**MCQs for Internal Assessment (At least 8) 1**

- is secondary air pollutant.
- a) O<sub>3</sub> b) CO c) dust d) CO<sub>2</sub>
  2. The size of RSPM -----  
a.) <10 b) >10 c) =10, d) <100
  3. The tropospheric lapse rate is \_\_\_\_\_  
(a) 4.5 °C/km (b) 6.5 °C/km (c) 5.5 °C/km
  4. ----- is major greenhouse gas  
a.) CO<sub>2</sub> b-) CH<sub>4</sub> c-) CFCS d-) NO<sub>x</sub>
  5. High pressure sound or unwanted sound is called-----  
(a) noise(b) sound(c) loud (d) None of these
  6. Threshold limit of hearing is  
(a) 5 (b) 10 (c) 70 (d) 0
  7. Radiation pollution can affect  
(a) plants b) animals(c) Humans (d) all
  8. Radiation hazard is  
a) biological, b) physical, c) chemical d) none of these.

**Rubric for Internal Assessment for Theory Paper**

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI

**Major Theory Internal Assessment**

B.Sc. II (Environmental Science) SEMESTER – IV (NEP)

|                         |                                           |               |
|-------------------------|-------------------------------------------|---------------|
| Subject Code:<br>114211 | Major Theory:- Environmental Pollution -I | Max Marks: 20 |
| <b>S.N.</b>             | <b>Assessment Criteria</b>                | <b>Marks</b>  |
| <b>1.</b>               | Test -MCQ                                 | 10            |
| <b>2.</b>               | Assignment                                | 5             |
| <b>3.</b>               | Attendance                                | 3             |
| <b>4</b>                | Students' overall performance             | 2             |

### Major Theory:- Environmental Pollution-2

| Level | Semester | Course Code | Course Name                              | Credits | Teaching Hours | Exam Duration | Max Marks             |
|-------|----------|-------------|------------------------------------------|---------|----------------|---------------|-----------------------|
| 5.0   | IV       | 114212      | Major Theory:- Environmental Pollution-2 | 2       | 30             | 2 Hrs         | 30 (Ext.)<br>20 (Int) |

| Course Objectives: | <ul style="list-style-type: none"> <li>Explain the sources of water pollution, Major water pollutants, and types of water pollution</li> <li>Describe the Effect of water pollution on plants and animals</li> <li>Describe causes of soil pollution, major soil pollutants Effects of soil pollutants on plants, animals and Humans</li> <li>Explain Sources, Composition, and Properties of Solid Waste</li> <li>Explain Impact of solid waste on human and Environment</li> </ul> |                         |                             |                                                                                                                                               |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| Course Outcomes:   | CO-1: Understand the sources and types of water pollution<br>CO-2: Perceive Effect of water pollution<br>CO-3: Evaluate causes of soil pollution, major soil pollutants Effects of soil pollutants on plants, animals and Humans<br>CO-4: Understand the Sources, Composition, and Properties of Solid Waste<br>CO-5: Estimate Impact of solid waste on human and Environment                                                                                                        |                         |                             |                                                                                                                                               |
| Unit System        | Contents                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Workload Allotted (Hrs) | Weightage of Marks Allotted | Incorporation of Pedagogies                                                                                                                   |
| Unit I             | <b>Water pollution-1</b><br>1.1 : Introduction and Definition<br>1.2 : Sources of water pollution- (Domestic, Industrial, Agricultural and run-off)<br>1.3 : Major water pollutants- (Oxygen demanding, inorganic chemicals & nutrients, heavy metals, sediments, disease causing waste, radioactive waste, synthetic organic waste).<br>1.4 : Types of water pollution – fresh water and marine water.                                                                              | 8                       | 8                           | Chalk and talk, FW, Visits, use of ICT charts, models, problem based learning and collaborative learning. Theory, Self-study and Case studies |
| Unit II            | <b>2 Water pollution- 2</b><br>2.1 Effects of water pollution on plants.<br>2.2 Effects of water pollution on human beings<br>2.3 Water Pollution control measures.<br>2.4 Case studies on Eutrophication and Minamata disease.                                                                                                                                                                                                                                                      | 7                       | 7                           |                                                                                                                                               |
| Unit III           | <b>3. Soil pollution</b><br>3.1 Introduction and Definition<br>3.2 Causes of soil pollution, major soil pollutants (Pesticides, heavy metals, excess nutrients and toxic substances).<br>3.3 Effects of soil pollutants on plants. and humans<br>3.4 Control measures for soil pollution. Case study: soil degradation and salination.                                                                                                                                               | 8                       | 8                           |                                                                                                                                               |
| Unit IV            | <b>4. Solid Waste</b><br>4.1 Introduction, Definition and sources of Solid Waste.<br>4.2 Composition, Types and Properties of Solid Waste                                                                                                                                                                                                                                                                                                                                            | 7                       | 7                           |                                                                                                                                               |

|  |                                                    |  |  |  |
|--|----------------------------------------------------|--|--|--|
|  | 4.3 Impact of solid waste on human and Environment |  |  |  |
|  | 4.4 Control measures. Case study on                |  |  |  |

#### Reference Books-

1. Environmental Chemistry – A.K. De, Wiley Eastern Ltd. New Delhi
2. Air Pollution by M.N. Rao and H.V.N. Rao. Tata McGraw Hill Publications Company New Delhi.
3. Environmental Pollution Control Engineering by C.S. Rao. New Age International Publishing.
4. Environmental Chemistry – V.P. Khudesia
5. Environmental Chemistry – B.K. Sharma
6. Environmental Chemistry – Kaur.
7. Industrial Chemistry – B. K. Sharma
8. Environmental Engineering – S.S.Deswal
9. Water supply & Sanitary Engineering – Rangawala
10. Environmental pollution control Engineering– C.S.Rao, Newage international publication
11. Environmental Engineering – S.S.Deswal
12. Water supply & Sanitary Engineering – Rangawala
13. Environmental pollution control Engineering– C.S.Rao, Newage international publication
14. Environmental Chemistry – Chhatwal Anand
15. Environmental Sciences, Daniel Botkin & Edward Keller, John Wiley & sons, New York
16. Environmental Sciences, Eldon D. Enger and Bradley F.Smith, WCB Publishers, Boston
17. Physico Chemical Examination of Water, Sewage, and Industrial Effluent, Pragati prakashan, Meerut.
18. A Text book of Environmental Pollution V. S. Mangle Dnyanpath publication Amravati.

#### Model Questions:

##### Short Type:

- 1) Sewage and domestic waste.
- 2) Explain thermal pollutants.
- 3) Explain ground water pollution.
- 4) Explain river water pollution.
- 5) Explain lake water pollution.
- 6) Explain Stream water pollution
- 7) Explain Marine water pollution.
- 8) Explain types of Eutrophication.
- 9) Explain effect of water pollution on human health.
- 10) Explain effects of water pollution on animals
- 11) Explain effects of water pollution on plants.

##### Long Type (At least 4):

- 1) Define water pollution and explain in details about Eutrophication.
- 2) Define marine pollution and explain in details about it.
- 3) Describe ground water pollution of lake water pollution.
- 4) Define land pollution and its effect on plants and animals.

##### MCQs for Internal Assessment.

- 1) ..... is secondary air pollutant  
a. a) O<sub>3</sub>                      b) CO                      c) dust                      d) None of these
- 2) The pH of acid rain is.....  
a. a) <6                      b) >6                      c) 7                      d) None of these
- 3) 1) About 75% of water pollution is caused by sewage.  
a. a) 50%                      b) 60%                      c) 75%                      d) 80%
- 4) ..... are used to control of Insects.  
i. a) Herbicides                      b) Insecticides                      c) Fertilizers                      d) Pesticides
- 5) ..... are used to control of pests.  
i. a) Herbicides                      b) Insecticides                      c) Pesticides                      d) None of these
- 6) Factors affecting ground water pollution  
i. a) Rainfall pattern                      b) Depth of water table c) Soil properties d) All of above

|                                                                                   |                  |               |                          |                  |
|-----------------------------------------------------------------------------------|------------------|---------------|--------------------------|------------------|
| 7) Marine pollution is associated with the changes in ..... condition of the sea. | i. a) Physical   | b) Chemical   | c) Biological            | d) All of above  |
| 8) The Minamata disease caused by .....                                           | i. a) Pb         | b) cd         | c) Hg                    | d) cr.           |
| 9) Minamata disease is occurred in the country .....                              | i. a) America    | b) Thailand   | c) India                 | d) Japan         |
| 10) The unit of turbidity is .....                                                | i. a) Hazen      | b) mg/l       | c) NTU                   | d) None of these |
| 11) pH of drinking water is .....acceptable.                                      | i. a) 2.5 to 3.0 | b) 4.5 to 5.5 | c) 6.5 to 8.5            | d) None of these |
| 12) Acceptable limit of TDS is.....in drinking water.                             | i. a) 500 mg/l   | b) 1000 mg/l  | c) 2000 mg/l             | d) 2500 mg/l     |
| 13) Water born disease caused by polluted beach water.                            | a) Rashes        | b) ear ache   | c) Respiratory Infection | d) All of above. |

**Rubric for Internal Assessment for Theory Paper**

| SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI<br><b>Major Theory Internal Assessment</b><br>B.Sc. II (Environmental Science) SEMESTER – IV (NEP) |                                           |               |
|--------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|---------------|
| Course Code: 114212                                                                                                                              | Major Theory-8: Environmental Pollution-2 | Max Marks: 20 |
| S.N.                                                                                                                                             | Assessment Criteria                       | Marks         |
| 1.                                                                                                                                               | Test -MCQ                                 | 10            |
| 2.                                                                                                                                               | Assignment                                | 5             |
| 3.                                                                                                                                               | Attendance                                | 3             |
| 4.                                                                                                                                               | Students' overall performance             | 2             |

Major-3: Global Environmental Change and Resilience

| Level | Course Code | Semester | Course Name                                       | Credit | Teaching Hours | Exam Duration | Max. Marks       |
|-------|-------------|----------|---------------------------------------------------|--------|----------------|---------------|------------------|
| 5.5   | 114217      | IV       | Major: Global Environmental Change and Resilience | 02     | 30             | 02            | Ext-30<br>Int-20 |

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                         |                             |                                                                                                                                                                                                     |  |
|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Course Objectives | <ol style="list-style-type: none"><li>1. To introduce students to major global environmental problems related to climate and atmospheric changes.</li><li>2. To explain the causes and mechanisms of climate change, global warming, and extreme weather events.</li><li>3. To develop understanding of greenhouse gases, greenhouse effect, and their role in climate instability.</li><li>4. To familiarize students with the concepts of El-Niño and La-Niña and their environmental impacts.</li><li>5. To provide knowledge about ozone layer depletion, acid rain, and their effects on ecosystems and human health.</li></ol>                                                                                                                                                                                                                                                                                                                                                       |                         |                             |                                                                                                                                                                                                     |  |
| Course Outcome    | <p>After successful completion of the course, students will be able to:</p> <p>CO1 Explain the causes, mechanisms, and impacts of climate change, extreme weather events, and climate instability including El-Niño and La-Niña phenomena.</p> <p>CO2 Describe the concept of global warming, greenhouse effect, greenhouse gases, and analyze their environmental and climatic consequences.</p> <p>CO3 Understand the causes, mechanisms, effects, and control measures related to ozone layer depletion and acid rain.</p> <p>CO4 Interpret the causes and chemical processes of ocean acidification and evaluate its impacts on marine ecosystems and biodiversity.</p> <p>CO5 Evaluate mitigation and management strategies for global environmental problems such as global warming, ozone depletion, acid rain, and ocean acidification.</p> <p>CO6 Develop awareness regarding sustainable environmental practices and international efforts for climate and ocean protection.</p> |                         |                             |                                                                                                                                                                                                     |  |
| Unit System       | Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Workload Allotted (Hrs) | Weightage of marks allotted | Incorporation of Pedagogies                                                                                                                                                                         |  |
| Unit-I            | <b>Climate Change and Extreme Weather:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 8                       | 8                           | 1.Lecture-Cum-Discussion Method.<br>2.Problem-Based Learning.<br>3.Field Visits and Industrial Exposure.<br>4.Laboratory Demonstrations and Practical Training.<br><b>5.Project-Based Learning.</b> |  |
|                   | 1.1 Rising global temperatures and heatwaves                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                         |                             |                                                                                                                                                                                                     |  |
|                   | 1.2 Floods, droughts and cyclones                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                         |                             |                                                                                                                                                                                                     |  |
|                   | 1.3 Increasing greenhouse gas emissions and climate instability                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                         |                             |                                                                                                                                                                                                     |  |
|                   | 1.4 El-Nino and La-Nina                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                         |                             |                                                                                                                                                                                                     |  |
| Unit-II           | <b>Global Warming and Climate Change:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 7                       | 7                           |                                                                                                                                                                                                     |  |
|                   | 2.1 Concept and historical trends of global warming,                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                         |                             |                                                                                                                                                                                                     |  |
|                   | 2.2 Mechanism of Green House Effects, Green House gases                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                         |                             |                                                                                                                                                                                                     |  |
|                   | 2.3 Consequences of Green House Effect                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                         |                             |                                                                                                                                                                                                     |  |
|                   | 2.4 Mitigative measures for global warming                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                         |                             |                                                                                                                                                                                                     |  |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                            |   |   |                        |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|---|---|------------------------|
| Unit-III                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>Ozone Layer Depletion and Acid Rain:</b><br>3.1 Concept <b>historical trends of</b> Ozone Layer Depletion and Mechanism | 8 | 8 | 6.ICT-Enabled Teaching |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 3.2 Consequences and Mitigative measures                                                                                   |   |   |                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 3.3 <b>Acid Rain:</b> Concept and mechanism                                                                                |   |   |                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 3.4 <b>Acid Rain:</b> Effects and control measures                                                                         |   |   |                        |
| Unit-IV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Ocean Acidification:<br>4.1 Causes and mechanism of Ocean Acidification                                                    | 7 | 7 |                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 4.2 Chemical Changes in Ocean Water                                                                                        |   |   |                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 4.3 Impacts on Marine Ecosystems                                                                                           |   |   |                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 4.4 Prevention and Management                                                                                              |   |   |                        |
| References:<br>1. Global Environmental Change — Steffen, W., Crutzen, P. J., & McNeill, J. R. Cambridge University Press.<br>2. Climate Change and Society — John Urry. Polity Press.<br>3. Global Warming: The Complete Briefing — Sir John Houghton. Cambridge University Press.<br>4. Resilience Thinking: Sustaining Ecosystems and People in a Changing World — Brian Walker & David Salt. Island Press.<br>5. Introduction to Climate Change Adaptation — Walter Leal Filho. Springer.<br>6. Environmental Science: Toward a Sustainable Future — Richard T. Wright & Dorothy F. Boorse. Pearson Education.<br>7. The Economics of Climate Change: The Stern Review — Nicholas Stern. Cambridge University Press.<br>8. Our Common Future — World Commission on Environment and Development. Oxford University Press.<br>9. Climate Change Impacts, Adaptation and Vulnerability — Intergovernmental Panel on Climate Change (IPCC). Cambridge University Press.<br>10. Principles of Environmental Science and Engineering — P. Venugopala Rao. Prentice Hall India |                                                                                                                            |   |   |                        |
| Model Questions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                            |   |   |                        |
| Short Type:<br><ul style="list-style-type: none"><li>• Define climate change.</li><li>• What are greenhouse gases?</li><li>• Differentiate between weather and climate.</li><li>• What is the greenhouse effect?</li><li>• State any two causes of global warming.</li><li>• What is ozone layer depletion?</li><li>• Define acid rain.</li><li>• What is ocean acidification?</li><li>• Write two effects of air pollution on human health.</li><li>• What are El-Niño and La-Niña phenomena?</li><li>• Mention any two impacts of climate change on marine ecosystems.</li><li>• State two preventive measures for global warming.</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                            |   |   |                        |
| Long Type: (Minimum 4)<br><ul style="list-style-type: none"><li>• Explain the causes, mechanisms, and impacts of climate change and extreme weather events.</li><li>• Describe the greenhouse effect and discuss the consequences and mitigation measures of global warming.</li><li>• Discuss the causes, mechanism, effects, and control measures of ozone layer depletion and acid rain.</li><li>• Explain the causes, chemical changes, ecological impacts, and management strategies of ocean acidification.</li><li>• Write a detailed note on El-Niño and La-Niña and their influence on global climate patterns.</li><li>• Discuss the role of greenhouse gases in climate instability and global environmental change.</li></ul>                                                                                                                                                                                                                                                                                                                                  |                                                                                                                            |   |   |                        |
| Which gas is the major contributor to global warming?<br>a) Oxygen, b) Nitrogen, c) Carbon dioxide, d) Helium<br>Answer: c) Carbon dioxide<br>The thinning of the ozone layer is mainly caused by:<br>a) Carbon monoxide b) Chlorofluorocarbons (CFCs), c) Oxygen, d) Hydrogen                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                            |   |   |                        |

Answer: b) Chlorofluorocarbons (CFCs)  
 Acid rain is primarily formed due to:  
 a) Methane and ozone, b) Sulfur dioxide and nitrogen oxides, c) Carbon dioxide and oxygen  
 d) Hydrogen and helium  
 Answer: b) Sulfur dioxide and nitrogen oxides  
 El-Niño is associated with:  
 a) Cooling of Pacific Ocean waters, b) Warming of Pacific Ocean waters, c) Formation of glaciers  
 d) Ozone depletion  
 Answer: b) Warming of Pacific Ocean waters  
 Ocean acidification occurs mainly due to increased absorption of:  
 a) Nitrogen, b) Oxygen, c) Carbon dioxide, d) Hydrogen  
 Answer: c) Carbon dioxide  
 Which layer of the atmosphere contains the ozone layer?  
 a) Troposphere, b) Mesosphere, c) Thermosphere, d) Stratosphere  
 Answer: d) Stratosphere  
 The greenhouse effect leads to:  
 a) Decrease in Earth's temperature, b) Increase in Earth's temperature, c) Formation of acid rain only  
 d) Reduction in sea level  
 Answer: b) Increase in Earth's temperature  
 Which international agreement aims to reduce greenhouse gas emissions?  
 a) Montreal Protocol, b) Kyoto Protocol, c) Ramsar Convention, d) Vienna Convention  
 Answer: b) Kyoto Protocol  
 Which of the following is a consequence of global warming?  
 a) Sea-level rise, b) Increased glacier formation, c) Reduced temperature, d) Ozone recovery  
 Answer: a) Sea-level rise  
 Coral reef damage is strongly linked with:  
 a) Soil erosion b) Ocean acidification, c) Noise pollution, d) Radioactive pollution  
 Answer: b) Ocean acidification

#### Assessment Rubric for Internal Assessment for Practical

|                 |                                                                                                                                                |                  |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| I               | SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI<br><b>Internal Assessment for Lab Work</b><br>B.Sc.II (Environmental Science) SEMESTER– IV (NEP) |                  |
| Code:<br>114218 | <b>Lab: Major</b> Global Environmental Change and Resilience Issues                                                                            | Max<br>Marks: 25 |
| <b>Sr. No.</b>  | <b>Assessment Criteria</b>                                                                                                                     | <b>Marks</b>     |
| 1               | Active Participation and Performance of Practical                                                                                              | 10               |
| 2               | MCQ TEST                                                                                                                                       | 05               |
| 3               | Field Visit Report / Assignment                                                                                                                | 05               |
| 4               | Attendance                                                                                                                                     | 05               |
|                 | Total                                                                                                                                          | 25               |

### Major Lab/Practical-. Environmental Pollution & Global Environmental Change and Resilience

| Level | Semester | Course Code | Course Name                                                                                | Credits | Teaching Hours | Exam Duration | Max Marks        |
|-------|----------|-------------|--------------------------------------------------------------------------------------------|---------|----------------|---------------|------------------|
| 5.0   | IV       | 114213      | Major Lab/Practical-. Environmental Pollution & Global Environmental Change and Resilience | 2       | 60             | 4 Hrs         | 25(Ext)+25 (Int) |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course Objectives:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <ul style="list-style-type: none"> <li>To know the Techniques of Sampling of pollutants.</li> <li>To handle and demonstrate sampling and analytical equipment.</li> <li>To understanding methodologies for qualitative and quantitatively determination Pollution.</li> <li>To study components of generated solid waste.</li> </ul>                                                                                                                                                                                                                                                                                |
| <b>Course Outcomes:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <p>CO-1. Demonstrate sample technique for sampling of gaseous and particulate air pollutant. CO-2. Analyse sampled air pollutant for its identification and concentration.</p> <p>CO-3. Determines degree of air pollutants in ambient air. CO-4. Able to sample bacteria from ambient air.</p> <p>CO-5. Analyse water for its physico- chemical quality parameters. CO-6. Estimates bacteria present in to the water samples.</p> <p>CO-7. Identifies components of solid waste. CO-8. Determines the properties of solid waste.</p> <p>CO-9. Measures noise levels and understand hazardous effects of noise.</p> |
| <b>Experiments on Air</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <ol style="list-style-type: none"> <li>To estimate RSPM by High Volume Sampler</li> <li>To determine settleable Particulate Matter by dust, fall Jar / paper method</li> <li>Sampling and analysis of Sox / NOx</li> <li>Estimation of CO<sub>2</sub> from air.</li> <li>To prove, the PM/ Smoke, Sox and CO<sub>2</sub> liberate during combustion of Coal.</li> <li>Identification and enumeration of bacteria from air.</li> <li>To Prepare Windrose Diagram.</li> </ol>                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>B Experiments on Water</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <ol style="list-style-type: none"> <li>Estimates the Chloride from given water sample.</li> <li>Determination Sulfates from given water sample.</li> <li>Determination Phosphate from given water sample</li> <li>Estimation of oil and grease from given water sample</li> <li>Determination of Nitrogen from soil by Kjeld Hals Method</li> <li>Identification and enumeration of bacteria from water.</li> </ol>                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>C Experiments on Soil/ Solid waste/ Noise</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <ol style="list-style-type: none"> <li>Physico chemical Analysis of soil from waste dumping Yard (pH, alkalinity and heavy metals)</li> <li>Determination of N/P/K content in soil samples</li> <li>Determination of physical (density, moisture content) properties of Solid waste</li> <li>To study composition of solid waste (House hold, Institutional, Agricultural)</li> <li>To study Principle and working of Noise Level Meter</li> <li>Survey of Noise Levels Institute/ Traffic/Market.</li> </ol>                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>D-Experiment on Global Environmental Change and Resilience</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <ol style="list-style-type: none"> <li><b>Assessment of Local Climate Variability:</b> Collect and analyze temperature and rainfall data of the local region for the last 10–20 years and interpret climate trends.</li> <li><b>Carbon Footprint Estimation:</b> Calculate individual or household carbon footprints based on energy use, transport, food habits, and waste generation.</li> <li><b>Study of Air Quality Parameters:</b> Monitor particulate matter, temperature, humidity, or gaseous pollutants in different locations and compare environmental quality.</li> </ol> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

4. **Biodiversity Assessment of a Local Ecosystem :** Conduct field surveys to record plant and animal diversity in forests, wetlands, gardens, or agricultural fields.
5. **Solid Waste Audit and Management Study:** Categorize and quantify biodegradable and non-biodegradable waste generated in campus or community areas and suggest management strategies.
6. **Water Quality Analysis**  
Analyze physical and chemical parameters of water samples such as pH, turbidity, dissolved oxygen, and hardness.
7. **Disaster Vulnerability Mapping:** Prepare a vulnerability map of the local area for floods, droughts, heat waves, or other environmental hazards.
8. **Study of Renewable Energy Resources:** Survey the use and efficiency of solar, wind, biogas, or other renewable energy systems in nearby communities or institutions.
9. **Ecosystem Resilience Observation Study:** Observe ecological recovery in disturbed ecosystems such as polluted ponds, degraded lands, or deforested areas.
10. **Community Awareness and Resilience Campaign:** Design and conduct awareness programs on climate change adaptation, sustainable resource use, and environmental conservation.

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**References:**

1. Physical and chemical methods in soil analysis by Dipak Sarkar and Abhijit Haldar
2. Method of soil analysis by Uttam Kumar and V. N. Mishra
3. Soil and water analysis: A practical manual by Dr. Rama Kant Singh, Dr. Pankaj Kumar Yadav
4. Physico Chemical Examination of Water, Sewage, and Industrial Effluent, Pragati Prakashan, Meerut.
5. Experimental Methods for General & Environmental Chemistry – Dr. Anita Rajor
6. 6 Environmental Guidelines and Standards in India – P. K. Goel & K.P. Sharma, Techno Science Publications, Jainpur.

**Rubric for Internal Assessment for Practical**

| SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI<br>Internal Assessment<br>B.Sc. II (Environmental Science) SEMESTER – IV (NEP) |                                                                                                             |               |
|------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|---------------|
| Course Code: 114213                                                                                                          | <b>Major Lab:</b> Major Lab/Practical-. Environmental Pollution& Global Environmental Change and Resilience | Max Marks: 25 |
| S.N.                                                                                                                         | Assessment Criteria                                                                                         | Marks         |
| 1.                                                                                                                           | Attendance                                                                                                  | 5             |
| 2.                                                                                                                           | Record / Assignments                                                                                        | 5             |
| 3.                                                                                                                           | Participation in Activity/ Field visit and Report                                                           | 10            |
| 5.                                                                                                                           | Students' overall performance                                                                               | 5             |

**Rubric for External Assessment for Practical**

| SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI<br>External Assessment for Lab Work<br>B.Sc. II (Environmental Science) SEMESTER –IV (NEP) |                                                                                           |                                |
|------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|--------------------------------|
| Course Code: 114213                                                                                                                      | Major Lab/Practical-. Environmental Pollution& Global Environmental Change and Resilience | Max Marks: 25,<br>Time: 4Hours |
| Sr. No.                                                                                                                                  | Assessment Criteria                                                                       | Marks                          |
| 1                                                                                                                                        | Practical Based on Air Pollutions.                                                        | 07                             |
| 2                                                                                                                                        | Practical Based on Water Pollution.                                                       | 07                             |
| 3                                                                                                                                        | Practical Based on Experiment on Global Environmental Change                              | 07                             |
| 4                                                                                                                                        | Viva Voce                                                                                 | 04                             |

**Minor Theory:- General Approach of Environmental Pollution.**

| Level | Semester | Course Code | Course Name                                                 | Credits | Teaching Hours | Exam Duration | Max Marks         |
|-------|----------|-------------|-------------------------------------------------------------|---------|----------------|---------------|-------------------|
| 5.0   | IV       | 114214      | Minor Theory:- General Approach of Environmental Pollution. | 2       | 30             | 2 Hrs         | 30(Ext) + 20(Int) |

| Course Objectives: | <ul style="list-style-type: none"> <li>To Understanding the concept of environmental pollution.</li> <li>To provide students with a comprehensive understanding of environmental issues.</li> <li>To Identifying causes and sources of pollution.</li> <li>To Understanding the impact of pollution.</li> <li>To understand the connection between environmental pollution and global issues.</li> </ul> |                         |                             |                                                                                                                                                |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| Course Outcomes:   | After the completion of this course, student is able to – CO-1.<br>Define and identify various types of pollutants. CO-2.<br>Identify pollution sources,<br>CO-3. Understand their impacts on human health and the environment. CO-4.<br>Analyze the causes and effects of pollution.<br>CO-5. Aware of the relationship between environmental pollution and human health,                               |                         |                             |                                                                                                                                                |
| Unit System        | Contents                                                                                                                                                                                                                                                                                                                                                                                                 | Workload Allotted (Hrs) | Weightage of Marks Allotted | Incorporation of Pedagogies                                                                                                                    |
| Unit I             | <b>1. Introduction to Environmental Pollution.</b><br>1.1 : Definition and types Environmental Pollution<br>1.2 : Definition and types of environmental pollutant.<br>1.3 : Environmental Pollution and global issues.<br>1.4 : Global causes of Environmental pollution.                                                                                                                                | 8                       | 8                           | Chalk and talk, FW, Visits, use of ICT charts, models, problem based learning and collaborative learning. Theory, Self- study and Case studies |
| Unit II            | <b>2. Water Pollution</b><br>2.1 : Definition of water pollution, types of water pollutant.<br>2.2 : Natural and Man-made sources to River, Lake and ground water pollution and sources of water pollutant<br>2.3 : Marine water pollution: Sources.<br>2.4 : Case study on water pollution: Ganga River.                                                                                                | 7                       | 7                           |                                                                                                                                                |
| Unit III           | <b>3. Air Pollution</b><br>3.1 : Introduction, definition of air pollution.<br>3.2 : Types of air pollution and air pollutants.<br>3.3 : Natural and manmade sources of air pollutants.<br>Global issues of air pollution<br>3.4 : Case study on Global warming and Acid rain.                                                                                                                           | 8                       | 8                           |                                                                                                                                                |
| Unit IV            | <b>4. Noise and soil Pollution.</b><br>4.1 : Introduction and definition of noise, difference between sound and noise, and Sources.<br>4.2 : Unit of sound, noise level standards and effect on human being.<br>4.3 : Natural composition of soil, Soil pollutants and their sources.<br>4.4 : Effects of soil pollution on human being, plant and ecosystem.                                            | 7                       | 7                           |                                                                                                                                                |

**Reference Books-**

1. Environmental Chemistry – A.K. De, Wiley Eastern Ltd. New Delhi
2. Air Pollution by M.N. Rao and H.V.N. Rao. Tata McGraw Hill Publications Company New Delhi.
3. Environmental Pollution Control Engineering by C.S. Rao. New Age International Publishing.
4. Environmental Chemistry – V.P. Khudesia
5. Environmental Chemistry – B.K. Sharma
6. Environmental Chemistry – Kaur.
7. Industrial Chemistry – B. K. Sharma
8. Environmental Engineering – S.S.Deswal
9. Water supply & Sanitary Engineering – Rangawala
10. Environmental pollution control Engineering– C.S.Rao, Newage international publication
11. Environmental Engineering – S.S.Deswal
12. Water supply & Sanitary Engineering – Rangawala
13. Environmental pollution control Engineering– C.S.Rao, Newage international publication
14. Environmental Chemistry – Chhatwal Anand
15. Environmental Sciences, Daniel Botkin & Edward Keller, John Wiley & sons, New York
16. Environmental Sciences, Eldon D. Enger and Bradley F.Smith, WCB Publishers, Boston
17. Physico Chemical Examination of Water, Sewage, and Industrial Effluent, Pragati prakashan, Meerut.
18. A Text book of Environmental Pollution V. S. Mangle Dnyanpath publication Amravati.

**Short Answer Questions**

1. Explain sources of Nox.
2. Explain effects of Sox on human being
3. What is RSPM?
4. What are aerosols?
5. What are noise levels standards?
6. Explain effects of noise pollution.
7. What is radiation?
8. What is radiation pollution?

**Long Type (At least 4):**

1. Give threefold classification of air pollutants with examples
2. Describe classification and sources of air pollutants
3. How to control noise pollution and give prescribed standards of noise
4. What is radioactive fallout explain in details.

**MCQs for Internal Assessment (At least 8) 1**

- is secondary air pollutant.  
a. O<sub>3</sub> b) CO c) dust d) CO<sub>2</sub>
2. The size of RSPM -----  
a.) <10 b) >10 c) =10, d) <100
3. The tropospheric lapse rate is \_\_\_\_\_  
(a) 4.5 °C/km (b) 6.5 °C/km (c) 5.5 °C/km
- 4 ----- is major greenhouse gas  
a.) CO<sub>2</sub> b-) CH<sub>4</sub> c-) CFCS d-) NO<sub>x</sub>
5. High pressure sound or unwanted sound is called-----  
(a) noise(b) sound(c) loud (d) None of these
6. Threshold limit of hearing is  
(a) 5 (b) 10 (c) 70 (d) 0
7. Radiation pollution can affect  
(a) plants b) animals(c) Humans (d) all
8. Radiation hazard is  
a) biological, b) physical, c) chemical d) none of these.

**Rubric for Internal Assessment for Theory Paper**

| SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI<br>Minor Theory Internal Assessment<br>B.Sc. II (Environmental Science) SEMESTER – IV (NEP) |                                                            |               |
|-------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|---------------|
| Course Code: 114214                                                                                                                       | Minor Theory: General Approach of Environmental Pollution. | Max Marks: 20 |
| S.N.                                                                                                                                      | Assessment Criteria                                        | Marks         |
| 1.                                                                                                                                        | Test -MCQ                                                  | 5             |
| 2.                                                                                                                                        | Class Assignments                                          | 5             |
| 3.                                                                                                                                        | Attendance                                                 | 5             |
| 4.                                                                                                                                        | Participation in Activity/ Field visit                     | 2             |
| 5.                                                                                                                                        | Overall Performance                                        | 3             |

Minor Lab : General Approach of Environmental Pollution.

| Level | Semester | Course Code | Course Name                                              | Credits | Teaching Hours | Exam Duration | Max Marks |
|-------|----------|-------------|----------------------------------------------------------|---------|----------------|---------------|-----------|
| 5.0   | IV       | 114215      | Minor Lab.: General Approach of Environmental Pollution. | 2       | 60             | 4 Hrs         | 25+25     |

|                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                              |
|------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course Objectives:</b>                | <ul style="list-style-type: none"> <li>To know the Techniques of Sampling of pollutants.</li> <li>To handle and demonstrate sampling and analytical equipment.</li> <li>To understanding methodologies for qualitative and quantitatively determination Pollution.</li> <li>To study components of generated solid waste.</li> </ul>                                                                                                                                                                                                                                             |                                                                                                                                                                              |
| <b>Course Outcomes:</b>                  | CO-1. Demonstrate sample technique for sampling of gaseous and particulate air pollutant. CO-2. Analyse sampled air pollutant for its identification and concentration. CO-3. Determines degree of air pollutants in ambient air. CO-4. Able to sample bacteria from ambient air. CO-5. Analyse water for its physico- chemical quality parameters. CO-6. Estimates bacteria present in to the water samples. CO-7. Identifies components of solid waste. CO-8. Determines the properties of solid waste. CO-9. Measures noise levels and understand hazardous effects of noise. |                                                                                                                                                                              |
| Expt. No                                 | Title Experiment.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Incorporation of Pedagogies                                                                                                                                                  |
| <b>A Experiments on Water Pollution.</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Sampling, Analysis, Field work comparative study, Assignment, project work.<br><br>Experiential learning, group learning, Inquiry based learning and Expeditionary learning. |
| 1                                        | Study of Sampling method for collection of water samples and their preservation methods.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                              |
| 2                                        | To determine TDS and TSS of water sample.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                              |
| 3                                        | To determine turbidity of water sample.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                              |
| 4                                        | To determine pH of natural water samples.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                              |
| 5                                        | To determine turbidity of water sample.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                              |
| 6                                        | To determine conductivity of water sample.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                              |
| 7                                        | To determine alkalinity of water sample                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                              |
| <b>B Experiments on Air Pollution</b>    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                              |
| 1                                        | To determine Settable particulate matter of ambient air by paper method.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                              |

|                                           |                                                                                     |  |
|-------------------------------------------|-------------------------------------------------------------------------------------|--|
| 2                                         | Collect information of National air Quality Index for selected nearer Metro cities. |  |
| 3                                         | Comparative measurement of CO2 percentage in your study area.                       |  |
| C Experiments on Noise and Soil Pollution |                                                                                     |  |
| 1                                         | Measure noise levels at different places.                                           |  |
| 2                                         | To determine acidity of soil.                                                       |  |
| 3                                         | To determine pH of soil.                                                            |  |
| 4                                         | To determine conductivity of soil.                                                  |  |
| 5                                         | To determine moisture content in soil.                                              |  |

#### Rubric for Internal Assessment for Practical

| SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI<br>Internal Assessment<br>B.Sc. II (Environmental Science) SEMESTER – IV (NEP) |                                                          |               |
|------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|---------------|
| Course Code: 114215                                                                                                          | Minor Lab.: General Approach of Environmental Pollution. | Max Marks: 25 |
| S.N.                                                                                                                         | Assessment Criteria                                      | Marks         |
| 1.                                                                                                                           | Attendance                                               | 5             |
| 2.                                                                                                                           | Record / Assignments                                     | 5             |
| 3.                                                                                                                           | Participation in Activity/ Field visit and Report        | 10            |
| 5.                                                                                                                           | Students' overall performance                            | 5             |

#### Rubric for External Assessment for Practical

| SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI External<br>PRACTICAL EXAMINATION<br>B.Sc. II (Environmental Science), SEMESTER – IV (NEP) |                                                          |                     |                |
|------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|---------------------|----------------|
| Course Code:<br>114215                                                                                                                   | Minor Lab.: General Approach of Environmental Pollution. | Max<br>Marks:<br>25 | Time: 4<br>Hrs |
| Sr. No.                                                                                                                                  | Exercise                                                 | Marks               |                |
| 1.                                                                                                                                       | Experiment based on Air Pollution                        | 7                   |                |
| 2.                                                                                                                                       | Experiment based on Water Pollution                      | 5                   |                |
| 3.                                                                                                                                       | Experiment based on Soil/ Solid waste                    | 5                   |                |
| 4.                                                                                                                                       | Experiment based on Noise Pollution                      | 5                   |                |
| 5.                                                                                                                                       | Q.5 Viva – voce                                          | 3                   |                |

**G/OE: Global Environmental Issues.**

| Level | Semester | Course Code | Course Name                        | Credits | Teaching Hours | Exam Duration | Max Marks             |
|-------|----------|-------------|------------------------------------|---------|----------------|---------------|-----------------------|
| 5.0   | IV       | 114266      | G/OE: Global Environmental Issues. | 2       | 30             | 2Hrs          | 30 (Ext.)<br>20 (Int) |

|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                   |                             |                                                          |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-----------------------------|----------------------------------------------------------|
| Course Objectives: | <ul style="list-style-type: none"> <li>To Identify Global Environmental Issues:</li> <li>To recognize major environmental challenges such as climate change, pollution, deforestation, biodiversity loss, and water scarcity.</li> <li>To examine Human Impact on the Environment:</li> <li>To explore how human activities contribute to environmental degradation and assess their consequences on ecosystems and natural resources.</li> <li>To know international treaties, national regulations, and sustainable development strategies to address environmental concerns.</li> <li>Develop Critical Thinking for Environmental Solutions:</li> <li>Analyse environmental problems and propose practical, evidence-based, and sustainable solutions.</li> </ul> |                   |                             |                                                          |
| Course Outcome     | <p>After the completion of this course, student is able to – CO-1: Understand concept of Environmental issues. CO-2: Identify causes of Environmental issues. CO-3: Classify the issues based on their segment and level of impact. CO-4: Try to find the solution for their mitigation. CO-5: Aware the society about causes, effects and control measures for environmental issues. CO-6: Cultivating a Sense of Environmental Responsibility among Students. ... CO-7: Fostering Critical Thinking and Problem Solving in Environmental Education. ... CO-8: Adopting Experiential Learning Approaches. ... CO-9: Collaborating with Local Communities and Organizations.</p>                                                                                     |                   |                             |                                                          |
| Unit System        | <b>Contents</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Workload Allotted | Weightage of Marks Allotted | Incorporation of Pedagogies                              |
| UNIT-I             | 1.1 : Introduction to Environmental Issues<br>1.2 : Definition and scope of environmental issues<br>1.3 : The relationship between humans and the environment<br>1.4 : Historical perspectives on environmental changes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 8Hrs              | 8 Marks                     | Place, Problem and Project based Teaching and Fieldwork: |
| UNIT-II            | 2.1 : Climate Change and Global Warming<br>2.2 : Causes of climate change (natural vs. anthropogenic)<br>2.3 : Greenhouse gases and the carbon cycle<br>Climate change impacts (rising temperatures, sea-level rise, extreme weather)<br>2.4 : Mitigation and adaptation strategies                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 7 Hrs             | 7 Marks                     |                                                          |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                    |       |         |  |
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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Global policies: Paris Agreement, COP conferences                                                                                                                                                                                                                                                  |       |         |  |
| UNIT-III                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 3.1 : Biodiversity and Ecosystem Loss<br>Importance of biodiversity<br>3.2 : Causes of biodiversity loss (deforestation, habitat destruction, poaching)<br>3.3 : Endangered species and conservation efforts<br>3.4 : Protected areas and wildlife reserves                                        | 8Hrs  | 8 Marks |  |
| UNIT-IV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 4.1 : Environmental Pollution: Definition and types<br>4.2 : Air pollution: causes, effects, and solutions<br>4.3 : Water pollution: Definition, causes and water scarcity.<br>4.3 : Solid waste: Sources types and impact. Pollution. Soil Pollution.<br>4.4 : Noise Pollution and deforestation. | 7 Hrs | 7 Marks |  |
| <p style="text-align: center;"><b>References</b></p> <ul style="list-style-type: none"> <li>• <b>Reference Books:</b></li> <li>• Carson, R. (1962). Silent Spring. Houghton Mifflin Harcourt. A foundational book on the impact of pesticides and environmental conservation.</li> <li>• Cunningham, W. P., &amp; Cunningham, M. A. (2020). Environmental Science: A Global Concern. McGraw-Hill Education. Covers global environmental challenges, scientific principles, and sustainable solutions.</li> <li>• Kolbert, E. (2014). The Sixth Extinction: An Unnatural History. Henry Holt and Co. Discusses biodiversity loss and human impact on species extinction.</li> <li>• Rock Strom, J., &amp; Klum, M. (2015). Big World, Small Planet: Abundance Within Planetary Boundaries. Yale University Press. Explores sustainability within Earth's ecological limits.</li> <li>• Speth, J. G. (2008). The Bridge at the Edge of the World: Capitalism, the Environment, and Crossing from Crisis to Sustainability. Yale University Press. Examines the link between economic systems and environmental issues.</li> </ul> <p><b>Journals and Articles:</b></p> <ul style="list-style-type: none"> <li>• Nature Climate Change – Covers the latest research on climate science and policy.</li> <li>• Environmental Research Letters – Open-access journal with studies on sustainability and pollution.</li> <li>• Science and Nature – General science journals that frequently publish groundbreaking environmental research.</li> <li>• Annual Review of Environment and Resources – Summarizes global environmental trends and policy solutions.</li> </ul> <p><b>Reports and Official Documents:</b></p> <ul style="list-style-type: none"> <li>• Intergovernmental Panel on Climate Change (IPCC) Reports – <a href="https://www.ipcc.ch/">https://www.ipcc.ch/</a></li> <li>• Comprehensive climate change assessments from leading scientists.</li> <li>• United Nations Environment Programme (UNEP) Reports – <a href="https://www.unep.org/">https://www.unep.org/</a></li> <li>• Covers biodiversity, pollution, and sustainable development.</li> <li>• World Resources Institute (WRI) Reports – <a href="https://www.wri.org/">https://www.wri.org/</a></li> <li>• Data-driven research on climate, energy, and environmental sustainability.</li> <li>• Sustainable Development Goals (SDGs) Reports (UN) – <a href="https://sdgs.un.org/">https://sdgs.un.org/</a></li> <li>• Tracks global progress on environmental sustainability goals.</li> </ul> |                                                                                                                                                                                                                                                                                                    |       |         |  |
| <p style="text-align: center;"><b>Model Questions</b></p> <p><b>Multiple-Choice Questions (MCQs)</b></p> <p>1. Which of the following is the leading cause of global climate change?<br/>a) Deforestation, b) Greenhouse gas emissions, c) Volcanic eruptions</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                    |       |         |  |

- d) Ocean currents
2. The depletion of the ozone layer is mainly caused by:
- a) Carbon dioxide, b) Methane gas, c) Chlorofluorocarbons (CFCs)
  - d) Nitrogen oxides
3. Which international agreement aims to reduce carbon emissions to mitigate climate change?
- a) Kyoto Protocol, b) Paris Agreement, c) Montreal Protocol
  - d) Basel Convention
4. What is the primary cause of biodiversity loss?
- a) Overpopulation, b) Habitat destruction, c) Air pollution
  - d) Industrial waste
5. The main goal of the Sustainable Development Goals (SDGs) is to:
- a) Promote economic growth at any cost, b) Ensure environmental sustainability along with social and economic development, c) Expand urbanization without restrictions, d) Increase industrial production

**Short Answer Questions**

1. Define climate change and explain its main causes.
2. What are renewable energy sources? Give two examples.
3. How does deforestation contribute to global warming?
4. What is sustainable development, and why is it important?
5. List three major environmental problems and briefly describe their impacts.

**Long Answer Questions**

1. Discuss the impact of climate change on human health and agriculture.
2. Explain the concept of the circular economy and how it can help reduce environmental problems.
3. Analyse the role of international organizations (e.g., UN, IPCC) in addressing global environmental challenges.
4. Compare and contrast the Kyoto Protocol and the Paris Agreement in terms of their goals and effectiveness.
5. What are the ethical and economic challenges of balancing economic growth with environmental protection?

VSC: Skills for Environmental Lab Technician: Water Sampling & Analysis.

| Level | Semester | Course Code | Course Name                                                              | Credits | Teaching Hours | Exam Duration | Max Marks |
|-------|----------|-------------|--------------------------------------------------------------------------|---------|----------------|---------------|-----------|
| 5.0   | IV       | 114275      | VSC: Skills for Environmental Lab Technician: Water Sampling & Analysis. | 2       | 60             | 4 Hrs.        | 50        |

|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course Objectives: | <ul style="list-style-type: none"> <li>Collect water samples from various sources (e.g., lakes, rivers, groundwater, treatment plants) following standardized procedures and safety protocols.</li> <li>Maintain chain-of-custody documentation for all collected samples.</li> <li>Conduct physical, chemical, and microbiological testing of water samples using appropriate instruments (e.g., spectrophotometers, titrators, incubators).</li> <li>Ensure all tests comply with regulatory standards such as EPA, ISO, or local environmental guidelines.</li> <li>Record, analyse, and report data with precision, maintaining high standards of QA/QC.</li> <li>Identify anomalies or contamination and escalate findings as necessary.</li> <li>Calibrate lab equipment regularly to ensure accurate readings.</li> <li>Perform routine maintenance and troubleshooting to minimize downtime.</li> </ul>                                                                                                                                                                                                                                                                             |
| Course Outcomes:   | <p>After the completion of this work student is able to –</p> <p>CO-1: Explain the significance of water quality in public health, industry, and the environment. CO-2: Identify sources of water contamination and pollution.</p> <p>CO-3: Understand sample preservation and storage protocols.</p> <p>CO-4: Perform physical, chemical, and biological tests (e.g., pH, turbidity, TDS, BOD, COD, coliform count).</p> <p>CO-5: Use analytical instruments such as spectrophotometers, titrators, turbidity meters, and pH meters. CO-6: Analyse and interpret water quality data according to standard guidelines (e.g., WHO, EPA, BIS). CO-7: Compare observed values with permissible limits.</p> <p>CO-8: Identify potential sources of error in water analysis.</p> <p>CO-9: Suggest corrective actions and troubleshooting steps in analysis workflows. CO-10: Discuss the impact of water pollution on ecosystems and human health.</p> <p>CO-11: Learn basic mitigation strategies for contaminated water sources.</p> <p>CO-12: Maintain proper lab notebooks and prepare standard analytical reports. CO-13: Practice safe handling of chemicals and laboratory equipment.</p> |
| Activities         | Contents                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Section: A         | <p><b>1- Introduction to Water Quality</b></p> <p>1.1: Importance of Water Quality: Understanding why clean and safe water is crucial for health, agriculture, industry, and the environment.</p> <p>1.2: Drinking water as wholesome water</p> <p>1.3: Water Sampling Techniques-Sampling Methods: How to collect water samples from different sources (rivers, lakes, wells, etc.).</p> <p>1.4: Handling and Storage of Samples: Proper techniques to preserve water samples before testing.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Section: B         | <p><b>2- Water Testing Methods</b></p> <p>2.1: Physical Properties: Temperature, turbidity, colour, and pH levels.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <p>2.2 : Chemical Properties: Dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD), heavy metals (like lead, mercury), and pesticides.</p> <p>2.3 : Microbiological Testing: Presence of pathogens (e.g., coliform bacteria, E. coli).</p> <p>2.4 : Toxicity Tests: How to evaluate water's toxic effects on aquatic life.</p>                                                                                                                                                                                                                                                                  |
| Section: C                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <p><b>3- Laboratory Techniques and Equipment</b></p> <p>3.1 : Common Laboratory Tools: Spectrophotometers, pH meters, turbidity meters,</p> <p>3.2 : microscopes, and filtration systems.</p> <p>3.3 : Analysis Methods: Gravimetric, titrimetric,</p> <p>3.4 : spectrometric, and chromatography techniques.</p>                                                                                                                                                                                                                                                                                                               |
| Section: D                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <p><b>4- Data Interpretation and Reporting</b></p> <p>4.1 : Analysing Results: How to interpret water test results.</p> <p>4.2 : Water Quality Standards: Understanding national/international water quality standards (e.g., BIS/WHO) and how to compare the results with these benchmarks.</p> <p>4.3 : Reporting: Writing reports that communicate findings, conclusions, and recommendations to stakeholders.</p> <p>4.4 : Effect of Poor Water Quality on Health: How contaminated water can affect human health and the environment and understanding local environmental laws and standards governing water quality.</p> |
| <p><b>Skills Developed</b></p> <ul style="list-style-type: none"> <li>• <b>Fieldwork Skills:</b> Knowledge of fixation of sampling point, water sample collection and related data collection.</li> <li>• <b>Policy and Advocacy:</b> Understanding of environmental laws, policy-making, and the ability to advocate for water resource conservation and protection from contamination.</li> <li>• <b>Community Engagement:</b> Working with local communities to protect water resource.</li> <li>• <b>Environmental Education:</b> Educating others about the importance of quality water.</li> <li>• <b>Research and Monitoring:</b> The ability to analyse data and produce reports to inform conservation efforts.</li> </ul> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

#### Rubric for Internal Assessment for VSC

| <p>SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI</p> <p><b>Internal Assessment</b></p> <p>B.Sc. II (Environmental Science) SEMESTER – IV(NEP)</p> |                                                                                     |               |
|---------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------------|
| Subject Code:<br>114275                                                                                                                           | <b>VSC: Skills for Environmental Lab Technician: Water Sampling &amp; Analysis"</b> | Max Marks: 50 |
| S.N.                                                                                                                                              | Assessment Criteria                                                                 | Marks         |
| 1.                                                                                                                                                | Test -MCQ                                                                           | 10            |
| 2.                                                                                                                                                | Analysis and Handling equipment.                                                    | 10            |
| 3                                                                                                                                                 | Case Study                                                                          | 10            |
| 4                                                                                                                                                 | Participation in Activity/ Field visit and its report                               | 10            |
| 5.                                                                                                                                                | Marinating Lab Protocol.                                                            | 10            |

SEC: Field and Lab skills for Environmental quality analysis.

| Level | Semester | Course Code | Course Name                                                   | Credits | Teaching Hours | Exam Duration | Max Marks |
|-------|----------|-------------|---------------------------------------------------------------|---------|----------------|---------------|-----------|
| 5.0   | IV       | 114276      | SEC: Field and Lab skills for Environmental quality analysis. | 2       | 60             | 4 Hrs.        | 50        |

|                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course Objectives:                                                                                                                                                                                                                                                                                                                                                                                                 | <ul style="list-style-type: none"> <li>Learn proper water sampling procedures for different sources (e.g., tap, groundwater, surface water).</li> <li>Understand sample preservation and storage protocols.</li> <li>Use analytical instruments such as spectrophotometers, titrators, turbidity meters, and pH meters.</li> <li>To know the principle working handling and calibration of analytical instruments.</li> <li>To learn to prepare standard reagents for chemical analysis.</li> </ul>                                                                |
| Course Outcomes:                                                                                                                                                                                                                                                                                                                                                                                                   | <p>After the completion of this course, student is able to -</p> <ol style="list-style-type: none"> <li>Learn proper water sampling procedures for different sources (e.g., tap, groundwater, surface water).</li> <li>Understand sample preservation and storage protocols.</li> <li>Use analytical instruments such as spectrophotometers, titrators, turbidity meters, and pH meters.</li> <li>Understand the importance of accuracy, precision, calibration, and validation.</li> <li>Practice safe handling of chemicals and laboratory equipment.</li> </ol> |
| <b>Activities</b>                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Environmental Sampling Techniques:</b> <ol style="list-style-type: none"> <li>Types of sampling: grab, composite, continuous.</li> <li>Equipment used for sampling air, water, and soil.</li> <li>Sample preservation and transport protocols.</li> <li>Overview of national and international environmental regulations (e.g., EPA, CPCB).</li> <li>Sample preservation and transport protocols.</li> </ol>    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Protocol for Preparation of standard solution preparation.</b> <ol style="list-style-type: none"> <li>Handling of weighing balance.</li> <li>Weighing of reagents.</li> <li>Handling of volumetric flask and measuring cylinder.</li> <li>Washing and drying techniques of glass wares.</li> </ol>                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Laboratory Analysis Techniques: Principle, Working, Calibration and handling of Equipment-</b> <ol style="list-style-type: none"> <li>Spectrophotometers</li> <li>Gas Chromatography (GC)</li> <li>Atomic Absorption Spectroscopy (AAS)</li> <li>Air quality monitors</li> <li>Noise level meters</li> <li>Flame photo meter</li> <li>Laminar air flow.</li> <li>BOD incubator.</li> <li>Microscopes</li> </ol> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

**Skills Developed**

- **Fieldwork Skills:** Knowledge of fixation of sampling point, water sample collection and related data collection.
- **Policy and Advocacy:** Understanding of environmental laws, policy-making, and the ability to advocate for water resource conservation and protection from
- **Community Engagement:** Working with local communities to protect water resource.
- **Research and Monitoring:** The ability to analyse data and produce reports to inform

**Rubric for Internal Assessment for SEC**

| SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI<br>Internal Assessment<br>B.Sc. II (Environmental Science) SEMESTER – IV(NEP) |                                                                                        |               |
|-----------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|---------------|
| Subject Code:<br>114276                                                                                                     | SEC: Field and Lab skills for Environmental quality analysis.                          | Max Marks: 50 |
| <b>S.N.</b>                                                                                                                 | <b>Skill Assessment Criteria</b>                                                       | <b>Marks</b>  |
| <b>1.</b>                                                                                                                   | Test -MCQ                                                                              | 10            |
| <b>2</b>                                                                                                                    | Follows SOPs, maintains cleanliness, accurate measurements.                            | 10            |
| <b>3</b>                                                                                                                    | Demonstration of Handling instrument, Proper use, calibration, and care of instruments | 20            |
| <b>4</b>                                                                                                                    | Overall performance                                                                    | 10            |

Field Project / Community Engagement Services in Environmental Science: Phase-II

| Level | Semester | Course Code | Course Name                                                                      | Credits | Teaching Hours | Exam Duration | Max Marks |
|-------|----------|-------------|----------------------------------------------------------------------------------|---------|----------------|---------------|-----------|
| 5.0   | IV       | 114216      | Field Project / Community Engagement Services in Environmental Science: Phase-II | 2       | 60             | --            | 50        |

**Course Objectives:**

- Promote experiential learning by involving students in real-world environmental issues through surveys, data collection, and field observations.
- Encourage active community participation by conducting awareness drives, environmental education programs, and eco-restoration activities.
- Enhance problem-solving and critical thinking skills through investigation of local environmental challenges such as pollution, waste management, biodiversity loss, and climate change impacts.
- Foster teamwork, leadership, and communication skills through collaborative fieldwork and interaction with local stakeholders.
- Bridge the gap between theoretical knowledge and practical application by integrating scientific methods with community needs for sustainable development.

**Course Outcomes:**

After successful completion of this course, students will be able to:

- Apply environmental science concepts and methodologies to assess and analyze real-world environmental issues through field-based activities.
- Conduct data collection, documentation, and analysis related to air, water, soil, biodiversity, or waste, using appropriate tools and techniques.
- Engage effectively with local communities and stakeholders to identify environmental problems and promote awareness through outreach and education programs.
- Demonstrate problem-solving, teamwork, and project management skills in the planning and execution of environmental field projects.
- Develop sustainable and practical solutions to local environmental challenges by integrating scientific knowledge with community insights.
- Communicate environmental findings clearly through reports, presentations, and community dialogue, reflecting ethical responsibility and civic engagement.

**Guidelines/ SoP for FP/CEP**

For understanding key principles of CE, forms of CE, operational guidelines and implementation strategy please refer [https://www.ugc.gov.in/pdfnews/4187860\\_Revised-Final-Guidelines.pdf](https://www.ugc.gov.in/pdfnews/4187860_Revised-Final-Guidelines.pdf)

**As per NEP 2020, students of B Sc. II of Semester III and IV need to perform a Field Project (FP) for TWO (2) credits i.e. 50 Marks.**

**The guidelines regarding the field project are as follows:**

**Field Data Collection:**

- Collect samples of air, water, or soil following standard protocols.
- Use field instruments like air quality monitors, sound level meters, or radiation detectors to measure pollution levels.
- Observe and record pollution indicators, sources, and environmental conditions.
- Conduct surveys and interviews with local residents, workers, or officials to gather qualitative information about pollution impacts and awareness.
- Keep detailed field notes that include the date, time, location, weather conditions, and observations made during the study.
- Take photographs of the sites, pollution sources, and community engagement activities.

**Community Engagement Activities:**

- Organize awareness activities such as poster presentations, street plays, tree plantation, clean-up drives, eco-quizzes, or workshops.

**Documentation of Activities:**

- Record all field observations, survey responses, and community feedback properly.
- Take photographs and maintain a field diary or logbook.

**Data Analysis:**

- Analyze the collected data using charts, graphs, and comparisons with environmental standards (e.g., CPCB norms, WHO guidelines).

**Result Interpretation:**

- Draw conclusions about the problem and its severity, based on evidence collected during the study.

**Report Writing:**

- Prepare a structured project report including:
  - Title Page
  - Abstract
  - Introduction and Objectives
  - Methodology
  - Results and Observations
  - Discussion
  - Community Impact
  - Conclusion and Suggestions
  - References
  - Photographs/Annexures

**Presentation:**

- Create a PowerPoint presentation or poster for final evaluation.
- Present the project findings before teachers and peers.

**Submission:**

- Submit the final report (hard and/or soft copy) along with necessary documents (data sheets, feedback forms, photos, etc.) on time.

**Project Format and Deliverables**

| Component                   | Description                                                   |
|-----------------------------|---------------------------------------------------------------|
| <b>Duration</b>             | 60 hours total (fieldwork + report writing + presentation)    |
| <b>Group Size</b>           | Individual or up to 4 students                                |
| <b>Guide</b>                | Supervised by departmental faculty                            |
| <b>Project Types</b>        | Survey-based, experimental, participatory, or interventionist |
| <b>Final Output</b>         | Written report + Presentation + Community feedback            |
| <b>Grading Methodology:</b> | Internal (faculty) + External (appointed examiner) = 50 marks |

**Students should:**

- **Revisit and reflect on Phase I:** What was observed? What problems or patterns emerged?
- **Identify upgrade paths:**

| Phase I Focus                                 | Phase II Upgrade                              |
|-----------------------------------------------|-----------------------------------------------|
| Documentation of Environmental Project        | Trial field observation or awareness campaign |
| Survey of Environmental Issue                 | Conservation/restoration initiative           |
| Awareness posters on Environmental Management | Live remedial observation                     |
| Find remedies                                 | Pilot implementation in community             |

**SUGGESTED FORMS OF COMMUNITY-ENGAGED PRACTICE IN ENVIRONMENTAL SCIENCE**

• **Environmental Awareness Campaigns**

Organize workshops, street plays, or information sessions on pollution types, causes, and prevention. Distribute pamphlets or posters in local languages highlighting environmental issues and solutions.

• **Surveys and Interviews**

Conduct structured surveys or informal interviews with residents, workers, and local authorities to assess pollution awareness and impacts.

Use questionnaires to collect data on community health, waste disposal habits, or water usage.

• **Community Clean-up Drives**

Plan and participate in cleaning local water bodies, streets, parks, or waste dumping sites. Involve local volunteers, schools, and NGOs for greater impact.

• **Monitoring and Sampling Activities**

Engage community members in simple environmental monitoring such as air quality measurement, water testing, or noise level monitoring using portable instruments.

Train locals on basic pollution detection methods.

- **Tree Plantation and Green Space Development**

Collaborate with community groups to plant trees and promote green spaces to improve air quality and reduce noise pollution.

- **Waste Management Workshops**

Educate communities on waste segregation, recycling, composting, and responsible disposal practices.

Help set up or improve local waste management systems.

- **Advocacy and Policy Engagement**

Facilitate community discussions to gather feedback on local environmental policies. Support community members in communicating concerns to local governance bodies.

- **Participatory Mapping and Documentation**

Work with locals to map pollution hotspots or vulnerable areas using simple mapping tools or apps. Document pollution sources and their effects through photos and notes.

- **Environmental Education in Schools**

Conduct interactive sessions in nearby schools to raise awareness about pollution and sustainability among children.

- **Health Impact Assessments**

Collaborate with community health workers to understand and document pollution-related health issues.

**Example Upgrade Paths:**

**Suggested Project Themes:**

**Assessment of Air Quality in Urban and Rural Areas**

- Monitoring particulate matter (PM2.5, PM10), CO, NO<sub>2</sub> near traffic junctions and residential zones

| Phase I Topic                                | Phase II Upgrade                                                          |
|----------------------------------------------|---------------------------------------------------------------------------|
| Testing pH and turbidity of local pond water | Seasonal water quality assessment using lab tests; impact on aquatic life |
| Survey of waste disposal habits in college   | Design and implement a waste segregation awareness and composting drive   |
| Measure noise near busy road                 | Study noise impact on residents and propose noise barriers                |
| List common plants in campus                 | Seasonal diversity study with species indexing and GIS mapping            |
| Survey of electricity use in hostel          | Energy audit and proposal for renewable energy options                    |

- Impact of local pollution sources on air quality
- **Water Quality Analysis of Local Water Bodies**
- Testing pH, dissolved oxygen, turbidity, heavy metals in rivers, lakes, or groundwater
- Impact of nearby industries/agriculture on water pollution
- **Solid Waste Management and Awareness**
- Study of waste generation, segregation, and disposal practices in households or institutions
- Planning and promoting composting or recycling programs
- **Noise Pollution Assessment and Mitigation**
- Measuring noise levels in markets, schools, hospitals and assessing health impacts
- Proposing noise barriers or awareness drives
- **E-Waste Awareness and Management**
- Survey on e-waste generation and disposal in communities
- Organizing collection drives and educating on safe disposal methods
- **Biodiversity Survey and Conservation**
- Documenting plant and animal species in local parks, forests, or campus
- Studying effects of urbanization on local biodiversity
- **Climate Change Impact Assessment**
- Monitoring temperature and rainfall changes in local area
- Studying effects on agriculture or water resources
- **Renewable Energy Potential Assessment**
- Survey of solar or wind energy potential in the region
- 

**Assessment Rubric for FP/CEPPhase-II**

| <b>SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI PRACTICAL<br/>EXAMINATION<br/>B.Sc. II (Environmental Science), SEMESTER – IV (NEP)</b> |                                       |                                                                                                      |                         |
|------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|------------------------------------------------------------------------------------------------------|-------------------------|
| FP/CEP                                                                                                                                   | <b>Course Code:</b><br>114216         | Field Project / Community Engagement Services in<br><b>Environmental Science:</b><br><b>Phase-II</b> | <b>Max Marks:</b><br>50 |
| <b>Q. No.</b>                                                                                                                            | <b>Exercise</b>                       |                                                                                                      | <b>Marks</b>            |
| 1                                                                                                                                        | Data Collection                       |                                                                                                      | 15                      |
| 2                                                                                                                                        | Data Analysis & Interpretation        |                                                                                                      | 12                      |
| 3                                                                                                                                        | Report Writing                        |                                                                                                      | 10                      |
| 4                                                                                                                                        | Oral/Poster Presentation              |                                                                                                      | 08                      |
| 5                                                                                                                                        | Community Engagement & Sustainability |                                                                                                      | 05                      |

# **SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI**

Three Years- Six Semesters Bachelor's Degree Programme

3 Years B.Sc. /4 Year B.Sc. (Hons) & 4 Year B.Sc. (Hons with Research) Programme



*Faculty of*  
*Science and Technology*  
*(Science Group)*

Subject: **ENVIRONMENTAL SCIENCE**  
(Semesters V and VI)

**Effective from Academic Year 2026-27**  
**(As per Uniform NEP 2020)**

## Contents

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|                                                                     |    |
|---------------------------------------------------------------------|----|
| • Examination, Evaluation and Assessment Scheme .....               | 03 |
| • THIRD YEAR: Level 5.5 - SEMESTER – V (T & L Credit Scheme) .....  | 05 |
| 1. Environmental Sciences MJ Theory 7 .....                         | 06 |
| 2. Environmental Sciences MJ Theory 8 .....                         | 09 |
| 3. Environmental Sciences MJ Theory 9 .....                         | 12 |
| 4. Environmental Sciences MJ Lab/ Practical .....                   | 15 |
| 5. Environmental Sciences MJ Elective Theory 1 .....                | 18 |
| 6. Environmental Sciences MJ Elective Lab/ Practical .....          | 21 |
| 7. Environmental Sciences MJ Elective Theory 2 .....                | 23 |
| 8. Environmental Sciences MJ Elective Lab/ Practical .....          | 26 |
| 9. Environmental Sciences MN Theory .....                           | 28 |
| 10. Environmental Sciences MN Lab/ Practical .....                  | 31 |
| 11. Environmental Sciences VSC- Lab/ Practical .....                | 33 |
| 12. Environmental Sciences SEC- Lab/ Practical. ....                | 35 |
| 13. Environmental Sciences FP/CES-3 Project .....                   | 37 |
| • THIRD YEAR: Level 5.5 - SEMESTER – VI (T & L Credit Scheme) ..... | 40 |
| 1. Environmental Sciences MJ Theory 10 .....                        | 41 |
| 2. Environmental Sciences MJ Theory 11 .....                        | 44 |
| 3. Environmental Sciences MJ Theory 12 .....                        | 48 |
| 4. Environmental Sciences MJ Lab/ Practical .....                   | 52 |
| 5. Environmental Sciences MJ Elective Theory .....                  | 55 |
| 6. Environmental Sciences MJ Elective Lab/ Practical .....          | 59 |
| 7. Environmental Sciences MJ Elective Theory.....                   | 61 |
| 8. Environmental Sciences MJ Elective Lab/ Practical .....          | 64 |
| 9. Environmental Sciences MN Theory .....                           | 68 |
| 10. Environmental Sciences MN Lab/ Practical .....                  | 71 |
| 11. Environmental Sciences VSC-5 Lab/ Practical .....               | 73 |
| 12. Environmental Sciences Internship/ OJT .....                    | 76 |

**SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI**  
**FACULTY: Science and Technology**  
**Subject: Environmental Science**  
**Teaching and Learning Scheme for the Degree of Bachelor of Science (B.Sc.)**  
**Three Years / Four Years - (Six/ Eight Semesters) Bachelor Degree Programme**  
**Examination, Evaluation and Assessment Scheme**

| Vertical No. | The Vertical               | Mode of Examination & Evaluation Assessment | Theory                                                                                                                                                                                                                                                                     |           |                  |           |           | Theory (Total) |           | Practical |           |                  |           |           |           | Practical (Total) |  |
|--------------|----------------------------|---------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|------------------|-----------|-----------|----------------|-----------|-----------|-----------|------------------|-----------|-----------|-----------|-------------------|--|
|              |                            |                                             | External                                                                                                                                                                                                                                                                   |           |                  | Internal  |           |                |           | External  |           |                  | Internal  |           |           |                   |  |
|              |                            |                                             | Max Marks                                                                                                                                                                                                                                                                  | Min Marks | Durati on (Hrs.) | Max Marks | Min Marks | Max Marks      | Min Marks | Max Marks | Min Marks | Durati on (Hrs.) | Max Marks | Min Marks | Max Marks | Min Marks         |  |
| A            | Major                      | External & Internal                         | 30                                                                                                                                                                                                                                                                         | 9         | 2                | 20        | 6         | 50             | 20        | 25        | 10        | 4                | 25        | 10        | 50        | 20                |  |
|              | Elective                   |                                             | 30                                                                                                                                                                                                                                                                         | 9         | 2                | 20        | 6         | 50             | 20        | 25        | 10        | 4                | 25        | 10        | 50        | 20                |  |
| B            | Minor                      |                                             | 30                                                                                                                                                                                                                                                                         | 9         | 2                | 20        | 6         | 50             | 20        | 25        | 10        | 4                | 25        | 10        | 50        | 20                |  |
| C            | Generic/ Open Elective     |                                             | --                                                                                                                                                                                                                                                                         | --        | --               | --        | --        | --             | --        | --        | --        | --               | --        | --        | --        | --                |  |
| D            | VSC                        | Internal                                    | ---                                                                                                                                                                                                                                                                        | ---       |                  |           |           |                |           | --        | --        |                  | 50        | 20        | 50        | 20                |  |
|              | SEC                        | Internal                                    | ---                                                                                                                                                                                                                                                                        | ---       |                  |           |           |                |           | --        | --        |                  | 50        | 20        | 50        | 20                |  |
| F            | Internship/ Apprenticeship | Internal                                    | Assessment of these verticals shall be based on various activities/practices. It shall be evaluated by giving maximum marks of 50 per 2 Credit Course with separate activity weightages/levels. A detailed SOP for this assessment process shall be prescribed separately. |           |                  |           |           |                |           |           |           |                  |           |           |           |                   |  |
|              | FP/CES                     |                                             |                                                                                                                                                                                                                                                                            |           |                  |           |           |                |           |           |           |                  |           |           |           |                   |  |
|              | CC                         |                                             |                                                                                                                                                                                                                                                                            |           |                  |           |           |                |           |           |           |                  |           |           |           |                   |  |

**Internal Assessment for Theory/Practical/Laboratory:**

All the internal assessments should be conducted on the basis of Continuous Assessment Tests (CAT).

***Continuous Assessment Tests (CAT):***

For internal assessment, the Continuous Assessment Tests (CAT) shall be conducted as under

- Three CAT each of 10 Marks (Theory) and 10 Marks (Practical).
  - First on completion of 25% Syllabus of the course or on completion of 25 teaching days,
  - Second on completion of 50% Syllabus of the course or on completion of 50 teaching days,
  - Third on completion of 75% Syllabus of the course or on completion of 75 teaching days. .
- Each concurrent assessment (CAT-I, II & V) will be mapped to relevant Course Learning Outcome.
- Total Performance in CAT (i.e.40 %) shall be based on the best two out of three in CAT examinations
- Internal assessment shall be carried out by the respective course teacher by choosing variety of assessment tools/methods such as class test, seminar, case study, field work, mini project work, quiz or any innovative method, which may be deemed to be appropriate for assessing the relevant course outcome.

**Evaluation and Assessment for FP/CES:**

- Project Report: The final report will be assessed based on its content, organization, and the quality of the research. (20 Marks)
- Oral Presentation: The presentation will be evaluated on clarity, engagement, and the ability to answer questions. (10 Marks)
- Faculty Evaluation: The faculty mentor will assess the student's performance throughout the project. (20 Marks)
- Total 50 Marks**

*Note: The external assessments of theory courses will be conducted in accordance with the guidelines issued by the SGBA University.*

**SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI**  
**FACULTY: Science and Technology**  
**Subject: ENVIRONMENTAL SCIENCE**  
**Teaching and Learning Scheme: for the Degree of Bachelor of Environmental Science (B.Sc.)**  
**Three Years / Four Years- (Six / Eight Semesters) Bachelor's Degree Programme**

**THIRD YEAR: Level 5.5 - SEMESTER – V (T & L Credit Scheme)**

| Mode of Teaching                                           | Ver. No | Vertical               | Type of Course           | Course Code | Course Name                                                    | Credits | Workload (Hrs/Week) | Vertical Workload (Hrs/Week) |
|------------------------------------------------------------|---------|------------------------|--------------------------|-------------|----------------------------------------------------------------|---------|---------------------|------------------------------|
| Classroom Teaching / Lab Work (Practical)/ Outdoor / Field | a.      | Major                  | Theory-7                 | 114218      | Fundamentals of Environmental Pollution and Control Technology | 2       | 2                   | 16                           |
|                                                            |         |                        | Theory-8                 | 114219      | Air and Water Pollution Control Technology                     | 2       | 2                   |                              |
|                                                            |         |                        | Theory-9                 | 114220      | Integrated Waste Management                                    | 2       | 2                   |                              |
|                                                            |         |                        | Lab/Practical-1-15       | 114221      | Practical based on Major-7,8 and 9                             | 2       | 4                   |                              |
|                                                            |         | Major (Elective )      | Theory Elective-1        | 114222      | Fundamentals of Health, Safety and Environment                 | 2       | 2                   |                              |
|                                                            |         |                        | Lab/Pract. Elective-1    | 114223      | Practical based on Elective -1                                 |         |                     |                              |
|                                                            |         |                        | Theory-2                 | 114224      | Environmental Restoration and planning                         |         |                     |                              |
|                                                            |         |                        | Lab/Practical Elective-2 | 114225      | Practical based on Major Electives- 2                          | 2       | 4                   |                              |
|                                                            | b.      | Minor                  | Theory-5                 | 114226      | Global climatic Issues.                                        | 2       | 2                   | 6                            |
|                                                            |         |                        | Lab/Practical -18        | 114227      | Practical based on Minor theory                                | 2       | 4                   |                              |
|                                                            | c.      | Generic/ Open Elective | -                        | -           | -                                                              | -       | -                   | -                            |
|                                                            | d.      | VSC                    | Lab/Practical -19        | 114277      | Course in Water Treatment Plant Operation                      | 2       | 4                   | 8                            |
|                                                            |         | SEC                    | -                        | 114278      | Field and Lab skills for Environmental quality analysis.       | 2       | 4                   |                              |
|                                                            | e.      | VEC                    | -                        | -           | -                                                              | -       | -                   | 0                            |
|                                                            | f.      | FP/CES                 | Project                  | 114228      |                                                                | 2       | 4                   | 4                            |
|                                                            |         | CC                     | -                        | -           | -                                                              | -       | -                   | -                            |
|                                                            |         | AI                     |                          |             |                                                                |         |                     |                              |
|                                                            |         | TOTAL                  |                          |             |                                                                | 22      | 34                  | 34                           |

Important:

- VSC Should be Complementary to Major

SEC has to be selected as per above T and L Scheme or from the Basket Provided by University, from the same Faculty/Discipline of the, Major/M

Sant Gadge Baba Amravati University, Amravati  
FACULTY: SCIENCE AND TECHNOLOGY  
Teaching and Learning Scheme: for the Degree of Bachelor of **Environmental Science**  
**Syllabus for Courses B.Sc. III**

**Major Theory -7: Fundamentals of Environmental Pollution and Control Technology**

| Level | Semester | Course Code | Course Name                                                                     | Credits | Teaching Hours | Exam Duration | Max Marks              |
|-------|----------|-------------|---------------------------------------------------------------------------------|---------|----------------|---------------|------------------------|
| 5.5   | V        | 114218      | Major Theory -7: Fundamentals of Environmental Pollution and Control Technology | 02      | 30             | 02 Hrs        | 30 (Ext.)<br>20 (Int.) |

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                         |                             |                                                                                                                                                                                                                               |  |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Course Objectives | <ul style="list-style-type: none"><li>To understand the fundamentals of environmental pollution.</li><li>To develop practical knowledge of sampling and preservation techniques.</li><li>To apply source correction and process control methods.</li><li>To recognize the role of urban planning in pollution control.</li><li>To develop environmental problem-solving and decision-making skills.</li></ul>                                                                                                                                                                                                                                                                                                                                       |                         |                             |                                                                                                                                                                                                                               |  |
| Course Outcome    | After the completion of this course, the student will be able to:<br><b>CO-1:</b> Understand the fundamental concepts of environmental pollution, its types, sources, effects, and environmental monitoring standards.<br><b>CO-2:</b> Apply techniques of environmental sampling and sample preservation for analyzing environmental quality parameters.<br><b>CO-3:</b> Identify and explain source correction methods and basic automation and process control techniques used in pollution control.<br><b>CO-4:</b> Understand the role of urban planning, green spaces, and sustainable infrastructure in controlling environmental pollution.<br><b>CO-5:</b> Analyze real-time case studies of environmental pollution control technologies. |                         |                             |                                                                                                                                                                                                                               |  |
| Unit System       | Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Workload Allotted (Hrs) | Weightage of marks allotted | Incorporation of Pedagogies                                                                                                                                                                                                   |  |
| Unit-I            | <b>Introduction to Environmental Pollution</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 8                       | 8                           | 1.Lecture-Cum-Discussion Method.<br>2.Problem-Based Learning.<br>3.Field Visits and Industrial Exposure.<br>4.Laboratory Demonstrations and Practical Training.<br><b>5.Project-Based Learning.</b><br>6.ICT-Enabled Teaching |  |
|                   | 1.1 Definition and types of environmental pollution.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                         |                             |                                                                                                                                                                                                                               |  |
|                   | 1.2 Environmental monitoring and standards (Air and Water).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                         |                             |                                                                                                                                                                                                                               |  |
|                   | 1.3 Techniques of Sampling Environmental Segments (Air and Water).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                         |                             |                                                                                                                                                                                                                               |  |
|                   | 1.4 Techniques of Sample Preservation (Air and Water).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                         |                             |                                                                                                                                                                                                                               |  |
| Unit-II           | <b>Correction and Process Control Techniques</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 7                       | 7                           |                                                                                                                                                                                                                               |  |
|                   | 2.1 Source Correction Methods: Process Modification, Raw Material Substitution.4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                         |                             |                                                                                                                                                                                                                               |  |
|                   | 2.2 Introduction to Automation and Process Control techniques: Need and Role.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                         |                             |                                                                                                                                                                                                                               |  |
|                   | 2.3 Feedback Control Method: Measures output continuously and corrects <b>Source</b> errors automatically. Feedforward Control Method: Predicts disturbances and takes corrective action before errors occur.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                         |                             |                                                                                                                                                                                                                               |  |
|                   | 2.4 Good Housekeeping Practices: Proper maintenance, leak prevention, and efficient handling of materials.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                         |                             |                                                                                                                                                                                                                               |  |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                      |   |   |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|--|
| Unit-III                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>Pollution Reduction Strategies</b><br>3.1 Techniques of Urban Planning in pollution control: Proper land-use zoning.                                              | 8 | 8 |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 3.2 Green Spaces and Afforestation                                                                                                                                   |   |   |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 3.3 Promotion of eco-friendly and energy-efficient infrastructure                                                                                                    |   |   |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 3.4 Development of public transport systems to reduce vehicle emissions                                                                                              |   |   |  |
| Unit-IV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>Applied Environmental Management: Indian Case Studies</b><br>4.1 Case Studies on Environmental Pollution Control Technology: Indore Solid Waste Management Model. | 7 | 7 |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 4.2 Delhi Air Pollution Control – CAAQMS Network                                                                                                                     |   |   |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 4.3 Tirupur Textile Industrial Pollution Control (Tamil Nadu)                                                                                                        |   |   |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 4.4 Chennai Rainwater Harvesting Initiative.                                                                                                                         |   |   |  |
| <b>References:</b><br><br>1. <b>Central Pollution Control Board (CPCB):</b> Environmental standards, monitoring guidelines, and pollution control reports.<br>2. <b>Ministry of Environment, Forest and Climate Change (MoEFCC):</b> Policies, environmental regulations, and sustainability initiatives.<br>3. <b>National Air Quality Monitoring Programme (NAMP):</b> Air monitoring methods and standards.<br>4. <b>Swachh Bharat Mission:</b> Information related to Indore solid waste management practices.<br>5. <b>Tamil Nadu Pollution Control Board (TNPCB):</b> Reference for Tirupur textile pollution control case study.<br>6. <b>Delhi CAAQMS network documents</b> and real-time portal resources. |                                                                                                                                                                      |   |   |  |
| <b>Model Questions</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                      |   |   |  |
| Short Type:<br><br>1. Define environmental pollution and list its major types.<br>2. What are the key environmental monitoring standards for air and water?<br>3. Briefly explain the need for sample preservation in water analysis.<br>4. What is raw material substitution in the context of source correction?<br>5. State the difference between feedback and feedforward control methods.<br>6. What are "Good Housekeeping Practices" in pollution control?<br>7. Explain the importance of green spaces in urban planning.<br>8. What is the fundamental concept behind the Chennai Rainwater Harvesting Initiative?                                                                                        |                                                                                                                                                                      |   |   |  |
| Long Type:<br><br>1. Discuss the various techniques of sampling and sample preservation for air and water quality analysis.<br>2. Explain source correction methods in detail, including process modification and raw material substitution with suitable examples.<br>3. Describe the role of urban planning in pollution reduction, emphasizing land-use zoning, eco-friendly infrastructure, and public transport systems.<br>4. Analyze the Indore Solid Waste Management Model as a successful case study for environmental pollution control in India.                                                                                                                                                        |                                                                                                                                                                      |   |   |  |
| MCQ<br>1. <b>Which of the following is the major source of air pollution in urban areas?</b><br>A. Agriculture B. Vehicular emissions, C. Afforestation, D. Fisheries<br><b>Answer:</b> B. Vehicular emissions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                      |   |   |  |

2. **BOD is mainly used to measure:**  
A. Soil fertility, B. Noise intensity, C. Organic pollution in water, D. Atmospheric pressure  
**Answer:** C. Organic pollution in water
3. **Device is commonly used to control particulate air pollutants?**  
A. Electrostatic precipitator, B. Incinerator, C. Chlorinator, D. Aerator  
**Answer:** A. Electrostatic precipitator
4. **The permissible limit of noise is measured in:**  
A. Pascal, B. Joule, C. Decibel, D. Newton, **Answer:** C. Decibel
5. **Treatment process mainly removes suspended solids from wastewater?**  
A. Primary treatment, B. Secondary treatment, , C. Tertiary treatment, D. Disinfection  
**Answer:** A. Primary treatment
6. **Acid rain is mainly caused by emissions of:**  
A. Oxygen and nitrogen, B. Sulphur dioxide and nitrogen oxides, C. Carbon monoxide and methane  
D. Hydrogen and helium  
**Answer:** B. Sulphur dioxide and nitrogen oxides
7. **The process of converting waste materials into reusable materials is called:**  
A. Incineration, B. Recycling, C. Landfilling, D. Composting, **Answer:** B. Recycling .
8. **Which law in India primarily deals with prevention and control of water pollution?**  
A. Wildlife Protection Act, 1972, B. Environment Protection Act, 1986, C. Water (Prevention and Control of Pollution) Act, 1974  
D. Forest Conservation Act, 1980

**Rubric for Internal Assessment for Major Theory Paper**

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI

**Internal Assessment B.Sc- III SEMESTER – V (NEP)**

|                 |                                                                                              |               |
|-----------------|----------------------------------------------------------------------------------------------|---------------|
| Code:<br>114218 | Paper: Major Theory 7: <b>Fundamentals of Environmental Pollution and Control Technology</b> | Max Marks: 20 |
| Sr. No.         | Assessment Criteria                                                                          | Marks         |
| 1               | Attendance                                                                                   | 05            |
| 2               | Class Assignments                                                                            | 05            |
| 3               | Unit Test - MCQ                                                                              | 05            |
| 4               | Overall Performance / Seminar / Case Study                                                   | 05            |

### Major Theory 8: Air and Water Pollution Control Technology

| Level | Course Code | Semester | Course Name                                                | Credit | Teaching Hours | Exam Duration | Max. Marks             |
|-------|-------------|----------|------------------------------------------------------------|--------|----------------|---------------|------------------------|
| 5.5   | V           | 114219   | Major Theory 8: Air and Water Pollution Control Technology | 02     | 30             | 02 Hrs        | 30 (Ext.)<br>20 (Int.) |

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                         |                             |                                                                                                                                                                                                                                                                      |
|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course Objectives | <ol style="list-style-type: none"><li>1. To understand air pollution and particulate control technologies.</li><li>2. To learn control techniques for gaseous and vehicular emissions.</li><li>3. To gain knowledge of wastewater characteristics and treatment methods.</li><li>4. To develop an understanding of biological wastewater treatment and sludge management.</li><li>5. To develop the ability to select appropriate pollution control technologies for varying environmental contexts</li></ol>                                                                                                                                                                                                                                                                                                           |                         |                             |                                                                                                                                                                                                                                                                      |
| Course Outcome    | After the completion of this course, the student will be able to:<br><b>CO-1:</b> Describe sources, types, and impacts of air pollutants and particulate matter.<br><b>CO-2:</b> Explain working principles and compare the efficiency of different air pollution control devices.<br><b>CO-3:</b> Analyze control methods for gaseous pollutants and automobile emissions.<br><b>CO-4:</b> Describe physical and chemical wastewater treatment processes and their real-world applications.<br><b>CO-5:</b> Explain biological treatment processes including aerobic and anaerobic systems.<br><b>CO-6:</b> Demonstrate knowledge of sludge treatment, stabilization, and safe disposal methods.<br><b>CO-7:</b> Select suitable and sustainable pollution control technologies for different environmental scenarios. |                         |                             |                                                                                                                                                                                                                                                                      |
| Unit System       | Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Workload Allotted (Hrs) | Weightage of marks allotted | Incorporation of Pedagogies                                                                                                                                                                                                                                          |
| Unit-I            | <b>Air Quality Management and Particulate Control</b><br>1.1 Sources and types of air pollutants.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 8                       | 8                           | Lecture Method<br>• Demonstration Method<br>• Experiential Learning<br>• Project-Based Learning<br>• Case Study Method<br>• Collaborative Learning<br>• Problem-Solving Method<br>• ICT-Enabled Learning<br>• Flipped Classroom Approach<br>• Outcome-Based Learning |
|                   | 1.2 Definition, source and classification of particulate matter.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                         |                             |                                                                                                                                                                                                                                                                      |
|                   | 1.3 Particulate Control Device - Gravity settling Chamber, Cyclone Separator, Electrostatic Precipitators                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                         |                             |                                                                                                                                                                                                                                                                      |
|                   | 1.4 Particulate Control Device - Fabric Filter, Venturi Scrubber                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                         |                             |                                                                                                                                                                                                                                                                      |
| Unit-II           | <b>Gaseous Pollutants and Vehicular Emission Control Techniques</b><br>2.1 Source and types of gaseous pollutants.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 7                       | 7                           |                                                                                                                                                                                                                                                                      |
|                   | 2.2 Flaring and Thermal Incineration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                         |                             |                                                                                                                                                                                                                                                                      |
|                   | 2.3 Control of other gaseous pollutants: Oxides of Sulphur and Volatile Organic Compounds.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                         |                             |                                                                                                                                                                                                                                                                      |
|                   | 2.4 Control of Automobile Exhaust Emission                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                         |                             |                                                                                                                                                                                                                                                                      |
| Unit-III          | <b>Physical and Chemical Treatments of Wastewater</b><br>3.1 Sources and characteristics of water pollutants.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 8                       | 8                           |                                                                                                                                                                                                                                                                      |
|                   | 3.2 Water Pollution Control Techniques: Pre-treatments, Aeration and Neutralization                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                         |                             |                                                                                                                                                                                                                                                                      |
|                   | 3.3 Physical Treatments: Screening and sedimentation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                         |                             |                                                                                                                                                                                                                                                                      |
|                   | 3.4 Chemical treatment methods: Coagulation, Flocculation and Chlorination.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                         |                             |                                                                                                                                                                                                                                                                      |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                  |   |   |  |
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| Unit-IV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 4.1 <b>Biological Treatment and Sludge Management</b><br>4.1 Biological treatment: Aerobic Process, activated sludge process, trickling filters. | 7 | 7 |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 4.2 Biological treatment: Upflow Anaerobic Sludge Blanket (UASB)                                                                                 |   |   |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 4.3 Definition and types of sludge, Thickening and dewatering                                                                                    |   |   |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 4.4 Stabilization and safe disposal Method.                                                                                                      |   |   |  |
| <b>References</b><br><br>1. M. N. Rao and H. V. N. Rao, <i>Air Pollution</i> , Tata McGraw-Hill Education, New Delhi.<br>2. S. K. Garg, <i>Environmental Engineering (Vol. I &amp; II)</i> , Khanna Publishers, New Delhi.<br>3. P. N. Modi, <i>Environmental Engineering</i> , Standard Book House, New Delhi.<br>4. B. K. Sharma, <i>Environmental Chemistry</i> , Krishna Prakashan Media Pvt. Ltd., Meerut.<br>5. C. S. Rao, <i>Environmental Pollution Control Engineering</i> , Wiley Eastern Ltd., New Delhi.<br>6. K. V. S. G. Murali Krishna, <i>Environmental Engineering and Technology</i> , BS Publications, Hyderabad.<br>7. Howard S. Peavy, Donald R. Rowe and George Tchobanoglous, <i>Environmental Engineering</i> , Tata McGraw-Hill Education                  |                                                                                                                                                  |   |   |  |
| <b>Model Questions</b><br>Short Type:<br><br>1. Define air pollution and list the major sources of air pollutants.<br>2. What are air quality standards? Explain any one air quality monitoring technique.<br>3. Explain the working principle of a cyclone separator.<br>4. Describe the working principle of a bag filter used for particulate control.<br>5. Differentiate between adsorption and absorption methods for gaseous pollutant control.<br>6. What is coagulation in water treatment? State its purpose.<br>7. Explain the activated sludge process used in wastewater treatment.<br>8. Define sludge and mention the different types of sludge formed in wastewater treatment plants                                                                                |                                                                                                                                                  |   |   |  |
| Long Type:<br><br>1. Explain the sources, types, and effects of air pollutants along with air quality standards and monitoring techniques.<br>2. Describe the construction and working principles of cyclone separators and bag filters used for particulate emission control.<br>3. Discuss the methods used for gaseous pollutant control through adsorption, absorption, electrostatic precipitators, and scrubbers.<br>4. Explain the physical and chemical methods used in water pollution control including screening, sedimentation, filtration, coagulation, neutralization, and disinfection.<br>5. Describe the biological and industrial wastewater treatment methods including activated sludge process, trickling filters, ion exchange process, and sludge management |                                                                                                                                                  |   |   |  |
| MCQ<br><br>1. The device commonly used for removing large particulate matter from industrial gases is: (a) Scrubber (b) Cyclone separator (c) Electrostatic precipitator (d) Absorber ( <i>Ans: b</i> )<br>2. Bag filters are mainly used for controlling: (a) Noise pollution (b) Water pollution (c) Particulate pollutants (d) Thermal pollution ( <i>Ans: c</i> )<br>3. In adsorption, pollutants are removed by: (a) Chemical burning (b) Dissolving in liquid (c) Adhering on the surface of solids (d) Sedimentation ( <i>Ans: c</i> ).<br>4. <b>Which equipment is commonly used to remove fine particulate matter from industrial exhaust gases?</b><br>A. Sedimentation tank<br>B. Electrostatic precipitator                                                             |                                                                                                                                                  |   |   |  |

|    |                                                                                     |
|----|-------------------------------------------------------------------------------------|
|    | C. Aeration tank                                                                    |
|    | D. Septic tank                                                                      |
|    | <b>Answer:</b> B. Electrostatic precipitator                                        |
| 5. | <b>Chlorination in water treatment is mainly used for:</b>                          |
|    | A. Removal of suspended solids                                                      |
|    | B. Reduction of water hardness                                                      |
|    | C. Disinfection of water                                                            |
|    | D. Removal of bad odor only                                                         |
|    | <b>Answer:</b> C. Disinfection of water                                             |
| 6. | <b>Which air pollutant is mainly responsible for photochemical smog?</b>            |
|    | A. Sulphur dioxide                                                                  |
|    | B. Carbon dioxide                                                                   |
|    | C. Nitrogen oxides                                                                  |
|    | D. Hydrogen sulphide                                                                |
|    | <b>Answer:</b> C. Nitrogen oxides                                                   |
| 7. | <b>Activated sludge process is a method of:</b>                                     |
|    | A. Air pollution control                                                            |
|    | B. Primary wastewater treatment                                                     |
|    | C. Secondary biological wastewater treatment                                        |
|    | D. Solid waste disposal                                                             |
|    | <b>Answer:</b> C. Secondary biological wastewater treatment                         |
| 8. | <b>Which of the following devices is used to measure dissolved oxygen in water?</b> |
|    | A. pH meter                                                                         |
|    | B. Spectrophotometer                                                                |
|    | C. DO meter                                                                         |
|    | D. Nephelometer                                                                     |
|    | <b>Answer:</b> C. DO meter .                                                        |

#### Rubric for Internal Assessment for Major Theory Paper

| SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI |                                                                          |               |
|-----------------------------------------------|--------------------------------------------------------------------------|---------------|
| Internal Assessment                           |                                                                          |               |
| B.Sc.- III SEMESTER – V (NEP)                 |                                                                          |               |
| Code:<br>11429                                | Paper: Major Theory 8: <b>Air and Water Pollution Control Technology</b> | Max Marks: 20 |
| Sr. No.                                       | Assessment Criteria                                                      | Marks         |
| 1                                             | Attendance                                                               | 05            |
| 2                                             | Class Assignments                                                        | 05            |
| 3                                             | Unit Test - MCQ                                                          | 05            |
| 4                                             | Overall Performance / Seminar / Case Study                               | 05            |

### Major Theory 9: Integrated Waste Management

| Level | Semester | Course Code | Course Name                                 | Credits | Teaching Hours | Exam Duration | Max Marks             |
|-------|----------|-------------|---------------------------------------------|---------|----------------|---------------|-----------------------|
| 5.5   | V        | 114220      | Major Theory 9: Integrated Waste Management | 2       | 30             | 2 Hrs         | 30(Ext.)<br>20 (Int.) |

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |
|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Course Objectives | 1. To understand the fundamentals of solid and hazardous waste.<br>2. To study waste segregation, collection, and transportation methods.<br>3. To learn waste treatment and recycling technologies.<br>4. To understand biomining and resource recovery techniques.<br>5. To enhance practical skills and job opportunities in the waste management sector.                                                                                                                    |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |
| Course Outcome    | After the completion of this course, students will be able to:<br><b>CO-1:</b> Understand the types and characteristics of waste.<br><b>CO-2:</b> Gain basic technical knowledge of waste management technologies.<br><b>CO-3:</b> Apply recycling and biomining techniques for waste treatment.<br><b>CO-4:</b> Interpret waste management rules and environmental safety measures.<br><b>CO-5:</b> Develop employability skills in waste management and environmental sectors |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |
| Unit System       | Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Workload Allotted (Hrs) | Weightage of marks allotted | Incorporation of Pedagogies                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |  |
| Unit-I            | <b>Fundamentals of Solid Waste Management</b><br>1.1 Definition, concept and importance of solid waste management.                                                                                                                                                                                                                                                                                                                                                              | 8                       | 8                           | <ul style="list-style-type: none"><li>• Use of charts, diagrams, models, and PPTs for effective teaching.</li><li>• Group discussions, seminars, assignments, and case studies on waste management issues.</li><li>• Demonstration of composting, vermicomposting, and waste segregation techniques.</li><li>• Experiential learning through visits to landfill sites, recycling units, and waste treatment plants.</li><li>• Project-based learning through waste audits, surveys, and recycling activities.</li><li>• ICT-enabled teaching using videos,</li></ul> |  |
|                   | 1.2 Sources and characteristics of solid waste (Physical, Chemical and Biological).                                                                                                                                                                                                                                                                                                                                                                                             |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |
|                   | 1.3 Segregation at source and colour coding system                                                                                                                                                                                                                                                                                                                                                                                                                              |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |
|                   | 1.4 Improper waste disposal and their effects.                                                                                                                                                                                                                                                                                                                                                                                                                                  |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |
| Unit-II           | <b>Solid Waste Treatment and Resource Recovery Technology</b><br>2.1 Vermicomposting technology and applications.                                                                                                                                                                                                                                                                                                                                                               | 7                       | 7                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |
|                   | 2.2 Biogas production.                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |
|                   | 2.3 Sanitary landfill method and Concept of leachate management                                                                                                                                                                                                                                                                                                                                                                                                                 |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |
|                   | 2.4 Bio-mining Technology: concept and advantages.                                                                                                                                                                                                                                                                                                                                                                                                                              |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |
| Unit-III          | <b>3.1Hazardous Waste, Biomedical Waste and E-Waste Management</b><br>3.1 Definition, sources, and classification of hazardous waste.                                                                                                                                                                                                                                                                                                                                           | 8                       | 8                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |
|                   | 3.2 Biomedical Waste: Definition, composition, and classification.                                                                                                                                                                                                                                                                                                                                                                                                              |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |
|                   | 3.3 Incineration and Pyrolysis                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |
|                   | 3.4 E-Waste: Definition, sources, and Concept of its management                                                                                                                                                                                                                                                                                                                                                                                                                 |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |
| Unit-IV           | <b>4.1 Environmental Laws, Management Practices and Emerging Opportunities</b><br>4.1 Objectives and important provisions of –                                                                                                                                                                                                                                                                                                                                                  | 7                       | 7                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                        |  |  |                                                                                                                                                                         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Municipal Solid Waste Management Rules, 2016 - and Biomedical Waste Management Rules, 2026<br>4.2 E-Waste Management Rules<br>4.3 Integrated Solid Waste Management (ISWM); Green technologies and sustainable waste management approaches<br>4.4 Entrepreneurship Opportunities in Waste Management & Green Startups. |  |  | documentaries, and online resources. (Pedagogies as mentioned above are integrated across all course units to foster deeper understanding and practical applicability). |
| <b>References</b> <ol style="list-style-type: none"> <li>1. <i>Integrated Solid Waste Management</i> – George Tchobanoglous, Hilary Theisen, and Samuel Vigil, McGraw Hill Publication.</li> <li>2. <i>Solid Waste Management</i> – M. N. Rao and H. V. N. Rao, CBS Publishers &amp; Distributors.</li> <li>3. <i>Environmental Engineering</i> – Howard S. Peavy, Donald R. Rowe, and George Tchobanoglous, McGraw Hill.</li> <li>4. <i>Environmental Pollution and Control</i> – C. S. Rao, Wiley Eastern Ltd.</li> <li>5. <i>Hazardous Waste Management</i> – Michael D. LaGrega, Phillip L. Buckingham, and Jeffrey C. Evans, Waveland Press.</li> <li>6. <i>Biomedical Waste Management</i> – J. K. Barua and H. P. Gurtoo.</li> <li>7. <i>E-Waste Management</i> – S. R. Johri, TERI Press.</li> </ol>                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                        |  |  |                                                                                                                                                                         |
| <b>Model Questions</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                        |  |  |                                                                                                                                                                         |
| Short Type: <ol style="list-style-type: none"> <li>1. Define solid waste and mention its types.</li> <li>2. Differentiate between biodegradable and non-biodegradable waste.</li> <li>3. What is waste segregation? Explain the colour coding system.</li> <li>4. Write a short note on the environmental impacts of solid waste.</li> <li>5. Explain the principle of composting.</li> <li>6. What is vermicomposting? Mention its advantages.</li> <li>7. Define biomethanation and write its applications.</li> <li>8. What is biomining technology? State its advantages.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                        |  |  |                                                                                                                                                                         |
| Long Type: <ol style="list-style-type: none"> <li>1. Explain the sources, types, and characteristics of solid waste.</li> <li>2. Discuss the environmental and public health impacts caused by improper waste disposal.</li> <li>3. Describe various methods of waste segregation, collection, and transportation.</li> <li>4. Explain the importance of the 3R principles in solid waste management.</li> <li>5. Discuss solid waste treatment technologies including composting, vermicomposting, biomethanation, incineration, and the sanitary landfill method.</li> <li>6. Explain biomining technology in detail with its process, advantages, and role in sustainable waste management.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                        |  |  |                                                                                                                                                                         |
| MCQ <ol style="list-style-type: none"> <li>1. Solid waste management mainly deals with: a) Water purification b) Handling of gaseous waste c) Collection, transport, treatment, and disposal of waste d) Mining activities</li> <li>2. Biomedical waste is mainly generated from: a) Agricultural fields b) Hospitals and clinics c) Construction sites d) Industries</li> <li>3. Which colour bin is generally used for biodegradable waste? a) Blue b) Red c) Green d) Black</li> <li>4. Vermicomposting uses: a) Bacteria b) Earthworms c) Fungi d) Algae</li> <li>5. Biomining technology is mainly used for: a) Mining coal b) Cleaning old landfill waste c) Water purification d) Oil extraction</li> <li>6. Which gas is mainly produced during biomethanation? a) Oxygen b) Nitrogen c) Methane d) Hydrogen</li> <li>7. E-waste includes discarded: a) Food materials b) Electronic devices c) Paper waste d) Agricultural waste</li> <li>8. The 3R principle stands for: a) Reduce, Reuse, Recycle b) Recover, Remove, Replace c) Rebuild, Restore, Recycle d) Reduce, Recover, Return</li> </ol> |                                                                                                                                                                                                                                                                                                                        |  |  |                                                                                                                                                                         |

| <b>Rubric for Internal Assessment for Major Theory Paper</b><br><b>SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI</b><br><b>Internal Assessment</b><br><b>B.Sc.- III SEMESTER – V (NEP)</b> |                                             |               |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|---------------|
| Code:<br>114220                                                                                                                                                                            | Major Theory 9: Integrated Waste Management | Max Marks: 20 |
| Sr. No.                                                                                                                                                                                    | Assessment Criteria                         | Marks         |
| 1                                                                                                                                                                                          | Attendance                                  | 05            |
| 2                                                                                                                                                                                          | Class Assignments                           | 05            |
| 3                                                                                                                                                                                          | Unit Test - MCQ                             | 05            |
| 4                                                                                                                                                                                          | Overall Performance / Seminar / Case Study  | 05            |

**Lab/Practical: Based on Major Theory -7,8 & 9**

| Level | Semester | Course Code | Course Name                                     | Credits | Teaching Hours | Exam Duration | Max Marks             |
|-------|----------|-------------|-------------------------------------------------|---------|----------------|---------------|-----------------------|
| 5.5   | V        | 114221      | Lab/Practical: Based on 114218, 114219 & 114220 | 2       | 60             | 4 Hrs         | 25(Ext.)<br>25 (Int.) |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
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| Course Objectives                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <ul style="list-style-type: none"> <li>To understand the techniques of sampling and controlling environmental pollution.</li> <li>To handle, operate, and demonstrate air and water quality monitoring equipment.</li> <li>To study the composition, physical characteristics, and management practices of solid, hazardous, and e-waste.</li> <li>To evaluate eco-friendly building materials, energy-efficient infrastructure, and transportation impacts.</li> <li>To gain experiential learning through field visits to industries, water treatment plants, and waste management facilities.</li> </ul>     |
| Course Outcome                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <p>After the completion of this course, students will be able to:</p> <p><b>CO-1:</b> Execute practical performance on sampling and control techniques in environmental pollution control</p> <p><b>CO-2:</b> Perform Air Quality Monitoring and Air Pollution Analysis experiments.</p> <p><b>CO-3:</b> Conduct Water Quality Monitoring and Water Pollution Analysis experiments.</p> <p><b>CO-4:</b> Classify, analyze, and execute experiments on hazardous waste, solid waste, and e-waste.</p> <p><b>CO-5:</b> Prepare comprehensive case studies and reports based on field visits and waste audits.</p> |
| <p><b>A. Experiments on Air &amp; Water Pollution Control:</b></p> <ol style="list-style-type: none"> <li>1. Practical Performance on Sampling and Control Techniques in Environmental Pollution control.</li> <li>2. Study of air quality monitoring instruments and measurement of air pollutants.</li> <li>3. Determination of particulate matter concentration in ambient air using a high-volume air sampler.</li> <li>4. Determination of chlorine demand and disinfection of water samples.</li> <li>5. Determination of smoke density of local area.</li> <li>6. Grab and composite sampling methods.</li> <li>7. Preservation of water samples for laboratory analysis.</li> <li>8. Survey of industrial Good Housekeeping practices.</li> </ol> <p><b>B. Air and Water Pollution Control Technology</b></p> <ol style="list-style-type: none"> <li>1. Study of Urban Land Use Mapping of industrial/ residential/ green zones.</li> <li>2. Survey of roadside plantations/urban green spaces.</li> <li>3. Observation and study of green buildings and renewable energy systems.</li> </ol> <p><b>c. Experiments on Solid, Hazardous &amp; E-Waste Management:</b></p> <ol style="list-style-type: none"> <li>1. Identification and classification of different types of solid waste.</li> <li>2. To study of physical characteristics of municipal solid waste.</li> <li>3. To study comparative characteristics of solid waste from different polluted sites of local area</li> <li>4. Perform solid waste audit of college campus or household.</li> <li>5. To study of E-waste components.</li> </ol> <p><b>D. Eco-friendly Infrastructure &amp; Surveys:</b></p> <ol style="list-style-type: none"> <li>1. Study of eco-friendly building materials and energy-efficient infrastructure.</li> <li>2. Comparative study of public and private transport pollution impact.</li> </ol> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <p><b>Field Visits &amp; Project Work:</b></p> <ol style="list-style-type: none"> <li>1. Preparation of project report on successful environmental pollution control initiatives in India / case study / solid waste management practices in local area.</li> <li>2. Field visit to a drinking water treatment plant or sewage / effluent treatment plant (STP/ETP).</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

3. Field visit to an industry for observing air pollution control equipment.
4. Visit to solid waste management facility or recycling plant.

## References

### □ **Standard Methods for the Examination of Water and Wastewater**

Published by the American Public Health Association.

Widely used laboratory manual for water and wastewater analysis.

### □ **Manual on Water and Wastewater Analysis**

Published by National Environmental Engineering Research Institute.

Useful for practical methods in environmental monitoring.

### □ **Environmental Engineering Laboratory Manual**

Covers experiments on air, water, and soil pollution analysis techniques.

### □ **Wastewater Engineering: Treatment and Resource Recovery** by George Tchobanoglous and co-authors.

Standard reference for wastewater treatment technologies and laboratory applications.

### □ **Introduction to Environmental Engineering and Science** by Gilbert M. Masters.

Includes practical approaches to pollution control and waste management.

### □ **Environmental Pollution Control Engineering** by C. S. Rao.

Useful for laboratory procedures and pollution control technologies.

### □ **Laboratory Manual for Environmental Chemistry**

Includes analytical methods for environmental sample testing.

### □ **Central Pollution Control Board (CPCB) Laboratory Guidelines and Manuals**

Provides protocols for:

- Air quality monitoring
- Water analysis
- Hazardous waste handling
- Environmental standards

### □ **United States Environmental Protection Agency (USEPA) Methods and Training Manuals**

Important source for pollution monitoring and waste management methodologies.

### □ **Environmental Engineering**

Covers laboratory principles related to pollution control systems.

### □ **Handbook of Solid Waste Management**

Useful for practical aspects of municipal and hazardous waste management.

### □ **Air Pollution Control Engineering** by Noel de Nevers.

Comprehensive guide to air pollution monitoring and control equipment.

### □ **Environmental Biotechnology: Principles and Applications**

Useful for bioremediation and biological waste treatment practicals.

### □ **Bureau of Indian Standards (BIS) Manuals and Standards**

Reference methods for environmental sampling and analysis.

### □ **Practical Environmental Analysis**

Includes practical exercises in pollution assessment and environmental monitoring.

### □ **Central Pollution Control Board (CPCB) Laboratory Resources**

Provides laboratory guidelines, monitoring protocols, instruments, and environmental analysis resources for air, water, and waste samples.

### □ **CPCB Water Laboratory Resources**

Includes QA/QC procedures, NABL-accredited parameters, analytical methods, and laboratory formats for water and wastewater analysis.

### □ **US EPA – Clean Water Act Analytical Methods**

Official analytical methods for wastewater and environmental sample analysis under the Clean Water Act. Useful for advanced laboratory practicals and environmental monitoring.

### □ **US EPA – Approved Chemical Test Methods**

Contains standardized procedures for chemical analysis of wastewater, sludge, and environmental samples.

### □ **US EPA – Approved Microbiological Test Methods**

Useful resource for microbiological examination of water and wastewater samples.

### □ **US EPA – Find a Water Laboratory Method**

Helps identify analytical methods for environmental remediation and water quality testing.

### □ **Environmental Engineering Laboratory Manual (NIT Mizoram PDF)**

Academic laboratory manual covering environmental engineering experiments and practical procedures.

|                          |                                                                                                                               |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| <input type="checkbox"/> | <b><u>Environmental Chemical Analysis Laboratory Manual</u></b>                                                               |
|                          | Includes environmental chemistry experiments, laboratory calculations, report writing, and analytical techniques.             |
| <input type="checkbox"/> | <b><u>NEERI Reference on Water and Wastewater Analysis</u></b>                                                                |
|                          | Reference information related to the classic NEERI manual widely used in environmental laboratories in India.                 |
| <input type="checkbox"/> | <b><u>CPCB Laboratory Information Management System (LIMS)</u></b>                                                            |
|                          | Provides information on CPCB laboratory divisions including air, water, bioscience, and instrumentation laboratories.         |
| <input type="checkbox"/> | <b><u>National Environmental Engineering Research Institute (NEERI)</u></b>                                                   |
|                          | Official research organization involved in environmental monitoring, pollution control technologies, and laboratory research. |
| <input type="checkbox"/> | <b><u>NCERT Science Laboratory Manuals</u></b>                                                                                |
|                          | Useful supplementary laboratory manuals for basic environmental and science practical skills.                                 |
| <input type="checkbox"/> | <b><u>APHA Standard Methods Information</u></b>                                                                               |
|                          | Internationally accepted standard methods for examination of water and wastewater.                                            |
| <input type="checkbox"/> | <b><u>Bureau of Indian Standards (BIS)</u></b>                                                                                |
|                          | Indian standards and protocols related to environmental sampling and analysis.                                                |
| <input type="checkbox"/> | <b><u>SWM Rules and Manuals – Ministry of Environment, Forest and Climate Change</u></b>                                      |
|                          | Digital resources related to solid waste management rules, manuals, and environmental regulations in India                    |

#### Assessment Rubric for Internal Assessment for Major Practical

|                 |                                                                                                                                                |                  |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| I               | SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI<br><b>Internal Assessment for Lab Work</b><br>B.Sc.III (Environmental Science) SEMESTER– V (NEP) |                  |
| Code:<br>114221 | Lab/Practical: Based on 114218, 114219 & 114220                                                                                                | Max<br>Marks: 25 |
| <b>Sr. No.</b>  | <b>Assessment Criteria</b>                                                                                                                     | <b>Marks</b>     |
| 1               | Active Participation and Performance of Practical                                                                                              | 10               |
| 2               | MCQ Test                                                                                                                                       | 05               |
| 3               | Field Visit Report / Assignment                                                                                                                | 05               |
| 4               | Attendance                                                                                                                                     | 05               |
|                 | Total                                                                                                                                          | 25               |

#### Assessment Rubric for External Assessment for Major Practical

|                       |                                                                                                                                                |                                  |
|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|
| E                     | SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI<br><b>External Assessment for Lab Work</b><br>B.Sc .III(Environmental Science) SEMESTER– V (NEP) |                                  |
| Course<br>Code:114221 | Lab/Practical: Based on 114218, 114219 & 114220                                                                                                | Max Marks:<br>25, ime:<br>4Hours |
| <b>Sr. No.</b>        | <b>Assessment Criteria</b>                                                                                                                     | <b>Marks</b>                     |
| 1                     | Any one experiment on Practical on <b>Environmental Pollution and Control Technology</b>                                                       | 06                               |
| 2                     | Any one experiment on <b>Air and Water Pollution Control Technology</b>                                                                        | 06                               |
| 3                     | Any one experiment on <b>Solid Waste and Hazardous Waste Management Technology</b>                                                             | 06                               |
| 5                     | Lab Journal / Practical Record Book                                                                                                            | 03                               |
| 6                     | Viva-Voce                                                                                                                                      | 04                               |

**Major Elective-1: Fundamentals of Health, Safety and Environment**

| Level | Course Code | Semester | Course Name                                                        | Credit | Teaching Hours | Exam Duration | Max. Marks         |
|-------|-------------|----------|--------------------------------------------------------------------|--------|----------------|---------------|--------------------|
| 5.5   | 114222      | V        | Major Elective-1<br>Fundamentals of Health, Safety and Environment | 02     | 30             | 02            | 30 Ext.<br>20 Int. |

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                         |                             |                                                                                                                                                                                                                        |
|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course Objectives | <div>1. Introduce students to the fundamental concepts and importance of Health, Safety and Environment (HSE).</div> <div>2. Develop awareness about occupational health, personal hygiene and workplace hazards.</div> <div>3. Provide knowledge of safety practices, Personal Protective Equipment (PPE) and accident prevention methods.</div> <div>4. Familiarize students with first aid, emergency response and fire safety procedures.</div> <div>5. Create understanding about safe handling and storage of hazardous substances and workplace sanitation.</div>                                                                                                                                                                          |                         |                             |                                                                                                                                                                                                                        |
| Course Outcome    | After successful completion of the course, students will be able to:<br><br>CO1 - Understand the basic concepts, scope and significance of Health, Safety and Environment (HSE) in daily life and workplaces.<br>CO2 - Identify different types of occupational hazards, occupational diseases and preventive health and safety measures.<br>CO3 - Demonstrate knowledge of Personal Protective Equipment (PPE), first aid, emergency response and accident prevention practices.<br>CO4- Apply basic safety procedures related to fire safety, electrical safety, laboratory safety and hazardous substance handling.<br>CO5- Develop awareness about environmental conservation, waste management and sustainable practices for healthy living. |                         |                             |                                                                                                                                                                                                                        |
| Unit System       | Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Workload Allotted (Hrs) | Weightage of marks allotted | Incorporation of Pedagogies                                                                                                                                                                                            |
| Unit-I            | <b>Introduction to Health, Safety and Environment:</b><br>1.1 Concept, scope and importance of Health, Safety and Environment (HSE).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 8                       | 8                           | 1-Lecture Method.<br>2- Interactive Teaching;<br>3- Demonstration Method.<br>4- Laboratory/Practical-Based Learning..<br>5- Field Visits / Industrial Visits.<br>6- Problem-Based Learning.<br>7- ICT-Enabled Teaching |
|                   | 1.2 Occupational health and personal hygiene                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                         |                             |                                                                                                                                                                                                                        |
|                   | 1.3 Types of workplace hazards – physical, chemical, biological and ergonomic hazards.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                         |                             |                                                                                                                                                                                                                        |
|                   | 1.4 Principles of safety, health protection and sustainable living.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                         |                             |                                                                                                                                                                                                                        |
| Unit-II           | <b>Basic Health and Safety Practices</b><br>2.1 Occupational diseases and their prevention.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 7                       | 7                           |                                                                                                                                                                                                                        |
|                   | 2.2 Personal Protective Equipment (PPE): types and applications.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                         |                             |                                                                                                                                                                                                                        |
|                   | 2.3 First aid, emergency care and accident prevention methods                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                         |                             |                                                                                                                                                                                                                        |
|                   | 2.4 Workplace sanitation, cleanliness and employee well-being.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                         |                             |                                                                                                                                                                                                                        |
| Unit-III          | <b>Safety Awareness and Hazard Control</b><br>3.1 Safety signs, symbols and hazard communication.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 8                       | 8                           |                                                                                                                                                                                                                        |
|                   | 3.2 Fire safety and evacuation procedures.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                         |                             |                                                                                                                                                                                                                        |
|                   | 3.3 Electrical and laboratory safety basics.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                         |                             |                                                                                                                                                                                                                        |

|         |                                                                                                               |   |   |  |
|---------|---------------------------------------------------------------------------------------------------------------|---|---|--|
|         | 3.4 Safe handling and storage of hazardous substances.                                                        |   |   |  |
| Unit-IV | <b>Safe handling and storage of hazardous substances.</b>                                                     | 7 | 7 |  |
|         | <b>4.1</b> Classification and identification of hazardous substances and chemical hazards.                    |   |   |  |
|         | <b>4.2</b> Safe handling and labeling, practices for hazardous chemicals and materials.                       |   |   |  |
|         | <b>4.3</b> Transportation and storage practices for hazardous chemicals and materials.                        |   |   |  |
|         | <b>4.4</b> Hazardous waste management, environmental protection measures and relevant safety laws/regulations |   |   |  |

#### References

1. **Environmental Science** — by G. Tyler Miller and Scott Spoolman
2. **Environmental Studies** — by Benny Joseph
3. **Textbook of Environmental Studies** — by Erach Bharucha
4. **Environmental Chemistry** — by A. K. De
5. **Environmental Toxicology** — by A. K. De
6. **Introduction to Environmental Engineering and Science** — by Gilbert M. Masters and Wendell P. Ela
7. **Environmental Pollution and Control** — by J. Jeffrey Peirce, P. Aarne Vesilind and Ruth F. Weiner
8. **Principles of Environmental Science** — by William P. Cunningham and Mary Ann Cunningham .
  - a. Environmental Studies – Bharucha, E. (2021). *Environmental Studies for Undergraduate Courses*. Universities Press, Hyderabad.
  - b. Occupational Health and Safety Management – Reese, C. D. (2018). *Occupational Health and Safety Management: A Practical Approach*. CRC Press.
  - c. Industrial Safety Management – Deshmukh, L. M. (2019). *Industrial Safety Management*. McGraw Hill Education, New Delhi.
  - d. Introduction to Safety Engineering – Krishnan, N. V. (2020). *Safety Engineering and Management*. Jaico Publishing House.
  - e. International Labour Organization – *Occupational Safety and Health Guidelines and Standards*.
  - f. World Health Organization – *Environmental Health and Occupational Health Guidelines*.
  - g. Fundamentals of Industrial Safety and Health – Friend, M. A. & Kohn, J. P. (2018). *Fundamentals of Occupational Safety and Health*. Rowman & Littlefield Publishers.
  - h. Environmental Science – Miller, G. T. & Spoolman, S. (2019). *Environmental Science*. Cengage Learning.
9. Safety, Health and Environment – Gupta, A. K. (2017). *Safety, Health and Environment Management*. University Science Press.
10. National Safety Council – Manuals and guidelines on industrial safety, health and environment management

#### Model Questions

##### A) Long Answer Questions

1. Explain the concept, scope and importance of Health, Safety and Environment (HSE) framework.
2. Describe the principles and components of HSE management systems in detail.
3. Discuss the relationship between environment and human health with suitable examples.
4. Explain environmental toxicology and describe the pathways of toxic substances in the environment.
5. What is bioaccumulation and biomagnification? Discuss their ecological and human health impacts.
6. Describe different types and sources of environmental pollutants and their effects on ecosystems.
7. Explain the methods of environmental risk assessment and hazard identification.
8. Discuss air, water, soil and noise pollution along with their prevention and control measures.
9. Explain ambient environmental quality standards and their importance in environmental protection.
10. Discuss sustainable infrastructure and green building concepts in environmental management.

#### Short Answer Questions

##### Paper I: Health, Safety and Environment – I

1. Define Health, Safety and Environment (HSE).
2. What are the main objectives of HSE management?
3. Define environmental toxicology.
4. What is toxicity?

5. Differentiate between bioaccumulation and biomagnification.
6. What are primary and secondary pollutants?
7. Define environmental risk assessment.
8. What are ambient air quality standards?
9. Write a short note on renewable energy resources.
10. What is sustainable development?

#### MCQ

1. HSE stands for: (a) Health, Safety and Energy (b) Health, Safety and Environment (c) Human Safety and Ecology (d) Health and Social Environment  
**Ans:** (b)
2. Major objective of HSE management is: (a) Increase pollution (b) Reduce workplace hazards (c) Increase waste (d) Promote unsafe practices  
**Ans:** (b)
3. Study of toxic effects on organisms is called: (a) Ecology (b) Toxicology (c) Meteorology (d) Geology  
**Ans:** (b)
4. Biomagnification means: (a) Reduction of pollutants (b) Increase of pollutants at higher trophic levels (c) Recycling of pollutants (d) Decomposition of pollutants  
**Ans:** (b)
5. Which is a primary air pollutant? (a) Ozone (b) Sulphur dioxide (c) PAN (d) Smog  
**Ans:** (b)
6. Environmental risk assessment is used to: (a) Increase pollution (b) Identify hazards (c) Produce waste (d) Reduce biodiversity  
**Ans:** (b)
7. Noise pollution is measured in: (a) Pascal (b) Joule (c) Decibel (d) Hertz  
**Ans:** (c)
8. Green buildings are related to: (a) Energy wastage (b) Sustainable infrastructure (c) Air pollution (d) Hazardous waste  
**Ans:** (b)
9. Which is a renewable energy source? (a) Coal (b) Petroleum (c) Solar energy (d) Natural gas  
**Ans:** (c)
10. Bioaccumulation means: (a) Breakdown of toxins (b) Accumulation of toxins in organisms (c) Recycling of waste (d) Removal of pollutants  
**Ans:** (b)

#### **Rubric for Internal Assessment for Theory Elective Paper**

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI

#### **Internal Assessment**

B.Sc- III SEMESTER – V (NEP)

|             |                                                                                |               |
|-------------|--------------------------------------------------------------------------------|---------------|
| Code:114222 | <b>Major Theory Elective-1: Fundamentals of Health, Safety and Environment</b> | Max Marks: 20 |
| Sr. No.     | Assessment Criteria                                                            | Marks         |
| 1           | Attendance                                                                     | 05            |
| 2           | Class Assignments                                                              | 05            |
| 3           | Unit Test - MCQ                                                                | 05            |
| 4           | Overall Performance                                                            | 05            |

**Practical-Elective-1 Fundamentals of Health, Safety and Environment**

| Level | Course Code | Semester | Course Name                                                         | Credit | Teaching Hours | Exam Duration | Max. Marks        |
|-------|-------------|----------|---------------------------------------------------------------------|--------|----------------|---------------|-------------------|
| 5.5   | 114223      | V        | Practical-Elective-1 Fundamentals of Health, Safety and Environment | 02     | 60             | 04            | Ext.25<br>Int. 25 |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course Objectives                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <ol style="list-style-type: none"> <li>To provide basic knowledge of health, safety and environmental management principles in workplace and industrial settings.</li> <li>To develop understanding of occupational hazards, accident prevention methods and safety measures.</li> <li>To impart practical skills in environmental monitoring, waste management and workplace safety practices.</li> <li>To familiarize students with safety equipment, emergency response procedures and environmental protection techniques.</li> <li>To encourage awareness and responsible behaviour towards health, safety and environmental sustainability in society and industry.</li> </ol>                                                           |
| Course Outcome                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <p>After the completion of this course, student will be able to</p> <p>CO-1 Explain the basic concepts of health, safety and environmental management in workplaces and industries.</p> <p>CO-2 Identify occupational hazards, safety symbols, PPE and accident prevention measures for safe working conditions.</p> <p>CO-3 Perform basic environmental monitoring and analysis such as noise level, pH, water quality and solid waste assessment.</p> <p>CO-4 Apply practical knowledge related to waste segregation, composting, environmental protection and safety procedures.</p> <p>CO-5 Demonstrate awareness, technical skills and responsible practices related to occupational health, safety and environmental sustainability.</p> |
| <p><b>List of Experiment/ Exercise</b></p> <ol style="list-style-type: none"> <li>Identification of physical, chemical, biological and ergonomic hazards in workplace.</li> <li>Study of occupational health and personal hygiene practices among students/workers.</li> <li>Demonstration and proper use of Personal Protective Equipment (PPE).</li> <li>Preparation and demonstration of first aid techniques for minor injuries and emergencies.</li> <li>Study and identification of occupational diseases and preventive measures.</li> <li>Demonstration of fire extinguisher operation and fire safety methods.</li> <li>Preparation of emergency evacuation plan for laboratory/classroom.</li> <li>Identification and interpretation of safety signs, symbols and hazard labels.</li> <li>Electrical safety inspection in laboratory, classroom or household appliances.</li> <li>Laboratory safety practices and safe chemical handling exercise.</li> <li>Demonstration of safe handling and storage methods for hazardous substances.</li> <li>Survey of workplace sanitation, cleanliness and employee well-being.</li> <li>Segregation and classification of solid waste, biomedical waste and e-waste.</li> <li>Preparation of waste management plan for college campus or household.</li> <li>Study of environmental conservation practices in local community.</li> <li>Survey of natural resource utilization and conservation methods.</li> <li>Community awareness activity on health, hygiene and environmental safety.</li> <li>Study of environmental ethics and sustainable living practices.</li> <li>Review of basic environmental laws and safety regulations through case studies.</li> <li>Preparation and presentation of project report related to Health, Safety and Environment issues.</li> </ol> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <p><b>References</b></p> <ol style="list-style-type: none"> <li>Occupational Health and Safety Management, CRC Press.</li> <li>Industrial Safety and Health Management, Pearson Education.</li> <li>Environmental Engineering, McGraw Hill Publication.</li> <li>Standard Methods for the Examination of Water and Wastewater (APHA), American Water Works Association and Water Environment Federation.</li> <li>Environmental Chemistry, New Age International Publishers.</li> <li>Solid Waste Management, CBS Publishers and Distributors.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

7. Manual on Water and Wastewater Analysis, National Environmental Engineering Research Institute, Nagpur.
  8. Environmental Science, Universities Press (India) Pvt. Ltd.
  9. Industrial Safety Management, Tata McGraw Hill Publishing.
  10. Introduction to Safety Engineering, Jaico Publishing House.
  11. Occupational Safety and Health Administration (OSHA). Safety and Health Guidelines.
  12. Central Pollution Control Board (CPCB). Solid Waste Management and Water Quality Guidelines.
  13. Bureau of Indian Standards (BIS). Standards for Drinking Water and Safety Practices.
  14. Ministry of Environment, Forest and Climate Change (MoEFCC). Environmental Protection and Waste Management Rules.
1. [OSHA Official Website](#)
  2. [CPCB Official Website](#)
  3. [MoEFCC Official Website](#)
  4. [BIS Official Website](#)

#### Assessment Rubric for Internal Assessment for Elective Practical

|                |                                                                                                                                             |               |
|----------------|---------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| I              | SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI<br><b>Internal Assessment for Lab Work</b><br>B.Sc.III (Environmental Science) SEMESTER–(NEP) |               |
| Code: 114223   | <b>Lab:</b> Elective-I: Health safety and environment - I                                                                                   | Max Marks: 25 |
| <b>Sr. No.</b> | <b>Assessment Criteria</b>                                                                                                                  | <b>Marks</b>  |
| 1              | Active Participation and Performance of Practical                                                                                           | 10            |
| 2              | Lab Journal / Practical Record Book                                                                                                         | 05            |
| 3              | Field Visit Report / Assignment                                                                                                             | 05            |
| 4              | Viva-Voce                                                                                                                                   | 05            |
|                | Total                                                                                                                                       | 25            |

#### Assessment Rubric for External Assessment for Practical

|                     |                                                                                                                                             |                               |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| E                   | SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI<br><b>External Assessment for Lab Work</b><br>B.Sc .III(Environmental Science) SEMESTER–(NEP) |                               |
| Course Code: 114223 | <b>Lab: Elective-1: Health safety and environment - I</b>                                                                                   | Max Marks: 25,<br>Time: 4 hrs |
| <b>Sr. No.</b>      | <b>Assessment Criteria</b>                                                                                                                  | <b>Marks</b>                  |
| 1                   | Any one major experiment                                                                                                                    | 10                            |
| 2                   | Any one minor experiment                                                                                                                    | 05                            |
| 3                   | Practical Record / Lab Journal                                                                                                              | 04                            |
| 4                   | Field Report Presentation                                                                                                                   | 03                            |
| 5                   | Viva-Voce                                                                                                                                   | 03                            |
| Total               |                                                                                                                                             | 25                            |

#### Theory Elective 2 - Planning and Restoration Environmental

| Level | Course Code | Semester | Course Name                                                                | Credit | Teaching Hours | Exam Duration | Max. Marks       |
|-------|-------------|----------|----------------------------------------------------------------------------|--------|----------------|---------------|------------------|
| 5.5   | 114224      | V        | <b>Major Theory</b><br>Elective 2 - Planning and Restoration Environmental | 02     | 30             | 02            | Ext-30<br>Int-20 |

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                         |                             |                                                                                                                                                                                                                                            |
|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course Objectives | 1. Acquire scientific foundations in ecology, including population genetics, nutrient cycles and biogeochemical processes to support evidence-based environmental restoration.<br>2. Develop proficiency in advanced technologies such as Geographic Information Systems (GIS) and Remote Sensing for spatial analysis and environmental monitoring.<br>3. Conduct environmental assessments to evaluate ecological conditions, identify impacts and support decision-making for environmental management.<br>4. Design ecological restoration plans including site diagnosis, goal setting and implementation strategies for degraded ecosystems.<br>5. Understand institutional, legal and economic frameworks including environmental legislation, ISO 14001 standards and global sustainability goals for effective environmental governance. |                         |                             |                                                                                                                                                                                                                                            |
| Course Outcome    | After the completion of this course, student will be able to-<br><br>CO-1-Problem Solving: Developing the capacity to address complex ecological , issues like biodiversity loss, soil degradation, and pollution<br>CO-2-Technical Monitoring: Gaining hands-on experience in sampling and , testing air, water, and soil quality using laboratory and field equipment.<br>CO-3-Learning to manage resources optimally to ensure that current development does not jeopardize the needs of future generations<br>CO-4-Environmental Analysis & Monitoring: Gain the ability to identify air, water, and soil pollutants and use BIOSENSORS<br>CO-5-Bioremediation Strategies: Evaluate and apply biological methods such as bioremediation, phytoremediation, and microembolization                                                              |                         |                             |                                                                                                                                                                                                                                            |
| Unit System       | Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Workload Allotted (Hrs) | Weightage of marks allotted | Incorporation of Pedagogies                                                                                                                                                                                                                |
| Unit-I            | <b>Foundations of Environmental Planning</b><br>1.1 Concepts and Importance: Historical perspective of environmental planning, from ancient practices                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 8                       | 8                           | 1-Lecture-Cum-Discussion Method.<br>2- Case Study Method;<br>3- Field-Based Learning;<br>4- Project-Based Learning;<br>5- Participatory Learning / Community Engagement.<br>6- GIS and Mapping-Based Teaching.<br>7- Experiential Learning |
|                   | 1.2- Planning Theories: Decision-making frameworks for land development with the natural environment                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                         |                             |                                                                                                                                                                                                                                            |
|                   | 1.3- Environmental Policy: Constitutional provisions in India, national environmental policies                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                         |                             |                                                                                                                                                                                                                                            |
|                   | 1.4- <b>Soil Reconstruction</b> : Topsoil management, organic amendments, and erosion control                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                         |                             |                                                                                                                                                                                                                                            |
| Unit-II           | <b>Ecosystem Dynamics and Resource Management</b><br>2.1 Ecosystem Structure: Classification of terrestrial and aquatic ecosystems                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 7                       | 7                           |                                                                                                                                                                                                                                            |
|                   | 2.2- Resource Assessment: Management of water (surface, ground, and marine), forestry, and mineral resources.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                         |                             |                                                                                                                                                                                                                                            |

|          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |   |   |  |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|--|
|          | 2.3- Techniques for water conservation and the restoration of lakes and rivers                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |   |   |  |
|          | 2.4- Agroforestry and reforestation (afforestation) methods.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |   |  |
| Unit-III | <b>Restoration Ecology:</b><br>3.1 Principles, Objectives and Importance of Ecological Restoration<br>3.2- Floating wetlands and their significance: Nutrient, Biodiversity, aesthetic, Nutrient pool<br><b>Ecological Restoration methods</b><br>3.3 Soil Bioengineering- Vegetation Bio-Shields: Replantation of native species (flood-resistant vegetation)<br>3.4 Passive Restoration (Natural Recovery): Removing the sources of degradation                                                                                                  | 8 | 8 |  |
| Unit-IV  | 4.1-Active Restoration: Revegetation of native plant species to restore vegetation cover along aquatic/riverine ecosystem<br>4.2- Biological Augmentation: (Bioaugmentation) concept and mechanism<br>4.3- Environmental Remediation Techniques<br>Physicochemical Remediation: Soil enrichment<br>Microbial <b>Degradation:</b> Bio stimulation, bioaugmentation and <b>Rhizo-filtration</b><br>4.4- Indian Restoration Models<br>Aravali Biodiversity Park (Delhi)<br>Mangrove restoration (Sundarbans)<br>Brahmaputra river restoration (Assam) | 7 | 7 |  |

#### References :

1. Handbook of ecological restoration by S. K. Alison
2. Ecological Restoration – Springer
3. Primer of Ecological Restoration – K D Holi
4. RAESOURCES & Env. Management – Bruce M.
5. Environmental Planning and Management, Routledge.
6. Environmental Impact Assessment, McGraw Hill Education.
7. Ecology: Concepts and Applications, McGraw Hill.
8. Restoration Ecology: The New Frontier, Wiley-Blackwell.
9. Principles of Ecosystem Stewardship, Springer.
10. Wetlands Ecology and Management, Cambridge University Press.
11. Soil and Water Conservation Engineering, Standard Publishers.
12. Environmental Biology, Rastogi Publications.
13. Environmental Engineering, McGraw Hill.

#### Model Questions

##### Short Type:

1. What is environmental planning?
2. What is an Environmental Impact Assessment (EIA)?
3. What are the key principles of environmental policy development?
4. How does land-use planning contribute to environmental protection?
5. What is ecological restoration?
6. What is the difference between afforestation and reforestation?

##### Long Type:

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Define "Environmental Planning" and discuss the multi-disciplinary approach required to balance industrial growth with ecological preservation.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 2. : What are the key stages of an EIA, and how does it help in identifying potential risks and mitigation strategies for mega-infrastructure projects?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 3. Examine the strategies for sustainable water management in drought-prone regions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 4. Explain the difference between climate "mitigation" and "adaptation" strategies in environmental planning                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <input type="checkbox"/> What is the primary objective of an Environmental Management Plan (EMP)?<br>a) Increasing project profitability<br>b) Reducing the number of site visits<br>c) Mitigating and managing potential environmental impacts<br>d) Speeding up the construction timeline [1, 2]<br><input type="checkbox"/> Which term describes the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed?<br>a) Environmental Planning<br>b) Ecological Restoration<br>c) Urban Sprawl<br>d) Resource Extraction<br><input type="checkbox"/> The concept of "Sustainable Development" was popularized by which report?<br>a) Kyoto Protocol<br>b) Paris Agreement<br>c) Brundtland Report (1987)<br>d) Montreal Protocol [1]<br><input type="checkbox"/> Which planning tool is used to predict the environmental consequences of a proposed project before it is carried out?<br>a) Environmental Risk Assessment<br>b) Environmental Impact Assessment (EIA)<br>c) Ecological Succession<br>d) Land-use Zoning<br><input type="checkbox"/> In the context of restoration, what does "Afforestation" refer to?<br>a) Harvesting old-growth forests for timber<br>b) Planting trees in an area where there was no previous tree cover<br>c) Removing invasive species from a wetland<br>d) Natural regeneration of a forest after a fire [1, 2]<br><input type="checkbox"/> Which of the following is considered a "Nature-based Solution" in environmental planning to prevent soil erosion?<br>a) Deep removal of surface cover<br>b) Continuous excavation<br>c) Contour ploughing and terracing<br>d) Indiscriminate cutting of vegetation [1]<br><input type="checkbox"/> What is the main purpose of Environmental Auditing?<br>a) To secure funding for new projects<br>b) To verify compliance with environmental regulations and standards<br>c) To mar |

**Rubric for Internal Assessment for Majoer Elective-2 Theory Paper**

| SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI<br><b>Internal Assessment</b><br>B.Sc- III SEMESTER – V (NEP) |                                                                          |               |
|-------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|---------------|
| Code:<br>114224                                                                                             | Majoer Theory Elective-2 <b>“Environmental Planning and Restoration”</b> | Max Marks: 20 |
| Sr. No.                                                                                                     | Assessment Criteria                                                      | Marks         |
| 1                                                                                                           | Attendance                                                               | 05            |
| 2                                                                                                           | Class Assignments                                                        | 05            |
| 3                                                                                                           | Unit Test - MCQ                                                          | 05            |
| 4                                                                                                           | Overall Performance                                                      | 05            |

**Practical: Elective-2 “Environmental Planning and Restoration**

| Level | Course Code | Semester | Course Name                                                       | Credit | Teaching Hours | Exam Duration | Max. Marks        |
|-------|-------------|----------|-------------------------------------------------------------------|--------|----------------|---------------|-------------------|
| 5.5   | 114225      | V        | Practical: Elective-2<br>“Environmental Planning and Restoration” | 02     | 60             | 04            | Ext.25<br>Int. 25 |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course Objectives                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <ol style="list-style-type: none"> <li>To provide fundamental understanding of environmental planning, ecological restoration and resource management concepts.</li> <li>To develop knowledge of ecosystem structure, biodiversity assessment and environmental quality monitoring techniques.</li> <li>To impart practical skills in water, air and soil analysis, along with field-based ecological surveys and assessments.</li> <li>To train students in restoration ecology techniques such as seed ball preparation, ANR, nucleation and nursery development.</li> <li>To enhance capability in environmental planning, carbon assessment, stakeholder analysis and sustainable ecosystem management through field studies and visits.</li> </ol> |
| Course Outcome                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <p>At the completion of this course, student is able to –</p> <p>CO- 1 Explain the principles of environmental planning, ecosystem dynamics and ecological restoration approaches.</p> <p>CO- 2 Conduct environmental quality assessments including water, air and soil analysis using standard methods.</p> <p>CO -3 Perform biodiversity surveys, ecological monitoring and environmental baseline studies in field conditions.</p> <p>CO- 4 Apply restoration techniques such as seed ball preparation, assisted natural regeneration, nucleation and nursery planning.</p> <p>CO- 5 Develop environmental restoration plans using carbon sequestration studies, stakeholder analysis and field-based ecological data.</p>                           |
| <p><b>List of Experiment/ Exercise</b></p> <ol style="list-style-type: none"> <li>Determination of quality of wetland/riverine water bodies</li> <li>Determination of Floral Diversity using quadrat method</li> <li>Determination of Faunal Diversity using ecological method</li> <li>Biodiversity Audit and Baseline Survey in degraded forest.</li> <li>Identification and mapping of invasive species</li> <li>Bioindicator Surveys of local ecosystem (butterflies, birds and soil macrofauna)</li> <li>Assessment of Soil Quality (pH, organic matter, NPK etc).</li> <li>Seed Collection of native species and preparation of seed bank.</li> <li>Assisted Natural Regeneration (ANR) practices.</li> <li>To study success of ecological restoration (Field Study).</li> <li>Observation of regeneration rate in social forestry plantation sites.</li> <li>Drafting a Forest Restoration Plan (Policy document preparation).</li> <li>Carbon Sequestration Measurement using biomass and DBH-based calculations.</li> <li>Community Interviews on forest resource use.</li> <li>Soil Erosion Control experiment using vegetation and runoff measurement.</li> <li>Visit to riverine ecosystem to study impacts of dam construction (Baseline data collection and comparative analysis).</li> </ol> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <p><b>1. References</b></p> <ol style="list-style-type: none"> <li>Environmental Planning and Management, Routledge.</li> <li>Ecology: Concepts and Applications, McGraw Hill Education.</li> <li>Restoration Ecology, Wiley-Blackwell.</li> <li>Principles of Ecosystem Stewardship, Springer.</li> <li>Wetlands Ecology and Management, Cambridge University Press.</li> <li>Soil and Water Conservation Engineering, Standard Publishers.</li> <li>Environmental Engineering, McGraw Hill.</li> <li>Landscape Ecology, Wiley.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

10. Environmental Science, Universities Press (India) Pvt. Ltd.
11. Environmental Impact Assessment, McGraw Hill Education.
12. United Nations Environment Programme (UNEP). Ecosystem Restoration and Environmental Planning Reports.
13. Food and Agriculture Organization (FAO). Watershed Management and Land Restoration Guidelines.
14. Ministry of Environment, Forest and Climate Change (MoEFCC). Environmental Conservation and Policy Documents.
15. National Biodiversity Authority (NBA). Biodiversity Conservation Frameworks.
16. [UNEP Official Website](#)
17. [FAO Official Website](#)
18. [MoEFCC Official Website](#)
19. [CBD Official Website](#)

**Assessment Rubric for Internal Assessment for Elective Practical**

|                        |                                                                                                                                                |                  |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| I                      | SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI<br><b>Internal Assessment for Lab Work</b><br>B.Sc.III (Environmental Science) SEMESTER– V (NEP) |                  |
| Course Code:<br>114225 | <b>Lab: Elective-2 “Environmental Planning and Restoration”</b>                                                                                | Max<br>Marks: 25 |
| <b>Sr. No.</b>         | <b>Assessment Criteria</b>                                                                                                                     | <b>Marks</b>     |
| 1                      | Active Participation and Performance of Practical                                                                                              | 10               |
| 2                      | MCQ Test                                                                                                                                       | 05               |
| 3                      | Field Visit Report / Assignment                                                                                                                | 05               |
| 4                      | Attendance                                                                                                                                     | 05               |

**Assessment Rubric for External Assessment for Elective Practical**

|                        |                                                                                                                                                |                                   |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|
| E                      | SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI<br><b>External Assessment for Lab Work</b><br>B.Sc .III(Environmental Science) SEMESTER– V (NEP) |                                   |
| Course Code:<br>114225 | <b>Lab: Elective-2 “Environmental Planning and Restoration”</b>                                                                                | Max Marks:<br>25, Time:<br>4Hours |
| <b>Sr. No.</b>         | <b>Assessment Criteria</b>                                                                                                                     | <b>Marks</b>                      |
| 1                      | Any one experiment on Floral and Faunal Diversity Surveys                                                                                      | 06                                |
| 2                      | Any one experiment on Site Assessment and Planning                                                                                             | 06                                |
| 3                      | Any one experiment on Monitoring and Ecological Evaluation                                                                                     | 06                                |
| 4                      | Practical Record / Lab Journal                                                                                                                 | 03                                |
| 5                      | Viva-Voce                                                                                                                                      | 04                                |

**Minor Theory: Global Climate Issues**

| Level | Course Code | Semester | Course Name                         | Credit | Teaching Hours | Exam Duration | Max. Marks       |
|-------|-------------|----------|-------------------------------------|--------|----------------|---------------|------------------|
| 5.5   | 114226      | V        | Minor Theory: Global Climate Issues | 02     | 30             | 02            | Ext-30<br>Int-20 |

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                         |                             |                                                                                                                                                                                             |
|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course Objectives | 1. To know concept of Climate Change.<br>2. Understand the mechanism of Green House Effect.<br>3. To know effects associated with Climate Change.<br>4. Understand Climatic phenomena.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                         |                             |                                                                                                                                                                                             |
| Course Outcome    | After the completion of the course, student can –<br>CO1: Understand Earth’s past climate system.<br>CO2: Aware about Energy balance on the surface of earth.<br>CO3: Explain mechanism of greenhouse effect and causes of global warming. CO4: Identify causes of global warming and climate change.<br>CO5: Involve and helps to mitigate climate change.<br>CO6: Explain causes of global warming, as well as emission trends and driving forces that are responsible for fossil fuel emissions and deforestation.<br>CO7: Understand anthropogenic climate change and its causes.<br>CO8: Identify technological options to reduce emissions, their barriers and costs and co-benefits.<br>CO9: Explain the understanding of climate mitigation in difference disciplines and the discipline's contribution to climate mitigation |                         |                             |                                                                                                                                                                                             |
| Unit System       | Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Workload Allotted (Hrs) | Weightage of marks allotted | Incorporation of Pedagogies                                                                                                                                                                 |
| Unit-I            | 1.1 : Fundamentals of Climate and Weather: Difference between climate and weather                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 8                       | 8                           | 1-Lecture Method.<br>2-Interactive Discussion Method.<br>3-Problem-Based Learning.<br>4-Field Visit / Experiential Learning.<br>5-ICT-Based Teaching.<br>6-Laboratory Demonstration Method. |
|                   | 1.2 Fundamentals of Climate and Weather: Components of the climate system, Atmospheric structure and composition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                         |                             |                                                                                                                                                                                             |
|                   | 1.3 <b>Evidence of Climate Change:</b> Rising global temperatures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                         |                             |                                                                                                                                                                                             |
|                   | 1.4 <b>Evidence of Climate Change:</b> Melting glaciers and sea-level rise                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                         |                             |                                                                                                                                                                                             |
| Unit-II           | <b>Carbon Cycle and Climate Processes</b><br>1.1 Earth’s Carbon Reservoirs (Atmospheric, Terrestrial, and Aquatic)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 7                       | 7                           |                                                                                                                                                                                             |
|                   | 1.2 Global carbon cycle mechanis- Physical and Biological                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                         |                             |                                                                                                                                                                                             |
|                   | 2.3 Human Influence on Carbon Emissions: Anthropogenic CO <sub>2</sub> emissions, Industrialization and fossil fuel combustion                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                         |                             |                                                                                                                                                                                             |
|                   | 2.4 Climate Feedback Mechanisms: Positive and negative feedbacks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                         |                             |                                                                                                                                                                                             |
| Unit-III          | <b>Impacts of Global Climate Change</b><br>3.1 Impacts on Ecosystems and Biodiversity                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 8                       | 8                           |                                                                                                                                                                                             |
|                   | 3.2 Impacts on Agriculture                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                         |                             |                                                                                                                                                                                             |
|                   | 3.3 Impacts on Human Health                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                         |                             |                                                                                                                                                                                             |
|                   | 3.4 Socio-Economic Consequences                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                         |                             |                                                                                                                                                                                             |
| Unit-IV           | Mitigation, Adaptation and Policy Responses:<br>4.1 Climate Change Mitigation Strategies: Renewable energy technologies and Energy conservation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 7                       | 7                           |                                                                                                                                                                                             |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                         |  |  |  |
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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 4.2 Climate Change Adaptation Measures: Climate-resilient infrastructure and Community-based adaptation |  |  |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 4.3 International Agreements and Policies: Kyoto Protocol and Paris Agreement                           |  |  |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 4.4 Sustainable Development and Future Perspectives: Sustainable Development Goals and climate action   |  |  |  |
| <b>References</b> <ol style="list-style-type: none"> <li>1. Climate Change 2021: The Physical Science Basis – Intergovernmental Panel on Climate Change. Cambridge University Press.</li> <li>2. Global Warming: The Complete Briefing. Cambridge University Press.</li> <li>3. Introduction to Climate Change. Jones &amp; Bartlett Learning.</li> <li>4. Principles of Environmental Science. McGraw Hill Education.</li> <li>5. Environmental Science. Jones &amp; Bartlett Publishers.</li> <li>6. Climate Change and Society. Polity Press.</li> <li>7. The Economics of Climate Change: The Stern Review. Cambridge University Press.</li> <li>8. Fundamentals of Ecology. Cengage Learning.</li> <li>9. Environmental Chemistry. New Age International Publishers.</li> <li>10. Atmosphere, Climate and Change. Scientific American Library.</li> <li>11. <a href="#">IPCC Official Reports</a></li> <li>12. <a href="#">UN Climate Change (UNFCCC)</a></li> <li>13. <a href="#">United Nations Sustainable Development Goals</a></li> <li>14. <a href="#">NASA Climate Change Portal</a></li> </ol> |                                                                                                         |  |  |  |
| <b>Model Questions</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                         |  |  |  |
| Short Type: <ol style="list-style-type: none"> <li>1. What is meant by global climate change?</li> <li>2. Define the greenhouse effect.</li> <li>3. Name the major greenhouse gases responsible for global warming.</li> <li>4. What is the difference between climate and weather?</li> <li>5. What is global warming?</li> <li>6. What are the main causes of climate change?</li> <li>7. What are the effects of melting glaciers and polar ice caps?</li> <li>8. What is carbon footprint?</li> <li>9. Suggest two measures to reduce climate change impacts.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                         |  |  |  |
| Long Type: <ol style="list-style-type: none"> <li>1. Explain the causes, impacts, and mitigation measures of global climate change.</li> <li>2. Discuss the role of greenhouse gases in global warming and climate change.</li> <li>3. Describe the effects of climate change on agriculture, biodiversity, and human health.</li> <li>4. Explain the causes and consequences of ozone layer depletion and suggest preventive measures.</li> <li>5. Discuss the impact of global climate issues on developing countries with suitable examples.</li> <li>6. Explain the importance of renewable energy resources in controlling global climate change.</li> <li>7. Discuss international agreements and policies related to climate change mitigation and adaptation, such as the Paris Agreement and the Kyoto Protocol.</li> <li>8. Describe the role of afforestation, sustainable development, and public awareness in addressing global climate issues.</li> </ol>                                                                                                                                     |                                                                                                         |  |  |  |
| MCQ <ol style="list-style-type: none"> <li>1. Which gas is mainly responsible for global warming?<br/>a) Oxygen, b) Nitrogen, c) Carbon dioxide, d) Hydrogen</li> <li>2. The gradual increase in Earth's average temperature is called:<br/>a) Acid rain, b) Global warming, c) Soil erosion, d) Desertification</li> <li>3. Which layer of the atmosphere contains the ozone layer?<br/>a) Troposphere, b) Mesosphere, c) Stratosphere, d) Thermosphere</li> <li>4. Which international agreement focuses on reducing greenhouse gas emissions?<br/>a) Montreal Protocol, b) Kyoto Protocol, c) Geneva Convention, d) Ramsar Convention</li> <li>5. Which of the following is a renewable source of energy?<br/>a) Coal, b) Petroleum, c) Solar energy, d) Natural gas</li> </ol>                                                                                                                                                                                                                                                                                                                          |                                                                                                         |  |  |  |

6. Deforestation contributes to climate change because it:  
 a) Increases oxygen production, b) Reduces carbon dioxide absorption, c) Increases rainfall  
 d) Reduces soil erosion
7. Acid rain is mainly caused by:  
 a) Carbon dioxide and methane, b) Sulfur dioxide and nitrogen oxides, c) Oxygen and nitrogen, d) Hydrogen and helium
8. Which of the following is a major effect of climate change?  
 a) Stable sea levels, b) Increased glacier formation, c) Rising sea levels, d) Decrease in temperature.

**Rubric for Internal Assessment for Minor Theory Paper**

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI

**Internal Assessment B.Sc- III SEMESTER – V (NEP)**

|             |                                                       |               |
|-------------|-------------------------------------------------------|---------------|
| Code:114226 | <b>Paper: Minor Theory - ( Global Climate Issues)</b> | Max Marks: 20 |
| Sr. No.     | Assessment Criteria                                   | Marks         |
| 1           | Attendance                                            | 05            |
| 2           | Class Assignments                                     | 05            |
| 3           | Unit Test - MCQ                                       | 05            |
| 4           | Overall Performance / Seminar / Case Study            | 05            |
|             |                                                       |               |

### Minor Lab / Pract: Global Climatic Issues

| Level | Semester | Course Code | Course Name                               | Credits | Teaching Hours | Exam Duration | Max Marks              |
|-------|----------|-------------|-------------------------------------------|---------|----------------|---------------|------------------------|
| 5.5   | V        | 114227      | Minor Lab / Pract: Global Climatic Issues | 02      | 60             | 4 Hrs         | 25 (Ext.)<br>25 (Int.) |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
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| Course Objectives                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <ol style="list-style-type: none"> <li>1. To develop a practical understanding of global climatic issues through laboratory work, field studies, surveys, and environmental monitoring activities.</li> <li>2. To enhance students' skills in observing, analyzing, and interpreting environmental and climate-related data scientifically.</li> <li>3. To create awareness about climate change, pollution, biodiversity loss, renewable energy, and sustainable environmental practices.</li> <li>4. To encourage critical thinking, problem-solving, and community participation in climate change mitigation and adaptation activities.</li> <li>5. To promote environmentally responsible behavior and application of sustainable practices in daily life and society.</li> </ol> |
| Course Outcome                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <p>After the completion of this course, the student will be able to:</p> <p><b>CO-1:</b> Understand the causes and impacts of global climate change.<br/> <b>CO-2:</b> Analyze environmental problems scientifically.<br/> <b>CO-3:</b> Apply sustainable practices in daily life.<br/> <b>CO-4:</b> Develop awareness regarding climate mitigation and adaptation.<br/> <b>CO-5:</b> Participate effectively in environmental conservation activities.</p>                                                                                                                                                                                                                                                                                                                            |
| List of Experiment/ Exercise                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <ol style="list-style-type: none"> <li>1. Study of weather parameters using meteorological instruments (temperature, humidity, rainfall, wind speed).</li> <li>2. Interpretation of weather map.</li> <li>3. Study of sign and symbols related to weather map</li> <li>4. Determination of CO<sub>2</sub> as a green house gas</li> <li>5. Determination of H<sub>2</sub>S as a green house gas</li> <li>6. Determination of methane as a green house gas</li> <li>7. Demonstration of greenhouse effect using simple laboratory models.</li> <li>8. Study of atmospheric layers and composition through charts/models.</li> <li>9. Collection and interpretation of global temperature anomaly data.</li> <li>10. Case study analysis of glacier melting and sea-level rise.</li> <li>11. Construction of a model illustrating the global carbon cycle.</li> <li>12. Study of physical and biological carbon pump mechanisms using diagrams/models.</li> <li>13. Estimation of carbon footprint for household or institutional activities.</li> <li>14. Survey on fossil fuel consumption and energy use patterns.</li> <li>15. Assessment of land-use changes and deforestation impacts using satellite images/maps.</li> <li>16. Documentation of climate change impacts on local biodiversity and ecosystems.</li> <li>17. Survey of climate change effects on agriculture and crop productivity in nearby areas.</li> <li>18. Health impact assessment related to heat stress, vector-borne diseases, or air pollution.</li> <li>19. Evaluation of renewable energy technologies such as solar cookers, solar panels, or biogas systems.</li> </ol> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

**References/E-Contents / E-Books/Digital Resources / Web Links**

1. [EPA Climate Change Resources for Educators and Students](#)  
Includes climate experiments, classroom activities, datasets, and educational tools.
2. [IGNOU Practical Manual Repository](#)  
Practical manuals and environmental science laboratory materials useful for climate-related exercises.
3. [Teach Climate Change – Earth@Home Lab Activities](#)  
Collection of laboratory and field activities related to climate adaptation, mitigation, and climate data analysis.
4. [Climate Change Science Practical Manual – UN CC:Learn](#)  
Practical manual covering climate models, vulnerability assessment, and response strategies.
5. [Office for Climate Education – Evidence of Climate Change Activities](#)  
Student-centered practical activities using satellite images, graphs, and climate evidence.
6. [ESA Climate for Schools Resource Packs](#)  
Teacher guides, worksheets, satellite data exercises, and STEM-based climate practicals.
7. [Greenhouse Effect and Human Activities Lesson Activities](#)  
Demonstration-based practical activities for understanding greenhouse gases and global warming.

**Digital Resources / Educational Websites**

1. [NASA Climate Change Education Resources](#)
2. [IPCC Official Website](#)
3. [UN Climate Change Learning Partnership \(UN CC:Learn\)](#)
4. [NOAA Climate.gov Education Resources](#)
5. [Office for Climate Education](#)
6. [European Space Agency Climate for Schools](#)
7. [UNESCO Climate Change Education Resources](#)
8. [EPA Climate Change Science Resources](#)

**Assessment Rubric for Internal Assessment for Minor Practical**

|                 |                                                                                                                                                      |                  |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| I               | SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI<br><b>Internal Assessment for Minor Lab Work</b><br>B.Sc.III (Environmental Science) SEMESTER– V (NEP) |                  |
| Code:<br>114227 | <b>Minor Lab: Global Climatic Issues</b>                                                                                                             | Max<br>Marks: 25 |
| <b>Sr. No.</b>  | <b>Assessment Criteria</b>                                                                                                                           | <b>Marks</b>     |
| 1               | Active Participation and Performance of Practical                                                                                                    | 10               |
| 2               | MCQ Test                                                                                                                                             | 05               |
| 3               | Field Visit Report / Assignment                                                                                                                      | 05               |
| 4               | Attendance                                                                                                                                           | 05               |

**Assessment Rubric for External Assessment for Minor Practical**

|                        |                                                                                                                                                      |                               |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| E                      | SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI<br><b>External Assessment for Minor Lab Work</b><br>B.Sc .III(Environmental Science) SEMESTER– V (NEP) |                               |
| Course Code:<br>114227 | <b>Minor Lab: Global Climatic Issues</b>                                                                                                             | Max Marks:25, Time:<br>4Hours |
| <b>Sr. No.</b>         | <b>Assessment Criteria</b>                                                                                                                           | <b>Marks</b>                  |
| 1                      | Any two-experiment based on Global Climatic Issues                                                                                                   | 16                            |
| 2                      | Practical Record / Lab Journal                                                                                                                       | 04                            |
| 3                      | Viva-Voce                                                                                                                                            | 05                            |

**VSC: Course in Water and Wastewater Treatment**

| Level | Course Code | Semester | Course Name                                   | Credit | Teaching Hours | Exam Duration | Max. Marks       |
|-------|-------------|----------|-----------------------------------------------|--------|----------------|---------------|------------------|
| 5.5   | V           | 114277   | VSC: Course in Water and Wastewater Treatment | 02     | 60             | 04 Hrs        | 50<br>(Internal) |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
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| Course Objectives                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <ol style="list-style-type: none"> <li>To provide basic knowledge of water and wastewater treatment processes and their environmental importance.</li> <li>To develop practical skills in water purification and wastewater management techniques.</li> <li>To train students in the operation and maintenance of treatment systems and equipment.</li> <li>To promote awareness about water conservation and pollution control practices.</li> <li>To enhance problem-solving and technical skills related to water and wastewater treatment.</li> </ol>                                                      |
| Course Outcome                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <p align="center"><b>After the completion of this course, student will be able to</b></p> <p><b>CO-1:</b> Understand the principles and processes involved in water and wastewater treatment.</p> <p><b>CO-2:</b> Perform basic water quality analysis and treatment techniques.</p> <p><b>CO-3:</b> Gain practical skills in operating and maintaining treatment systems.</p> <p><b>CO-4:</b> Develop awareness regarding sustainable water management and pollution prevention.</p> <p><b>CO-5:</b> Apply technical knowledge to solve environmental problems related to water and wastewater treatment.</p> |
| List of Experiment/ Exercise                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <p align="center"><b>Course in Water and Wastewater Treatment</b></p> <ol style="list-style-type: none"> <li>Identification and use of common laboratory instruments for water quality analysis.</li> <li>Estimation of dissolved oxygen (DO) in potable and wastewater samples.</li> <li>Determination of total hardness, alkalinity, and chlorides in water.</li> <li>Determination of biochemical oxygen demand (BOD) of wastewater samples.</li> <li>Determination of chemical oxygen demand (COD) of sewage or industrial effluent.</li> <li>Comparative study of drinking water quality standards prescribed by Bureau of Indian Standards and World Health Organization.</li> <li>Demonstration of aeration process for improving water quality.</li> <li>Study and operation of screening devices for removal of floating solids.</li> <li>Demonstration of sedimentation process for water purification</li> <li>Determination of residual chlorine in treated water samples.</li> <li>Demonstration of water disinfection using chlorination</li> <li>Study of preliminary wastewater treatment units: bar racks and grit chambers</li> <li>Observation and operation of biological treatment systems such as Activated Sludge Process (ASP)</li> <li>Demonstration of anaerobic digestion and sludge stabilization techniques.</li> <li>Visit to a water treatment plant or sewage treatment plant and preparation of a technical report on operation and maintenance practices.</li> </ol> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>References:</b> <ol style="list-style-type: none"> <li><i>Water Supply and Sanitary Engineering</i> – Dhanpat Rai Publications, New Delhi.</li> <li><i>Environmental Engineering</i> – Khanna Publishers, New Delhi.</li> <li><i>Elements of Environmental Engineering</i> – S. Chand &amp; Company Ltd., New Delhi.</li> <li><i>Environmental Engineering and Management</i> – S. K. Kataria &amp; Sons, New Delhi.</li> <li><i>Wastewater Engineering: Treatment and Resource Recovery</i> – McGraw-Hill Education, USA.</li> <li><i>Water and Wastewater Technology</i> – Pearson Education, USA.</li> <li><i>Introduction to Environmental Engineering and Science</i> – Pearson Prentice Hall, USA.</li> <li><i>Environmental Engineering</i> – McGraw-Hill International Edition, USA.</li> <li><i>Principles of Water Treatment</i> – Wiley Publications, USA.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

10. *Bureau of Indian Standards* – IS 10500: Drinking Water Specifications.
11. *World Health Organization* – Guidelines for Drinking-water Quality.

**Assessment Rubric for External Assessment for Practical**

|                        |                                                                                                                                          |                   |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| E                      | SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI<br><b>External Assessment for VSC</b><br>B.Sc.III (Environmental Science) SEMESTER -V(NEP) |                   |
| Course Code:<br>114277 | VSC- Course in Water Treatment Plant Operation                                                                                           | Max Marks:<br>25, |
| <b>Sr. No.</b>         | <b>Assessment Criteria</b>                                                                                                               | <b>Marks</b>      |
| 1.                     | Attendance and Participation                                                                                                             | 10                |
| 2.                     | Laboratory Skills for handling instruments, chemicals and glassware                                                                      | 10                |
| 3.                     | Laboratory skill for performing experimentation                                                                                          | 10                |
| 4.                     | Report Writing on treatment plant                                                                                                        | 10                |
| 5.                     | Presentation                                                                                                                             | 10                |

**SEC: Field and Laboratory skills for Environmental quality analysis**

| Level | Semester | Course Code | Course Name                                                         | Credits | Teaching Hours | Exam Duration | Max Marks     |
|-------|----------|-------------|---------------------------------------------------------------------|---------|----------------|---------------|---------------|
| 5.5   | V        | 114278      | SEC: Field and Laboratory skills for Environmental quality analysis | 02      | 60             | 4 Hrs         | 50 (Internal) |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course Objectives                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <ol style="list-style-type: none"> <li>1. To learn proper water sampling procedures for different sources (e.g., tap, groundwater, surface water).</li> <li>2. To understand sample preservation and storage protocols.</li> <li>3. To use analytical instruments such as spectrophotometers, titrators, turbidity meters, and pH meters.</li> <li>4. To know the principle, working, handling, and calibration of analytical instruments.</li> <li>5. To learn to prepare standard reagents for chemical analysis.</li> </ol>                                                                                                                 |
| Course Outcome                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <p>After the completion of this course, the student will be able to:</p> <p><b>CO-1:</b> Execute proper water sampling procedures for different sources (e.g., tap, groundwater, surface water).</p> <p><b>CO-2:</b> Implement standard sample preservation and storage protocols.</p> <p><b>CO-3:</b> Operate analytical instruments such as spectrophotometers, titrators, turbidity meters, and pH meters effectively.</p> <p><b>CO-4:</b> Understand the importance of accuracy, precision, calibration, and validation in experimental data.</p> <p><b>CO-5:</b> Practice safe handling of chemicals and complex laboratory equipment</p> |
| List of Experiment/ Exercise                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <p><b>A. Environmental Sampling Techniques:</b></p> <ol style="list-style-type: none"> <li>1. Study of different types of sampling: Grab, Composite, and Continuous sampling.</li> <li>2. Demonstration of equipment used for sampling air, water, and soil.</li> <li>3. Execution of sample preservation and transport protocols.</li> <li>4. Overview of national and international environmental regulations (e.g., EPA, CPCB).</li> </ol> <p><b>B. Preparation of Standard Solutions and Basic Laboratory Skills:</b></p> <ol style="list-style-type: none"> <li>5. Protocol for the preparation of standard solutions.</li> <li>6. Handling of weighing balance for weighing reagents.</li> <li>7. Handling of volumetric flasks and measuring cylinders.</li> <li>8. Standard washing and drying techniques of laboratory glassware.</li> </ol> <p><b>C. Laboratory Analysis Techniques (Principle, Working, Calibration, and Handling of Equipment):</b></p> <ol style="list-style-type: none"> <li>9. Spectrophotometers</li> <li>10. Gas Chromatography (GC)</li> <li>11. Atomic Absorption Spectroscopy (AAS)</li> <li>12. Air monitoring instruments</li> <li>13. Noise level meters</li> <li>14. Flame photometer</li> <li>15. Laminar air flow</li> <li>16. BOD incubator</li> <li>17. Microscopes</li> </ol> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <p><b>References</b></p> <ol style="list-style-type: none"> <li>1. <i>Standard Methods for the Examination of Water and Wastewater</i> – Comprehensive manual for laboratory analysis of water and wastewater quality parameters (APHA).</li> <li>2. <i>Environmental Chemistry Laboratory Manual</i> – Covers practical methods for environmental chemical analysis and pollution control.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

3. *Laboratory Manual for Environmental Biotechnology* – Includes laboratory exercises for environmental biotechnology and pollution control.

**Digital Resources / Laboratory Guidelines:**

- American Public Health Association (APHA)
- US Environmental Protection Agency (EPA) Laboratory Methods
- World Health Organization (WHO) Water Quality Guidelines
- Central Pollution Control Board (CPCB) Laboratory Guidelines
- UN Environment Programme (UNEP)

**Assessment Rubric for Internal Assessment for SEC**

|                 |                                                                                                                                                |                  |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| I               | SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI<br><b>Internal Assessment for SEC Work</b><br>B.Sc.III (Environmental Science) SEMESTER– V (NEP) |                  |
| Code<br>114278: | SEC: Field and Laboratory skills for Environmental quality analysis                                                                            | Max<br>Marks: 50 |
| <b>Sr. No.</b>  | <b>Assessment Criteria</b>                                                                                                                     | <b>Marks</b>     |
| 1.              | Attendance and Laboratory Discipline                                                                                                           | 05               |
| 2.              | Sample Collection and Handling Skills                                                                                                          | 10               |
| 3.              | Experimental Procedure and Technical Skills                                                                                                    | 10               |
| 4.              | Observation, Calculations, and Data Interpretation                                                                                             | 10               |
| 5               | Laboratory Record / Practical Journal                                                                                                          | 10               |
| 6               | Practical Test / Report Submission                                                                                                             | 05               |

**Field Project / Community Engagement Services in Environmental Science:**

| Level | Semester | Course Code | Course Name                                                             | Credits | Teaching Hours | Exam Duration | Max Marks |
|-------|----------|-------------|-------------------------------------------------------------------------|---------|----------------|---------------|-----------|
| 5.5   | V        | 114228      | Field Project / Community Engagement Services in Environmental Science: | 2       | 60             | --            | 50        |

**Course Objectives:**

- Promote experiential learning by involving students in real-world environmental issues through surveys, data collection, and field observations.
- Encourage active community participation by conducting awareness drives, environmental education programs, and eco-restoration activities.
- Enhance problem-solving and critical thinking skills through investigation of local environmental challenges such as pollution, waste management, biodiversity loss, and climate change impacts.
- Foster teamwork, leadership, and communication skills through collaborative fieldwork and interaction with local stakeholders.
- Bridge the gap between theoretical knowledge and practical application by integrating scientific methods with community needs for sustainable development.

**Course Outcomes:**

After successful completion of this course, students will be able to:

- Apply environmental science concepts and methodologies to assess and analyze real-world environmental issues through field-based activities.
- Conduct data collection, documentation, and analysis related to air, water, soil, biodiversity, or waste, using appropriate tools and techniques.
- Engage effectively with local communities and stakeholders to identify environmental problems and promote awareness through outreach and education programs.
- Demonstrate problem-solving, teamwork, and project management skills in the planning and execution of environmental field projects.
- Develop sustainable and practical solutions to local environmental challenges by integrating scientific knowledge with community insights.
- Communicate environmental findings clearly through reports, presentations, and community dialogue, reflecting ethical responsibility and civic engagement.

**Guidelines/ SoP for FP/CEP**

For understanding key principles of CE, forms of CE, operational guidelines and implementation strategy please refer [https://www.ugc.gov.in/pdfnews/4187860\\_Revised-Final-Guidelines.pdf](https://www.ugc.gov.in/pdfnews/4187860_Revised-Final-Guidelines.pdf)

**As per NEP 2020, students of B Sc. III of Semester V need to perform a Field Project (FP) for TWO (2) credits i.e. 50 Marks.**

**The guidelines regarding the field project are as follows:**

**Field Data Collection:**

- Collect samples of air, water, or soil following standard protocols.
- Use field instruments like air quality monitors, sound level meters, or radiation detectors to measure pollution levels.
- Observe and record pollution indicators, sources, and environmental conditions.
- Conduct surveys and interviews with local residents, workers, or officials to gather qualitative information about pollution impacts and awareness.
- Keep detailed field notes that include the date, time, location, weather conditions, and observations made during the study.
- Take photographs of the sites, pollution sources, and community engagement activities.

**Community Engagement Activities:**

- Organize awareness activities such as poster presentations, street plays, tree plantation, clean-up drives, eco-quizzes, or workshops.

**Documentation of Activities:**

- Record all field observations, survey responses, and community feedback properly.
- Take photographs and maintain a field diary or logbook.

**Data Analysis:**

- Analyze the collected data using charts, graphs, and comparisons with environmental standards (e.g., CPCB norms, WHO guidelines).

**Result Interpretation:**

- Draw conclusions about the problem and its severity, based on evidence collected during the study.

**Report Writing:**

- Prepare a structured project report including:
  - Title Page
  - Abstract
  - Introduction and Objectives
  - Methodology
  - Results and Observations
  - Discussion
  - Community Impact
  - Conclusion and Suggestions
  - References
  - Photographs/Annexures
- **Presentation:** Create a PowerPoint presentation or poster for final evaluation.
- Present the project findings before teachers and peers.

**Submission:**

- Submit the final report (hard and/or soft copy) along with necessary documents (data sheets, feedback forms, photos, etc.) on time
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| <p><b>SUGGESTED FORMS OF COMMUNITY-ENGAGED PRACTICE IN ENVIRONMENTAL SCIENCE</b></p> <ul style="list-style-type: none"> <li> <b>Environmental Awareness Campaigns</b><br/> Organize workshops, street plays, or information sessions on pollution types, causes, and prevention. Distribute pamphlets or posters in local languages highlighting environmental issues and solutions. </li> <li> <b>Surveys and Interviews</b><br/> Conduct structured surveys or informal interviews with residents, workers, and local authorities to assess pollution awareness and impacts.<br/> Use questionnaires to collect data on community health, waste disposal habits, or water usage. </li> <li> <b>Community Clean-up Drives</b><br/> Plan and participate in cleaning local water bodies, streets, parks, or waste dumping sites. Involve local volunteers, schools, and NGOs for greater impact. </li> <li> <b>Monitoring and Sampling Activities</b><br/> Engage community members in simple environmental monitoring such as air quality measurement, water testing, or noise level monitoring using portable instruments.<br/> Train locals on basic pollution detection methods. </li> <li> <b>Tree Plantation and Green Space Development</b><br/> Collaborate with community groups to plant trees and promote green spaces to improve air quality and reduce noise pollution. </li> <li> <b>Waste Management Workshops</b><br/> Educate communities on waste segregation, recycling, composting, and responsible disposal practices. Help set up or improve local waste management systems. </li> <li> <b>Advocacy and Policy Engagement</b><br/> Facilitate community discussions to gather feedback on local environmental policies. Support community members in communicating concerns to local governance bodies. </li> <li> <b>Participatory Mapping and Documentation</b><br/> Work with locals to map pollution hotspots or vulnerable areas using simple mapping tools or apps. Document pollution sources and their effects through photos and notes. </li> <li> <b>Environmental Education in Schools</b><br/> Conduct interactive sessions in nearby schools to raise awareness about pollution and sustainability among children. </li> <li> <b>Health Impact Assessments</b><br/> Collaborate with community health workers to understand and document pollution-related health issue </li> </ul> |
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Assessment Rubric for FP/CEP

| SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI PRACTICAL<br>EXAMINATION<br>B.Sc. III (Environmental Science), SEMESTER – V (NEP) |                                       |                                                                            |                  |
|---------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|----------------------------------------------------------------------------|------------------|
| FP/CEP                                                                                                                          | Course Code:<br>114228                | Field Project / Community Engagement Services<br>in Environmental Science: | Max Marks:<br>50 |
| Q. No.                                                                                                                          | Exercise                              |                                                                            | Marks            |
| 1                                                                                                                               | Data Collection                       |                                                                            | 15               |
| 2                                                                                                                               | Data Analysis & Interpretation        |                                                                            | 12               |
| 3                                                                                                                               | Report Writing                        |                                                                            | 10               |
| 4                                                                                                                               | Oral/Poster Presentation              |                                                                            | 08               |
| 5                                                                                                                               | Community Engagement & Sustainability |                                                                            | 05               |

**SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI**  
**FACULTY: Science and Technology**  
**Subject: ENVIRONMENTAL SCIENCE**  
**Teaching and Learning Scheme: for the Degree of Bachelor of Environmental Science (B.Sc.)**  
**Three Years / Four Years- (Six / Eight Semesters) Bachelor's Degree Programme**

**THIRD YEAR: Level 5.5 - SEMESTER – VI (T & L Credit Scheme)**

| Mode of Teaching                                           | Ver. No | Vertical                   | Type of Course    | Course Code | Course Name                                                                  | Credits | Workload (Hrs/Week) | Vertical Workload (Hrs/Week) |  |
|------------------------------------------------------------|---------|----------------------------|-------------------|-------------|------------------------------------------------------------------------------|---------|---------------------|------------------------------|--|
| Classroom Teaching / Lab Work (Practical)/ Outdoor / Field | a.      | Major                      | Theory-10         | 114229      | Natural Resource Management, Sustainability and Natural Resource Management. | 2       | 2                   | 16                           |  |
|                                                            |         |                            | Theory-11         | 114230      | Environmental Management and Governance                                      | 2       | 2                   |                              |  |
|                                                            |         |                            | Theory-12         | 114231      | Geospatial Technologies and Environmental legislation.                       | 2       | 2                   |                              |  |
|                                                            |         |                            | Lab/Practical-15  | 114232      | Practical based on Major-                                                    | 2       | 4                   |                              |  |
|                                                            |         | Major (Elective)           | Theory Elective-3 | 114233      | Health, Safety and Environmental Management Systems                          | 2       | 2                   |                              |  |
|                                                            |         |                            | Lab               | 114234      | Practical based on elective-3                                                |         |                     |                              |  |
|                                                            |         |                            | Theory Elective-4 | 114235      | Environmental Restoration and management                                     |         |                     |                              |  |
|                                                            |         |                            | Lab/Practical-17  | 114236      | Practical based on Major-Elective-4                                          | 2       | 4                   |                              |  |
|                                                            | b.      | Minor                      | Theory5           | 114237      | Environmental Education and Awareness                                        | 2       | 2                   | 6                            |  |
|                                                            |         |                            | Lab/Practical-18  | 114238      | Practical based on Minor                                                     | 2       | 4                   |                              |  |
|                                                            | c.      | Generic/Open Elective      | -                 | -           | -                                                                            | -       | -                   | -                            |  |
|                                                            | d.      | VSC                        | Lab/Practical-19  | 114279      | Hand on -Environmental audit                                                 | 2       | 4                   | 4                            |  |
|                                                            |         | SEC                        | -                 | -           | -                                                                            | -       | -                   |                              |  |
|                                                            | e.      | VEC                        | -                 | -           | -                                                                            | -       | -                   | 0                            |  |
|                                                            |         | Internship /Apprenticeship | OJT               | 114239      |                                                                              | 4       | 8                   | 8                            |  |
|                                                            | f.      | FP/CES                     | Project           | -           | --                                                                           | --      | --                  | --                           |  |
|                                                            |         | CC                         | -                 | -           | -                                                                            | -       | -                   | -                            |  |
|                                                            |         | TOTAL                      |                   |             |                                                                              | 22      | 34                  | 34                           |  |

Important:

- VSC Should be Complementary to Major

SEC has to be selected as per above T and L Scheme or from the Basket Provided by University, from the same Faculty/Discipline of the, Major/M

Sant Gadge Baba Amravati University, Amravati  
FACULTY: SCIENCE AND TECHNOLOGY  
Teaching and Learning Scheme: for the Degree of Bachelor of **Environmental Science**  
**Syllabus for Courses B.Sc. III Semester -VI**  
**Major Theory-10 Sustainable Natural Resource Management**

| Level | Course Code | Semester | Course Name                                             | Credit | Teaching Hours | Exam Duration | Max. Marks       |
|-------|-------------|----------|---------------------------------------------------------|--------|----------------|---------------|------------------|
| 5.5   | 114229      | VI       | Major Theory-10 Sustainable Natural Resource Management | 02     | 30             | 02            | Ext-30<br>Int-20 |

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course Objectives | <div><div><div>1. To understand the fundamental concepts and principles of sustainable natural resource management.</div><div>2. To explore the strategies and practices for forest resource management and conservation.</div><div>3. To assess the environmental impacts of mineral extraction and learn sustainable mining practices</div><div>4. To develop knowledge about the integrated management of soil, water, and land resources.</div><div>5. To recognize the importance of biodiversity and evaluate strategies for its conservation</div></div></div>                                                                                                                                                                                                                                                                              |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Course Outcome    | <div>After the completion of this course , student is able to-</div> <div><div>CO-1: Evaluate the principles of sustainability and apply them to the management of various natural resources.</div><div>CO-2: Formulate effective forest management and conservation plans to combat deforestation and habitat loss.</div><div>CO-3: Analyze the impact of mining activities and propose sustainable mineral resource management techniques.</div><div>CO-4: Implement integrated soil, water, and land management strategies to prevent degradation.</div><div>CO-5: Explain the basic concepts, scope, and applications of Biostatistics in biological, environmental, agricultural, and health sciences.</div><div>CO-6: Apply statistical methods for collection, classification, tabulation, and presentation of biological data.</div></div> |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Unit System       | Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Workload Allotted (Hrs) | Weightage of marks allotted | Incorporation of Pedagogies                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Unit-I            | Forest Resource Management                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 8                       | 8                           | <div><div><div><input type="checkbox"/> Classroom Lectures and Interactive Teaching</div><div><input type="checkbox"/> ICT Enabled Teaching and Audio-Visual Learning</div><div><input type="checkbox"/> Group Discussion, Seminar and Case Study Method</div><div><input type="checkbox"/> Field Visits to Forest Areas, Biodiversity Parks and Mining Sites</div><div><input type="checkbox"/> Project-Based Learning and Report Writing</div></div></div> |
|                   | 1.1 Introduction to Forest Resources: Types, ecological, and economic significance.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|                   | 1.2 Deforestation: Causes, consequences, and brief global trends.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|                   | 1.3 Sustainable Forest Management Practices: Basic concept of silviculture, social forestry, and agroforestry.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|                   | 1.4 Forest Policies and Conservation: Overview of National Forest Policy, Joint Forest Management (JFM).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Unit-II           | Mineral Resource Management                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 7                       | 7                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|                   | 2.1 Overview of Mineral Resources: Classification, distribution, and utilization.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|                   | 2.2 Environmental Impacts of Mining: Ecological degradation, pollution, and health hazards.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|                   | 2.3 Sustainable Mining Practices: Eco-friendly extraction, resource recovery, and recycling.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|                   | 2.4 Mine Reclamation and Restoration: Legal framework, post-mining land use, and rehabilitation.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Unit-III          | Soil, Water and Land Management                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 8                       | 8                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|                   | 3.1 Soil Resources: Soil conservation methods and sustainable soil management                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|                   | 3.2 Water resources: sources, uses, and conservation methods                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|                   | 3.3 Land Use Management: Sustainable land management practices                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

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| Unit-IV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>Biostatistics:</b><br>4.1. Introduction of statistics and biostatistics,<br>Data: its types, tabulation of data, types of tables | 7 | 7 |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 4.2. Statistical Methods: Mean, mode, median                                                                                        |   |   |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 4.3. Standard deviation, regression analysis.                                                                                       |   |   |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 4.4. Representation of Data diagrammatic representation and graphical representation of data.                                       |   |   |  |
| <b>References</b><br>1. Odum, E.P. (1971). <i>Fundamentals of Ecology</i> . W.B. Saunders Company.<br>2. Sharma, P.D. (2012). <i>Ecology and Environment</i> . Rastogi Publications.<br>3. Singh, J.S., Singh, S.P., & Gupta, S.R. (2014). <i>Ecology, Environmental Science and Conservation</i> . S. Chand Publishing.<br>4. Agarwal, K.C. (2001). <i>Environmental Biology</i> . Nidi Publ. Ltd. Bikaner.<br>5. Ministry of Environment, Forest and Climate Change (MoEFCC), Govt. of India – <i>Guidelines and Annual Reports</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                     |   |   |  |
| <b>Model Questions</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                     |   |   |  |
| <b>Short Type:</b><br>1. Define sustainable forest management.<br>2. What is the significance of Joint Forest Management (JFM)?<br>3. Classify the different types of mineral resources.<br>4. What are the major environmental impacts of open-cast mining?<br>5. Explain the concept and importance of watershed management.<br>6. What are the primary anthropogenic causes of land desertification?<br>7. Differentiate between In-situ and Ex-situ biodiversity conservation.<br>8. State the main objectives of the Wildlife Protection Act.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                     |   |   |  |
| <b>Long Type:</b><br><br>1. Discuss the causes and consequences of deforestation in detail and suggest sustainable management practices to mitigate it.<br>2. Explain the environmental impacts of mining activities and describe the detailed process of mine reclamation and ecological restoration.<br>3. Elaborate on integrated soil and water management strategies with a special focus on rainwater harvesting and sustainable agriculture.<br>4. Define biodiversity. Explain the major threats to biodiversity today and discuss the global strategies adopted for its conservation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                     |   |   |  |
| <b>MCQ</b><br>1. Which of the following is an <i>ex-situ</i> conservation method?<br>(a) National Park (b) Wildlife Sanctuary (c) Botanical Garden (d) Biosphere Reserve<br>2. The Joint Forest Management (JFM) concept was officially introduced in India in the year:<br>(a) 1972 (b) 1980 (c) 1990 (d) 2000<br>3. The process of restoring mined land to a natural or economically usable state is known as:<br>(a) Excavation (b) Reclamation (c) Deforestation (d) Depletion<br>4. Which agricultural practice is most effective in preventing soil erosion on steep mountain slopes?<br>(a) Overgrazing (b) Monoculture (c) Terrace farming (d) Shifting cultivation<br>5. The CITES international agreement is primarily related to:<br>(a) Ozone depletion (b) International trade of endangered species (c) Greenhouse gases (d) Wetland conservation<br>6. Rainwater harvesting is primarily recognized as a technique for:<br>(a) Soil conservation (b) Groundwater recharge (c) Mineral extraction (d) Forest management<br>7. The primary aim of social forestry is to:<br>(a) Increase commercial timber logging (b) Plant trees on barren lands for environmental and social benefits (c) Clear forests for agriculture (d) Ban all human activities in forests<br>8. Genetic diversity specifically refers to:<br>(a) Variation of species within an ecosystem (b) Variation of genes within a specific species (c) Diversity of ecosystems in a region (d) The total number of biomes on Earth |                                                                                                                                     |   |   |  |

| <b>Rubric for Internal Assessment of Major Theory Paper</b><br><b>SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI</b><br><b>Internal Assessment</b><br><b>B.Sc- IIISEMESTER – VI (NEP)</b> |                                                             |               |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|---------------|
| Code:<br>114229                                                                                                                                                                          | : Major Theory -10- Sustainable Natural Resource Management | Max Marks: 20 |
| Sr. No.                                                                                                                                                                                  | Assessment Criteria                                         | Marks         |
| 1                                                                                                                                                                                        | Attendance                                                  | 05            |
| 2                                                                                                                                                                                        | Class Assignments                                           | 05            |
| 3                                                                                                                                                                                        | Unit Test - MCQ                                             | 05            |
| 4                                                                                                                                                                                        | Overall Performance / Seminar / Case Study                  | 05            |

| <b>Major Theory-11: Environmental Management and Governance</b> |             |          |                                                          |        |                |               |                  |
|-----------------------------------------------------------------|-------------|----------|----------------------------------------------------------|--------|----------------|---------------|------------------|
| Level                                                           | Course Code | Semester | Course Name                                              | Credit | Teaching Hours | Exam Duration | Max. Marks       |
| 5.5                                                             | 114230      | VI       | Major Theory-11: Environmental Management and Governance | 02     | 30             | 02            | Ext-30<br>Int-20 |

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|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course Objectives | 1.To Understand key principles and tools of environmental management.<br>2.To Conduct basic Environmental Impact Assessments for projects and activities.<br>3. To Design and implement Environmental Management Systems in organizations<br>4.Apply Life Cycle Assessment techniques to evaluate environmental impacts.<br>5. To Assess and interpret ecological footprints for individuals, communities, and organizations.                                                                          |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Course Outcome    | After the completion of this course, student is able to-<br>CO-1 Critically analyze environmental impacts and propose mitigation strategies.<br>CO-2 Describe the structure and components of EMS.<br>CO-3 Perform life cycle assessments to support sustainable decision-making.<br>CO-4 Measure ecological footprints and suggest actions to reduce environmental impacts.<br>CO-5 Integrate environmental management practices into organizational and personal decision-making for sustainability. |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Unit System       | Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Workload Allotted (Hrs) | Weightage of marks allotted | Incorporation of Pedagogies                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Unit-I            | <b>Unit-I Environmental Impact Assessment (EIA)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 8                       | 8                           | <input type="checkbox"/> Classroom Lectures and Interactive Teaching<br><input type="checkbox"/> ICT Enabled Teaching with Audio-Visual Presentations<br><input type="checkbox"/> Group Discussion, Seminar and Case Study Analysis<br><input type="checkbox"/> Practical Demonstration and Environmental Data Interpretation<br><input type="checkbox"/> Project-Based Learning, Assignment and Report Writing<br><input type="checkbox"/> Industrial Visits and Field Surveys related to EIA and EMS, |
|                   | 1.1 -Definition, Goals & objectives of Environment Impact Assessment                                                                                                                                                                                                                                                                                                                                                                                                                                   |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|                   | 1.2 - EIA categories in India                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|                   | 1.3 – EIA Process and Methodology                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|                   | 1.4. Role of EIA in sustainable development                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|                   | <b>Unit-II Environmental Management Systems (EMS)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Unit-II           | 2.1- Definition, concept, and importance of EMS                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 7                       | 7                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|                   | 2.2. Principles and objectives of EMS                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|                   | 2.3. EMS and sustainable development                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|                   | 2.4. Benefits of EMS implementation in industries and organizations                                                                                                                                                                                                                                                                                                                                                                                                                                    |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Unit-III          | <b>Unit III - Life Cycle Assessment (LCA)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|                   | 3.1 -Fundamentals of LCA – Definition, scope, and objectives                                                                                                                                                                                                                                                                                                                                                                                                                                           | 8                       | 8                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|                   | 3.2 – Procedure for LCA - Defining goal and scope, preparation of life cycle inventory                                                                                                                                                                                                                                                                                                                                                                                                                 |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|                   | 3.3 - Assessment of environmental impact                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|                   | 3.4 - Areas for Improvement and Interpretations.                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Unit-IV           | <b>Unit IV: Ecological Footprint (EF) &amp; Environmental Design (ED)</b>                                                                                                                                                                                                                                                                                                                                                                                                                              |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 4.2 - Components of EF – Carbon, water, land, and resource footprints |   |   |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 4.3 - Environmental Design – Principles & scope                       |   |   |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 4.4 -Importance and Applications of Environmental Design.             |   |   |  |
| <b>References:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                       |   |   |  |
| <div>1. Press (India) Pvt. Ltd.</div> <div>2. Fundamentals of Ecology and Environment<br/>Publisher: Rastogi Publications.</div> <div>3. Environmental Pollution and Control<br/>Publisher: Galgotia Publishing Company.</div> <div>4. A Textbook of Environmental Studies<br/>Publisher: Himalaya Publishing House.</div> <div>5. Environmental Management and Sustainable Development<br/>Publisher: BS Publications.</div> <div>6. Review of Indian Studies on Environmental Impact Assessment<br/>Kritika &amp; Sharma, A. (2025). <i>Review of Indian Studies on Environmental Impact Assessment</i>. Integrated Environmental Assessment and Management, 21(1), 117– Environmental Management<br/>Publisher: Excel Books, New Delhi.</div> <div>7. Environmental Impact Assessment<br/>Publisher: APH Publishing Corporation, New Delhi.</div> <div>8. Environmental Science and Engineering<br/>Publisher: Prentice Hall India / McGraw Hill India.</div> <div>9. Textbook of Environmental Studies<br/>Publisher: S. Chand Publishing.</div> <div>10. Environmental Engineering and Management<br/>Publisher: S.K. Kataria &amp; Sons.</div> <div>11. Environmental Studies<br/>Publisher: Universities 130.<br/>DOI: 10.1093/inteam/vjae004</div> <div>12. Review of Environmental Impact Assessment Applications in New Delhi’s Urban Development<br/>Kritika. (2026). <i>Review of Environmental Impact Assessment Applications in New Delhi’s Urban Development: A Systematic PRISMA Review</i>. Integrated Environmental Assessment and Management.<br/>DOI: 10.1093/inteam/vjag041</div> <div>13. A BIM-based Integrated Framework for Building Sustainability Assessment in India<br/><i>Environmental Impact Assessment Review</i>, 118, 108318.<br/>Discusses sustainability assessment, LCA, GRIHA, and IGBC frameworks in India.</div> <div>14. Environmental Life Cycle Assessment of Indian Coal-Fired Power Plants<br/>Singh, U., Sharma, N., &amp; Mahapatra, S.S. (2016). <i>Environmental life cycle assessment of Indian coal-fired power plants</i>. International Journal of Coal Science and Technology, 3(2), 215–225.<br/>DOI: 10.1007/s40789-016-0136-z</div> <div>15. Life Cycle Environmental Assessment of State and National Highways in India<br/>Aryan, Y., Dikshit, A.K., &amp; Shinde, A.M. <i>Life cycle environmental assessment of state and national highways in India</i>.<br/>Based on ISO 14040 and ISO 14044 standards.</div> <div>16. Environmental and Economic Performance Evaluation of Municipal Wastewater Treatment Plants in India<br/>Kamble, S., Singh, A., Kazmi, A., &amp; Starkl, M. (2019). <i>Environmental and economic performance evaluation of municipal wastewater treatment plants in India: A life cycle approach</i>. Water Science &amp; Technology.<br/>DOI: 10.2166/wst.2019.110</div> <div>17. Ecological Footprint Reduction of Built Envelope in India<br/><i>Journal of Building Engineering</i>, 21, 278–286.<br/>DOI: 10.1016/j.jobe.2018.10.018</div> <div>18. Ecological Footprint of Residential Buildings in Composite Climate of India<br/><i>Sustainability</i>, 13(21), 11949.<br/>DOI: 10.3390/su132111949</div> <div>19. Life-Cycle Ecological Footprint Assessment of Grid-Connected Rooftop Solar PV System<br/>Biswas, A., Husain, D., &amp; Prakash, R. (2020). <i>Life-cycle ecological footprint assessment of grid-connected rooftop solar PV system</i>.<br/>DOI: 10.1080/19397038.2020.1783719</div> |                                                                       |   |   |  |
| <b>Model Questions</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                       |   |   |  |
| <div>1. Short Type:</div> <div>1. Define Environmental Impact Assessment (EIA).</div> <div>2. What are the objectives of Environmental Management?</div> <div>3. List any four steps involved in EIA.</div> <div>4. What is Environmental Management System (EMS)?</div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                       |   |   |  |

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| <ol style="list-style-type: none"> <li>State the importance of ISO 14001.</li> <li>Differentiate between ISO 14000 and ISO 14001.</li> <li>Define Life Cycle Assessment (LCA).</li> <li>What is Life Cycle Inventory (LCI)?</li> <li>Define Ecological Footprint (EF).</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <p>Long Type:</p> <ol style="list-style-type: none"> <li>Explain the concept, objectives, and importance of Environmental Impact Assessment (EIA).</li> <li>Describe the various steps involved in the EIA process with suitable examples.</li> <li>Discuss the key classifications of EIA in India.</li> <li>Explain the concept, need, and benefits of Environmental Management Systems (EMS).</li> <li>Describe the structure and elements of ISO 14001 Environmental Management System.</li> <li>Differentiate between ISO 14000 and ISO 14001 with suitable examples.</li> <li>Explain the fundamentals, scope, and objectives of Life Cycle Assessment (LCA).</li> <li>Describe the procedure involved in Life Cycle Assessment including goal definition, scope, inventory analysis, and impact assessment.</li> <li>Explain the concept and components of Ecological Footprint with suitable examples.</li> <li>Discuss the principles and importance of Environmental Design in sustainable development.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <p>MCQ:</p> <ol style="list-style-type: none"> <li>EIA stands for: <ol style="list-style-type: none"> <li>Environmental Industrial Assessment</li> <li>Environmental Impact Assessment</li> <li>Ecological Impact Analysis</li> <li>Environmental Internal Audit</li> </ol> <b>Answer:</b> b) Environmental Impact Assessment </li> <li>Which of the following is the first step in EIA? <ol style="list-style-type: none"> <li>Monitoring</li> <li>Screening</li> <li>Auditing</li> <li>Reporting</li> </ol> <b>Answer:</b> b) Screening </li> <li>ISO 14001 is related to: <ol style="list-style-type: none"> <li>Quality management</li> <li>Financial auditing</li> <li>Environmental Management System</li> <li>Waste disposal only</li> </ol> <b>Answer:</b> c) Environmental Management System </li> <li>EMS mainly helps organizations to: <ol style="list-style-type: none"> <li>Increase pollution</li> <li>Improve environmental performance</li> <li>Reduce productivity</li> <li>Avoid documentation</li> </ol> <b>Answer:</b> b) Improve environmental performance </li> <li>LCA stands for: <ol style="list-style-type: none"> <li>Life Cycle Assessment</li> <li>Land Conservation Analysis</li> <li>Life Cost Audit</li> <li>Local Climate Assessment</li> </ol> <b>Answer:</b> a) Life Cycle Assessment </li> <li>Which stage is included in LCA? <ol style="list-style-type: none"> <li>Inventory analysis</li> <li>Marketing</li> <li>Packaging only</li> <li>Tax assessment</li> </ol> <b>Answer:</b> a) Inventory analysis </li> <li>Ecological Footprint measures: <ol style="list-style-type: none"> <li>Industrial profit</li> <li>Human demand on natural resources</li> <li>Population density only</li> <li>Noise pollution</li> </ol> <b>Answer:</b> b) Human demand on natural resources </li> <li>Carbon footprint is a component of: <ol style="list-style-type: none"> <li>EMS</li> <li>Ecological Footprint</li> <li>EIA</li> <li>ISO 9001</li> </ol> <b>Answer:</b> b) Ecological Footprint </li> <li>Environmental Design mainly focuses on: <ol style="list-style-type: none"> <li>Luxury construction</li> <li>Sustainable and eco-friendly planning</li> <li>Industrial expansion only</li> <li>Mining activities</li> </ol> <b>Answer:</b> b) Sustainable and eco-friendly planning </li> </ol> |

|                                                                                                                                                                                                         |
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| <p>10. Human comfort and sustainability are principles of:</p> <p>a) Environmental Design</p> <p>b) EIA</p> <p>c) ISO Audit</p> <p>d) Risk Assessment</p> <p><b>Answer:</b> a) Environmental Design</p> |
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| <b>Rubric for Internal Assessment of Major Theory Paper</b><br>SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI<br><b>Internal Assessment</b><br>B.Sc.- III SEMESTER – VI (NEP) |                                                           |               |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|---------------|
| Code:114230                                                                                                                                                                  | Major Theory -11- Environmental Management and Governance | Max Marks: 20 |
| Sr. No.                                                                                                                                                                      | Assessment Criteria                                       | Marks         |
| 1                                                                                                                                                                            | Attendance                                                | 05            |
| 2                                                                                                                                                                            | Class Assignments                                         | 05            |
| 3                                                                                                                                                                            | Unit Test - MCQ                                           | 05            |
| 4                                                                                                                                                                            | Overall Performance / Seminar / Case Study                | 05            |

| Major Theory-12: Geospatial Technologies and Environmental Legislations |             |          |                                                                         |        |                |               |                  |
|-------------------------------------------------------------------------|-------------|----------|-------------------------------------------------------------------------|--------|----------------|---------------|------------------|
| Level                                                                   | Course Code | Semester | Course Name                                                             | Credit | Teaching Hours | Exam Duration | Max. Marks       |
| 5.5                                                                     | 114231      | VI       | Major Theory-12: Geospatial Technologies and Environmental Legislations | 02     | 30             | 02            | Ext-30<br>Int-20 |

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| Course Objectives | <ol style="list-style-type: none"> <li>To introduce the basic concepts of Remote Sensing and Geographic Information System (GIS).</li> <li>To understand different types of satellite data, sensors, and image interpretation techniques.</li> <li>To develop practical knowledge of GIS mapping and spatial data handling.</li> <li>To study environmental applications of Remote Sensing and GIS in resource management and monitoring.</li> <li>To introduce students to the concept, scope, and importance of environmental legislation and governance.</li> <li>To develop understanding of national and international environmental laws, policies, and conventions.</li> <li>To familiarize students with constitutional provisions and legal frameworks related to environmental protection.</li> <li>To provide knowledge of major environmental acts related to air, water, forest, wildlife, biodiversity, and pollution control.</li> </ol>                                                                 |                         |                             |                             |
| Course Outcome    | <p>After successful completion of the course, students will be able to:</p> <p>CO-1. Explain the basic principles and components of Remote Sensing and GIS.</p> <p>CO-2. Interpret satellite images and spatial data.</p> <p>CO-3. Use GIS software for mapping and spatial analysis.</p> <p>CO-4. Apply Remote Sensing and GIS techniques in environmental management and planning.</p> <p>CO-5. Prepare thematic maps for environmental applications.</p> <p>CO-6. Explain the principles, scope, and significance of environmental legislation and governance.</p> <p>CO-7. Describe constitutional provisions, environmental policies, and international agreements related to environmental protection.</p> <p>CO-8 Interpret major environmental laws such as the Water Act, Air Act, Environment Protection Act, Forest Conservation Act, and Wildlife Protection Act.</p> <p>CO-9. Identify the functions and responsibilities of pollution control boards, environmental authorities, and judicial bodies.</p> |                         |                             |                             |
| Unit System       | Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Workload Allotted (Hrs) | Weightage of marks allotted | Incorporation of Pedagogies |
| Unit-I            | <b>Unit I: Fundamentals of Geospatial Technologies</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 8                       | 8                           | Lectures<br>Demonstrations  |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                       |   |   |                                                                         |
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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 1.2 Basics of Remote Sensing – Principles, types and applications                                                                                                                     |   |   |                                                                         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 1.3 Geographic Information System (GIS) – Components, functions and applications                                                                                                      |   |   |                                                                         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 1.4 Global Positioning System (GPS) – Working principle and environmental applications                                                                                                |   |   |                                                                         |
| Unit-II                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>Unit-II Applications of Geospatial Technologies in Environment</b><br>2.1 GIS and Remote Sensing in Natural Resource Management                                                    | 7 | 7 |                                                                         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 2.2: Air, Water and Soil Pollution Monitoring                                                                                                                                         |   |   |                                                                         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 2.3: Watershed Management and Land Use/Land Cover Mapping                                                                                                                             |   |   |                                                                         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 2.4 Environmental Design, Disaster Management and Climate Change Studies using Geospatial Tools                                                                                       |   |   |                                                                         |
| Unit-III                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>Sustainable Development and Environmental Governance</b><br>3.1 Environmental Education and Public Awareness Programmes                                                            | 8 | 8 |                                                                         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 3.2 Green Technology and Sustainable Environmental Practices                                                                                                                          |   |   |                                                                         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 3.3 Role of National Environmental organizations and Agreements.                                                                                                                      |   |   |                                                                         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 3.4 Role of International Environmental organizations and Agreements                                                                                                                  |   |   |                                                                         |
| Unit-IV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>Environmental Legislations and Policies</b><br>4.1 Introduction to Environmental Laws – Need and significance                                                                      | 7 | 7 |                                                                         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 4.2 Environmental Protection Act, 1986: Objectives, Features and Powers                                                                                                               |   |   |                                                                         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 4.3 Water (Prevention and Control of Pollution) Act - 1974 Objectives, Features and Powers, and Air (Prevention and Control of Pollution) Act, 1981 - Objectives, Features and Powers |   |   |                                                                         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 4.4 Wildlife Protection Act, 1972 - Objectives, Features and Powers and Forest Conservation Act, 1980 - Objectives, Features and Powers,                                              |   |   |                                                                         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                       |   |   |                                                                         |
| <b>References:</b> <ul style="list-style-type: none"><li>○ Environmental Studies – Universities Press, Hyderabad.</li><li>○ Environmental Science – Tata McGraw Hill Education.</li><li>○ Remote Sensing and Geographical Information System – BS Publications, Hyderabad.</li><li>○ Principles of Geographic Information Systems – Oxford University Press India.</li><li>○ Environmental Law and Policy in India – Oxford University Press, New Delhi.</li><li>○ Environmental Management – Excel Books, New Delhi.</li></ul> <ul style="list-style-type: none"><li>● Textbook of Environmental Studies – S. Chand Publishing.</li><li>● Fundamentals of Remote Sensing – Universities Press.</li><li>● Remote Sensing and Image Interpretation – John Wiley &amp; Sons.</li><li>● Geographic Information Systems and Science – Wiley Publications.</li><li>● Introduction to Environmental Engineering and Science – Pearson Education.</li><li>● Environmental Science: A Global Concern – McGraw Hill Education.</li><li>● Principles of Environmental Science – McGraw Hill.</li><li>● Fundamentals of Geographic Information Systems – Wiley India / Wiley Publications.</li><li>● GIS Fundamentals: A First Text on Geographic Information Systems – Eider Press.</li><li>● Environmental Policies and Strategies – APH Publishing Corporation.</li></ul> <b>Important Journals and Periodicals</b> <ol style="list-style-type: none"><li>1. Remote Sensing of Environment — Elsevier Publications.</li><li>2. Geocarto International — Taylor &amp; Francis Publications.</li><li>3. International Journal of Remote Sensing</li><li>4. International Journal of Geographical Information Science</li><li>5. Remote Sensing Applications: Society and Environment</li></ol> <b>Useful Online Resources</b> <ul style="list-style-type: none"><li>● INFLIBNET Remote Sensing &amp; GIS Book</li></ul> |                                                                                                                                                                                       |   |   |                                                                         |

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| <ul style="list-style-type: none"> <li>• <a href="#">Cambridge Remote Sensing &amp; GIS Resources</a></li> <li>• <a href="#">Wiley GIS &amp; Remote Sensing Books</a></li> <li>• <a href="#">Springer Remote Sensing for Environmental Monitoring</a>.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Model Questions</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <p><b>Short Questions:</b></p> <ol style="list-style-type: none"> <li>1. Define Geospatial Technology.</li> <li>2. What is Remote Sensing?</li> <li>3. Write any two applications of GIS.</li> <li>4. Define GPS and mention its uses.</li> <li>5. What is Natural Resource Management?</li> <li>6. State the importance of Land Use/Land Cover Mapping.</li> <li>7. What is Disaster Management?</li> <li>8. Define Climate Change.</li> <li>9. What is the Environmental Protection Act, 1986?</li> <li>10. <input type="checkbox"/> Write the objectives of the Water (Prevention and Control of Pollution) Act, 1974.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <p><b>Long Type:</b></p> <ol style="list-style-type: none"> <li>1. Explain the concept, scope and importance of Geospatial Technologies.</li> <li>2. Describe the principles, types and applications of Remote Sensing.</li> <li>3. Discuss the components, functions and environmental applications of GIS.</li> <li>4. Explain the working principle and applications of GPS in environmental studies.</li> <li>5. Describe the role of GIS and Remote Sensing in Natural Resource Management.</li> <li>6. Explain the applications of Geospatial Technologies in air, water and soil pollution monitoring.</li> <li>7. Discuss watershed management and land use/land cover mapping using geospatial tools.</li> <li>8. Explain the role of Geospatial Technologies in disaster management and climate change studies.</li> <li>9. Discuss the salient features of the Environmental Protection Act, 1986.</li> <li>10. Explain the objectives and provisions of the Water Act, 1974 and Air Act, 1981.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <p><b>MCQ</b></p> <ol style="list-style-type: none"> <li>1. Which technology is used to collect information about the Earth without direct contact?<br/>a) GIS, b) GPS, c) Remote Sensing, d) Surveying<br/><b>Answer:</b> c) Remote Sensing</li> <li>2. GIS stands for:<br/>a) Global Information System, b) Geographic Information System, c) Geographical Internet Service<br/>d) Global Imaging Science<br/><b>Answer:</b> b) Geographic Information System</li> <li>3. GPS is mainly used for:<br/>a) Water purification, b) Soil analysis, c) Location and navigation, d) Waste treatment<br/><b>Answer:</b> c) Location and navigation</li> <li>4. Which geospatial tool is most useful for land use mapping?<br/>a) GPS, b) GIS, c) Thermometer, d) Microscope<br/><b>Answer:</b> b) GIS</li> <li>5. Remote sensing satellites are mainly used for:<br/>a) Cooking food, b) Environmental monitoring, c) Banking ,d) Printing maps only<br/><b>Answer:</b> b) Environmental monitoring</li> <li>6. The Environmental Protection Act in India was enacted in:<br/>a) 1972, b) 1974, c) 1981, d) 1986<br/><b>Answer:</b> d) 1986</li> <li>7. The Water (Prevention and Control of Pollution) Act was passed in:<br/>a) 1974, b) 1980, c) 1986, d) 1991<br/><b>Answer:</b> a) 1974</li> <li>8. The Air (Prevention and Control of Pollution) Act was enacted in:<br/>a) 1972, b) 1981, c) 1986, d) 2002<br/><b>Answer:</b> b) 1981</li> <li>9. Which Act is related to wildlife conservation in India?<br/>a) Forest Conservation Act, b) Wildlife Protection Act ,c) Air Act, d) Water Act<br/><b>Answer:</b> b) Wildlife Protection Act</li> </ol> |

| Rubric for Internal Assessment for MajorTheory Paper<br>SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI<br><b>Internal Assessment</b><br>B.Sc- IIISEMESTER – VI (NEP) |                                                                        |               |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|---------------|
| Code:114231                                                                                                                                                         | Paper: Major-12: Geospatial Technologies and Environmental Legislation | Max Marks: 20 |
| Sr. No.                                                                                                                                                             | Assessment Criteria                                                    | Marks         |
| 1                                                                                                                                                                   | Attendance                                                             | 05            |
| 2                                                                                                                                                                   | Class Assignments                                                      | 05            |
| 3                                                                                                                                                                   | Unit Test - MCQ                                                        | 05            |
| 4                                                                                                                                                                   | Overall Performance / Seminar / Case Study                             | 05            |

**Lab/ Pract- Based on Major – 114228, 114229 & 114230**

| Level | Course Code | Semester | Course Name                                 | Credit | Teaching Hours | Exam Duration | Max. Marks        |
|-------|-------------|----------|---------------------------------------------|--------|----------------|---------------|-------------------|
| 5.5   | 114232      | VI       | Lab/ Pact.: Major – 114228, 114229 & 114230 | 02     | 60             | 04            | Ext.25<br>Int. 25 |

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| Course Objectives                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <ol style="list-style-type: none"> <li>To develop practical skills in assessing and measuring forest resources and tree biomass.</li> <li>To analyze the physical and chemical properties of soil and water to evaluate land and watershed health</li> <li>To provide hands-on training in ecological methodologies for measuring and evaluating biodiversity.</li> <li>To identify common minerals and understand the environmental implications of resource extraction</li> <li>To facilitate field-based learning through visits to conservation sites, watersheds, or degraded landscapes</li> </ol>                                                                                                                                   |
| Course Outcome                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <p><b>After the completion of this course, student will be able to-</b></p> <p><b>CO-1:</b> Students will be able to measure forest inventory parameters and estimate above-ground biomass.</p> <p><b>CO-2:</b> Students will demonstrate proficiency in standard laboratory techniques for soil and water quality analysis.</p> <p><b>CO-3:</b> Students will be capable of applying ecological indices (e.g., Shannon-Wiener) to assess biodiversity.</p> <p><b>CO-4:</b> Students will analyze natural resource degradation and suggest sustainable management practices based on experimental data.</p> <p><b>CO-5:</b> Students will successfully compile, interpret, and present field data in comprehensive scientific reports.</p> |
| List of Experiment/ Exercise                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <p><b>A-Practical on Sustainable Natural Resource Management</b></p> <ol style="list-style-type: none"> <li>Observation and study of major minerals.</li> <li>Assessment of environmental impacts of mining/quarries activities in local area.</li> <li>Study of water conservation methods such as rainwater harvesting and watershed management.</li> <li>Estimation of Tree Biomass of local forest area.</li> <li>Estimation of Carbon Sequestration at local area</li> <li>Study of Leaf Litter Decomposition.</li> <li>To study the composition of Leaf Litter from local area</li> <li>Water Quality Assessment near Mining Area.</li> <li>Estimation of Soil Erosion using USLE Method.</li> <li>Study of Invasive/Alien Species in Local Area.</li> <li>Field Visit to National Park/Wildlife Sanctuary or Botanical Garden.</li> <li>To study the biodiversity of college campus</li> <li>Preparation of Biodiversity Register of College Campus.</li> </ol> <p><b>B- Practical on Environmental Management and Governance</b></p> <ol style="list-style-type: none"> <li>Study of environmental problems in the local area.</li> <li>Preparation of a simple EIA checklist for road or building construction.</li> <li>Identification of positive and negative environmental impacts of developmental projects.</li> <li>Visit to a nearby industry or construction site for the study of environmental practices.</li> <li>Study of ISO 14001 certification logo and documentation.</li> <li>Comparison between ISO 14000 and ISO 14001 standards.</li> <li>Environmental audit of different sections of college campus.</li> <li>Calculation of personal carbon footprint using simple methods.</li> <li>Preparation of flow chart for life cycle of plastic bottle or paper bag.</li> </ol> <p><b>C- Practical on Geospatial Technologies and Environmental Legislations</b></p> <ol style="list-style-type: none"> <li>Identification of satellite images and Arial photographs</li> <li>Collection of GPS coordinates.</li> <li>Interpretation of satellite images.</li> <li>Preparation of Land Use/Land Cover (LULC) maps.</li> <li>Spatial analysis exercises in GIS.</li> <li>Study of EIA notification procedures and environmental clearance process.</li> <li>Charts preparation of Protected Areas and wild life sanctuary.</li> <li>Visit to Pollution Control Board / Environmental Agency/NEERI/NBSSLUP</li> </ol> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

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| 9. Submission of field visit report of MPCB or Environmental Agencies<br>10. Indexing of toposheet<br>11. Study of sign and symbols of toposheet<br>12. Study of marginal information of toposheet.<br>13. Preparation of thematic map – River/Watershed Area/Lake<br>14. Interpretation of weather map<br>15. Study of sign and symbols weather map                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>References</b> <ol style="list-style-type: none"> <li>1. Environmental Studies – Universities Press, Hyderabad.</li> <li>2. Textbook of Environmental Studies – S. Chand Publishing, New Delhi.</li> <li>3. Environmental Management – Excel Books, New Delhi.</li> <li>4. Remote Sensing and Geographical Information System – BS Publications, Hyderabad.</li> <li>5. Environmental Law and Policy in India – Oxford University Press, New Delhi.</li> <li>6. Fundamentals of Remote Sensing – Universities Press, Hyderabad.</li> <li>7. Environmental Science – New Central Book Agency, Kolkata.</li> <li>8. A Handbook of Geology – World Press Pvt. Ltd.</li> <li>9. Remote Sensing and Image Interpretation – John Wiley &amp; Sons.</li> <li>10. Geographic Information Systems and Science – Wiley Publications.</li> <li>11. GIS Fundamentals: A First Text on Geographic Information Systems – Eider Press.</li> <li>12. Introduction to Environmental Engineering and Science – Pearson Education.</li> <li>13. Environmental Science: A Global Concern – McGraw Hill Education.</li> <li>14. Principles of Environmental Science – McGraw Hill.</li> <li>15. Environmental Management for Sustainable Development – Routledge Publications.</li> <li>16. Manual of Remote Sensing – American Society of Photogrammetry.</li> </ol> |
| <b>E-Contents / E-Books (Free or Purchase Links)</b> <ol style="list-style-type: none"> <li>1. MoEFCC Annual Reports &amp; Guidelines: <a href="https://moef.gov.in/">https://moef.gov.in/</a></li> <li>2. Central Ground Water Board (CGWB) Manuals: <a href="http://cgwb.gov.in/">http://cgwb.gov.in/</a></li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Digital Resources / Web Links</b> <ol style="list-style-type: none"> <li>1. India Biodiversity Portal: <a href="https://indiabiodiversity.org/">https://indiabiodiversity.org/</a></li> <li>2. Forest Survey of India (FSI) E-resources: <a href="https://fsi.nic.in/">https://fsi.nic.in/</a></li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

#### Assessment Rubric for Internal Assessment for Practical

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|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------|--------------|---------------|
| I                  | SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI<br><b>Internal Assessment for Lab Work</b><br>B.Sc.III (Environmental Science) SEMESTER–VI (NEP) |              |               |
| Course Code:114232 | <b>Major Lab:</b> Environmental Resource Management and Geospatial Studies                                                                     |              | Max Marks: 25 |
| <b>Sr. No.</b>     | <b>Assessment Criteria</b>                                                                                                                     | <b>Marks</b> |               |
| 1                  | Active Participation and Performance of Practical                                                                                              | 10           |               |
| 2                  | Lab Journal / Practical Record Book                                                                                                            | 05           |               |
| 3                  | Field Visit Report / Assignment                                                                                                                | 05           |               |
| 4                  | Viva-Voce                                                                                                                                      | 05           |               |
|                    | Total                                                                                                                                          | 25           |               |

#### Assessment Rubric for External Assessment for Practical

|                     |                                                                                                                                                 |                             |  |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|--|
| E                   | SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI<br><b>External Assessment for Lab Work</b><br>B.Sc .III(Environmental Science) SEMESTER– VI (NEP) |                             |  |
| Course Code: 114232 | <b>Major Lab:</b> Environmental Resource Management and Geospatial Studies                                                                      | Max Marks: 25, time: 4Hours |  |
| <b>Sr. No.</b>      | <b>Assessment Criteria</b>                                                                                                                      | <b>Marks</b>                |  |
| 1                   | Any one experiment on Practical on Sustainable Natural Resource Management                                                                      | 07                          |  |
| 2                   | Any one experiment on Practical on Environmental Management and Governance                                                                      | 07                          |  |
| 3                   | Any one experiment on Practical on Geospatial Technologies and Environmental Legislations                                                       | 07                          |  |
| 4                   | Viva-Voce                                                                                                                                       | 04                          |  |
|                     | Total                                                                                                                                           | 25                          |  |

### Major Elective-3: Health, Safety and Environmental Management Systems

| Level | Course Code | Semester | Course Name                                                           | Credit | Teaching Hours | Exam Duration | Max. Marks       |
|-------|-------------|----------|-----------------------------------------------------------------------|--------|----------------|---------------|------------------|
| 5.5   | 114233      | VI       | Major Elective-3: Health, Safety and Environmental Management Systems | 02     | 30             | 02            | Ext-30<br>Int-20 |

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| Course Objectives | <div><div><div>1. Develop advanced understanding of occupational health, industrial hygiene and workplace exposure assessment techniques.</div><div>2. Provide knowledge of occupational toxicology, chemical hazard management and occupational health programmes.</div><div>3. Enhance understanding of stress management, mental health and workplace wellness systems.</div><div>4. Familiarize students with Hazard Identification and Risk Assessment (HIRA) and advanced industrial safety management practices.</div><div>5. Train students in accident investigation, root cause analysis, safety reporting and safety audit techniques.</div><div>6. Develop awareness about process safety management, construction safety and behaviour-based safety approaches.</div></div></div>                                                                                           |                         |                             |                                                                                                                            |
| Course Outcome    | <div>After successful completion of the course, students will be able to:</div> <div>CO1 - Understand advanced concepts of occupational health, industrial hygiene and workplace exposure assessment techniques.</div> <div>CO2-Identify chemical hazards, occupational toxicological effects and appropriate hazard management practices.</div> <div>CO3- Apply knowledge of health surveillance, epidemiology, stress management and workplace wellness systems in occupational settings.</div> <div>CO4- Perform Hazard Identification and Risk Assessment (HIRA) and implement industrial safety management practices.</div> <div>CO5 -Analyze industrial accidents using root cause analysis, safety reporting and safety audit techniques.</div> <div>CO6 -Demonstrate understanding of process safety management, construction safety and behavior-based safety approaches.</div> |                         |                             |                                                                                                                            |
| Unit System       | Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Workload Allotted (Hrs) | Weightage of marks allotted | Incorporation of Pedagogies                                                                                                |
| Unit-I            | <b>Occupational Health and Industrial Hygiene</b><br>1.1 Industrial hygiene and occupational exposure assessment techniques.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 8                       | 8                           | 1) Lectures<br>2) Demonstrations<br>3) Practical laboratory sessions<br>4) Field visits<br>5) Case study<br>6) Discussions |
|                   | 1.2 Occupational toxicology and chemical hazard management                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                         |                             |                                                                                                                            |
|                   | 1.3 Health surveillance, epidemiology and occupational health programmes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                         |                             |                                                                                                                            |
|                   | 1.4 Stress management, mental health and workplace wellness systems.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                         |                             |                                                                                                                            |
| Unit-II           | <b>Advanced Industrial Safety Management</b><br>2.1 Hazard Identification and Risk Assessment (HIRA).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 7                       | 7                           |                                                                                                                            |
|                   | 2.2 Accident investigation, root cause analysis and safety reporting systems                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                         |                             |                                                                                                                            |
|                   | 2.3 Process safety management and construction safety management.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                         |                             |                                                                                                                            |
|                   | 2.4 Safety audit, inspection techniques and behavior-based safety approaches                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                         |                             |                                                                                                                            |
| Unit-III          | <b>Environmental and Disaster Management</b><br>3.1 Concept of Industrial disasters                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 8                       | 8                           |                                                                                                                            |
|                   | 3.2 Emergency preparedness and response planning for Industrial disasters                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                         |                             |                                                                                                                            |
|                   | 3.3 Climate change adaptation, carbon management and sustainability practices.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                         |                             |                                                                                                                            |

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| Unit-IV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>HSE Management Systems and Professional Practices</b>                           | 7 | 7 |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 4.1 Occupational Health and Safety Management System (ISO 45001).                  |   |   |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 4.2 Environmental Management System (ISO 14001)                                    |   |   |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 4.3 Indian and international legislation related to health, safety and environment |   |   |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 4.4 Research trends, entrepreneurship and career opportunities in HSE sector.      |   |   |  |
| <b>Reference Books</b><br><b>Health, Safety and Environment – II</b> <ol style="list-style-type: none"> <li>1. Industrial Safety Management — by L. M. Deshmukh</li> <li>2. Industrial Safety, Health and Environment Management Systems — by R. K. Jain and Sunil S. Rao</li> <li>3. Occupational Health and Safety Management — by Charles D. Reese</li> <li>4. Fundamentals of Industrial Safety and Health — by Mark A. Friend and James P. Kohn</li> <li>5. Safety and Accident Prevention in Chemical Operations — by H. H. Fawcett and W. S. Wood</li> <li>6. Industrial Hygiene and Chemical Safety — by M. H. Fulekar</li> <li>7. Industrial Hygiene Evaluation Methods — by R. E. Goyer and M. A. Mehlman</li> <li>8. Occupational Safety and Health Simplified for the Industrial Workplace — by Frank R. Spellman</li> <li>9. Process Safety Management — by Daniel A. Crowl and Joseph F. Louvar</li> <li>10. Chemical Process Safety — by Daniel A. Crowl and Joseph F. Louvar</li> <li>11. Risk Assessment and Management Handbook — by David Einolf</li> <li>12. Environmental Laws in India — by P. Leelakrishnan</li> <li>13. Environmental Protection and the Law — by A. Kumar</li> <li>14. Waste Management Practices — by John Pichtel</li> <li>15. Integrated Management Systems — by Charantimath Poornima</li> <li>16. ISO 14001 Environmental Systems Handbook — by Christopher Sheldon and Mark Yoxon</li> <li>17. Environmental and Pollution Awareness — by R. Rajagopalan</li> <li>18. Disaster Management — by S. K. Singh</li> <li>19. Hazardous Waste Management — by M. N. Rao and Razia Sultana</li> <li>20. Occupational Health and Hygiene — by</li> </ol> |                                                                                    |   |   |  |
| <b>Model Questions</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                    |   |   |  |
| <b>A) Long Answer Questions</b> <ol style="list-style-type: none"> <li>1. Explain the concept, objectives and importance of Industrial Hygiene in occupational health and safety management.</li> <li>2. Describe different types of occupational hazards in industries and explain preventive and control measures for each.</li> <li>3. Discuss Process Safety Engineering and explain the importance of process safety in chemical and manufacturing industries.</li> <li>4. Explain various techniques of risk assessment and risk management used in industrial safety practices.</li> <li>5. Describe the causes, effects and preventive measures of industrial accidents with suitable examples.</li> <li>6. Explain environmental compliance and discuss the role of industries in maintaining environmental standards and regulations.</li> <li>7. Discuss different methods of solid, liquid and hazardous waste management in industries.</li> <li>8. Explain the concept of cleaner production and sustainable waste management in industries.</li> <li>9. Discuss Integrated Management Systems (IMS) and explain the integration of ISO 9001, ISO 14001 and ISO 45001 standards.</li> <li>10. Explain important environmental and occupational safety legislations in India related to industries and workers' safety.</li> </ol>                                                                                                                                                                                                                                                                                                                                                 |                                                                                    |   |   |  |
| <b>B) Short Answer Questions</b> <ol style="list-style-type: none"> <li>1. Define Industrial Hygiene.</li> <li>2. What are occupational hazards?</li> <li>3. Write any four objectives of occupational safety.</li> <li>4. Define risk assessment.</li> <li>5. What is Process Safety Engineering?</li> <li>6. Differentiate between hazard and risk.</li> <li>7. What is hazardous waste?</li> <li>8. Define environmental compliance.</li> <li>9. What is meant by Integrated Management System (IMS)?</li> <li>10. Name any four environmental or occupational safety legislations in India.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                    |   |   |  |
| <b>Multiple Choice Questions (MCQs)</b> <ol style="list-style-type: none"> <li>1. Industrial Hygiene mainly deals with: a) Marketing strategies b) Prevention of workplace hazards c) Financial management d) Product sales <b>Ans: b</b></li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                    |   |   |  |

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| 2. Which of the following is a physical occupational hazard? a) Noise b) Bacteria c) Stress d) Smoke <b>Ans: a</b>                                                               |
| 3. Risk assessment is carried out to: a) Increase production b) Identify and evaluate hazards c) Reduce marketing cost d) Improve packaging <b>Ans: b</b>                        |
| 4. Process Safety Engineering is mainly concerned with: a) Office management b) Prevention of industrial accidents c) Human resource management d) Advertising <b>Ans: b</b>     |
| 5. Which waste requires special handling and disposal? a) Food waste b) Paper waste c) Hazardous waste d) Garden waste <b>Ans: c</b>                                             |
| 6. ISO 14001 standard is related to: a) Quality management b) Environmental management c) Financial auditing d) Marketing management <b>Ans: b</b>                               |
| 7. The major purpose of PPE is: a) Decoration b) Personal protection from hazards c) Increasing production speed d) Machine maintenance <b>Ans: b</b>                            |
| 8. Which of the following is included in Integrated Management System (IMS)? a) ISO 9001 b) ISO 14001 c) ISO 45001 d) All of the above <b>Ans: d</b>                             |
| 9 Environmental compliance means: a) Ignoring regulations b) Following environmental laws and standards c) Increasing waste generation d) Reducing employee salary <b>Ans: b</b> |
| 10. Which Indian Act is related to environmental protection? a) Environment Protection Act, 1986 b) Income Tax Act c) Banking Regulation Act d) Companies Act <b>Ans: a</b>      |

| Rubric for Internal Assessment for Theory Paper<br>SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI<br><b>Internal Assessment</b><br>B.Sc- III SEMESTER – VI (NEP) |                                                                  |               |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|---------------|
| Code:114233                                                                                                                                                     | Elective -3: Health, Safety and Environmental Management Systems | Max Marks: 20 |
| Sr. No.                                                                                                                                                         | Assessment Criteria                                              | Marks         |
| 1                                                                                                                                                               | Attendance                                                       | 05            |
| 2                                                                                                                                                               | Class Assignments                                                | 05            |
| 3                                                                                                                                                               | Unit Test - MCQ                                                  | 05            |
| 4                                                                                                                                                               | Overall Performance                                              | 05            |

**Practical: Elective-3 Health, Safety and Environmental Management Systems**

| Level | Course Code | Semester | Course Name                                                               | Credit | Teaching Hours | Exam Duration | Max. Marks      |
|-------|-------------|----------|---------------------------------------------------------------------------|--------|----------------|---------------|-----------------|
| 5.5   | 114234      | V        | Practical: Elective-3 Health, Safety and Environmental Management Systems | 02     | 60             | 04            | Ext.25+ Int. 25 |

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| Course Objectives                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <ol style="list-style-type: none"> <li>To develop understanding of occupational health, industrial safety and environmental management practices.</li> <li>To provide practical knowledge about workplace hazards, risk assessment and accident prevention techniques.</li> <li>To impart skills in waste management, recycling, vermicomposting and environmental monitoring practices.</li> <li>To familiarize students with environmental policies, IMS documentation and legal awareness related to health, safety and environment.</li> <li>To encourage safe work culture, environmental responsibility and sustainable industrial practices.</li> </ol>                                                                   |
| Course Outcome                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | After the completion of this course, student will be able to-<br>CO- 1 Explain the concepts of occupational health, safety management and environmental protection in workplace settings.<br>CO-2 Identify and assess various workplace hazards and apply appropriate .safety measures and preventive practices.<br>CO-3 Perform basic environmental and safety-related practicals such as waste ,analysis, ventilation study and hazard identification. ,<br>CO-4 Apply knowledge of waste management techniques, environmental policies, IMS documentation and legal requirements.<br>CO-5 Demonstrate responsible behavior, safety consciousness and . commitment towards sustainable industrial and environmental practices. |
| <b>List of Experiment/ Exercise</b> <ol style="list-style-type: none"> <li>Study of industrial hygiene practices in workplace or laboratory.</li> <li>Occupational exposure assessment of dust, noise or chemical hazards.</li> <li>Preparation and interpretation of Material Safety Data Sheet (MSDS).</li> <li>Identification and classification of toxic chemicals and hazardous substances.</li> <li>Survey of occupational health problems and workplace health practices.</li> <li>Preparation of health surveillance record and occupational health report.</li> <li>Stress assessment and workplace wellness survey.</li> <li>Hazard Identification and Risk Assessment (HIRA) for laboratory or industrial activities.</li> </ol> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

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| 9. Accident investigation and preparation of accident analysis report.<br>10. Root cause analysis of industrial accident case studies.<br>11. Safety audit and inspection of laboratory, workshop or campus facilities.<br>12. Demonstration and inspection of process safety and construction safety measures.<br>13. Preparation of emergency preparedness and disaster management plan.<br>14. Mock drill for fire safety, industrial emergency and evacuation procedures.<br>15. Identification, segregation and management of hazardous waste.<br>16. Study of climate change impacts and carbon footprint estimation.<br>17. Survey and documentation of cleaner production and green technology practices.<br>18. Study and documentation of ISO 45001 and ISO 14001 management systems.<br>19. Review and presentation on Indian and international HSE legislation through case studies.<br>20. Preparation and presentation of project report on occupational health, industrial safety or environmental management issues.                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>References</b><br><input type="checkbox"/> Industrial Safety and Health Management, Pearson Education.<br><input type="checkbox"/> Occupational Health and Safety Management, CRC Press.<br><input type="checkbox"/> Introduction to Environmental Engineering and Science, Pearson Education.<br><input type="checkbox"/> Environmental Engineering, McGraw Hill.<br><input type="checkbox"/> Environmental Science, Universities Press (India) Pvt. Ltd.<br><input type="checkbox"/> Solid Waste Management, CBS Publishers and Distributors.<br><input type="checkbox"/> Environmental Management Systems, Wiley India.<br><input type="checkbox"/> Safety Management: A Guide for Facility Managers, Wiley Publications.<br><input type="checkbox"/> Occupational Safety and Health Administration (OSHA). Safety and Health Standards.<br><input type="checkbox"/> Central Pollution Control Board (CPCB). Environmental and Waste Management Guidelines.<br><input type="checkbox"/> Bureau of Indian Standards (BIS). Safety and Environmental Standards.<br><input type="checkbox"/> Ministry of Environment, Forest and Climate Change (MoEFCC). Environmental Protection Rules and Policies.<br><input type="checkbox"/> <a href="#">OSHA Official Website</a><br><input type="checkbox"/> <a href="#">CPCB Official Website</a><br><input type="checkbox"/> <a href="#">MoEFCC Official Website</a><br><input type="checkbox"/> <a href="#">BIS Official Website</a> |

#### Assessment Rubric for Internal Assessment for Practical

|                     |                                                                                                                                                 |               |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| I                   | SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI<br><b>Internal Assessment for Lab Work</b><br>B.Sc.III (Environmental Science) SEMESTER– VI (NEP) |               |
| Course Code: 114234 | <b>Lab: Elective-3: Health, Safety and Environmental Management Systems</b>                                                                     | Max Marks: 25 |
| <b>Sr. No.</b>      | <b>Assessment Criteria</b>                                                                                                                      | <b>Marks</b>  |
| 1                   | Active Participation and Performance of Practical                                                                                               | 10            |
| 2                   | Attendance                                                                                                                                      | 05            |
| 3                   | Field Visit Report / Assignment                                                                                                                 | 05            |
| 4                   | MCQ Test                                                                                                                                        | 05            |
|                     | Total                                                                                                                                           | 25            |

#### Assessment Rubric for External Assessment for Practical

|                     |                                                                                                                                                 |                             |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|
| E                   | SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI<br><b>External Assessment for Lab Work</b><br>B.Sc .III(Environmental Science) SEMESTER– VI (NEP) |                             |
| Course Code: 114234 | Lab: Elective-3: Health, Safety and Environmental Management Systems                                                                            | Max Marks: 25, Time: 4Hours |
| <b>Sr. No.</b>      | <b>Assessment Criteria</b>                                                                                                                      | <b>Marks</b>                |
| 1                   | Any one major experiment                                                                                                                        | 07                          |
| 2                   | Any two minor experiment                                                                                                                        | 10                          |
| 3                   | Practical Record / Lab Journal                                                                                                                  | 04                          |
| 4                   | Viva-Voce                                                                                                                                       | 04                          |
| Total               |                                                                                                                                                 | 25                          |

**Practical Elective 4: Environmental Restoration & Management**

| Major Elective-4Level | Course Code | Semester | Course Name                                                     | Credit | Teaching Hours | Exam Duration | Max. Marks       |
|-----------------------|-------------|----------|-----------------------------------------------------------------|--------|----------------|---------------|------------------|
| 5.5                   | 114235      | VI       | Major Theory Elective 4: Environmental Restoration & Management | 02     | 30             | 02            | Ext-30<br>Int-20 |

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| Course Objectives | <div><div>1. Introduce Foundational Ecology: Establish a deep understanding of ecosystem dynamics, community assembly, succession, and natural landscape functions.</div><div>2. Analyze Environmental Degradation.</div><div>3. Teach Restoration Methodologies</div><div>4. Incorporate Policy and Ethics: Environmental impacts and management.</div><div>5. Develop Technical Skills for restoration and management.</div></div>                                                                                                                                                                                                                                                                                                                                                                                                                      |                         |                             |                                                                                                                                                                                                                                                                                                                                              |
| Course Outcome    | <div>After the completion of this course, student will be able to-</div> <div>CO-1-Evaluate the structural health, functional integrity, and baseline status of diverse ecological systems using standard environmental diagnostic frameworks.</div> <div>CO-2-Pinpoint exact indicators of biological, soil, and aquatic degradation in a given environment.</div> <div>CO-3- Design and formulate comprehensive ecological restoration plans tailored to safely recover degraded habitats and vital ecosystem services.</div> <div>CO-4- Execute baseline surveys: Conduct professional field surveys to gather initial physical, chemical, and biological data</div> <div>CO-5- Apply adaptive management protocols and longitudinal monitoring strategies to evaluate ongoing environmental recovery and adjust conservation plans in real-time</div> |                         |                             |                                                                                                                                                                                                                                                                                                                                              |
| Unit System       | Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Workload Allotted (Hrs) | Weightage of marks allotted | Incorporation of Pedagogies                                                                                                                                                                                                                                                                                                                  |
| Unit-I            | 1.1 Ecological restoration - Definition, Concept and Necessity                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 8                       | 8                           | <div>1- Interactive Lectures.</div> <div>2- <b>Field-Based Learning.</b></div> <div>3- Project-Based Learning.</div> <div>4- <b>Problem-Solving Approach.</b></div> <div>5- Participatory Learning.</div> <div>6- GIS and Remote Sensing Applications.</div> <div>7- <b>Collaborative Learning.</b></div> <div>8- ICT-Enabled Teaching</div> |
|                   | 1.2 Ecological restoration - Principles and its role in ecological restoration                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                         |                             |                                                                                                                                                                                                                                                                                                                                              |
|                   | 1.3- Types of restoration; Natural healing.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                         |                             |                                                                                                                                                                                                                                                                                                                                              |
|                   | 1.4- Comparative study of restoration ecology versus conservation biology.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                         |                             |                                                                                                                                                                                                                                                                                                                                              |
| Unit-II           | 2.1 Eco-restoration: Concept, Components, Mechanism.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 7                       | 7                           |                                                                                                                                                                                                                                                                                                                                              |
|                   | 2.2 Restoration monitoring indicators Biophysical analysis.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                         |                             |                                                                                                                                                                                                                                                                                                                                              |
|                   | 2.3- Eco-restoration by Plants: Measures to restore environment: Phyto-extraction, phyto-stabilization, phyto-transformation, rhizosphere and bioremediation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                         |                             |                                                                                                                                                                                                                                                                                                                                              |
|                   | 2.4- Approaches towards Restoration: Physical, chemical and biological methods of restoration                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                         |                             |                                                                                                                                                                                                                                                                                                                                              |
| Unit-III          | 3.1 Restoration of Lands: Degraded lands, mining lands; Restoration of soil fertility.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 8                       | 8                           |                                                                                                                                                                                                                                                                                                                                              |
|                   | 3.2- Eco-restoration of Water: Groundwater, surface water                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                         |                             |                                                                                                                                                                                                                                                                                                                                              |
|                   | 3.3- Restoration of Biological Diversity: Acceleration of ecological succession in wetlands and mangroves (Plants potential of carbon sequestration).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                         |                             |                                                                                                                                                                                                                                                                                                                                              |
|                   | 3.4 Role of Forest Research Institute (FRI), IIFM-Bhopal and WII in Restoration of Natural Resources                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                         |                             |                                                                                                                                                                                                                                                                                                                                              |
| Unit-IV           | 4.1- Environmental Pollution Management & Remediation: Bioremediation: Utilizing microorganisms to detoxify contaminated environments.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 7                       | 7                           |                                                                                                                                                                                                                                                                                                                                              |

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| <p><b>Books for Reference:</b></p> <ol style="list-style-type: none"> <li>1. Managing Cover Crops Profitably, Handbook Series Book, Published by the Sustainable Agriculture Research and Education (SARE) program</li> <li>2. Building Soils for Better Crops Sustainable Soil Management. Fred Magdoff and Harold van Es Handbook Series Book by the Sustainable Agriculture Research and Education (SARE) program. 2009.</li> <li>3. Manage insect on your farm, Miguel A. Altieri and Clara I. Nicholls with Marlene A. Fritz, Published by the Sustainable Agriculture Network Beltsville, MD, USA.</li> <li>4. A Whole-Farm Approach to Managing Pests, Sustainable Agriculture Research and Education (SARE) program.</li> <li>5. Smart Water Use on Your Farm or Ranch, Sustainable Agriculture Research and Education (SARE) program.</li> <li>6. Ecological Restoration: A Practical Approach, Steven I. Apfelbaum Applied Ecological Services, Inc. Brodhead, WI 53520</li> <li>7. Eco-restoration of a high-sulphur coal mine overburden dumping site in northeast India: 8. A case study J Dowarah, H P Deka Boruah, J Gogoi, N Pathak, N Saikia</li> <li>Dead Planet, Living Planet – Biodiversity and Ecosystem Restoration for Sustainable Development. A Rapid Response Assessment. United Nations Environment Programme, GRID-Arendal.</li> <li>9. Wetland Restoration: A Handbook For NZ Freshwater Systems, Campbell, D. and Jackson, R. New Zealand Hydrological and Limnological Societies, Christchurch, New Zealand. 2004.</li> <li>10. Cyclic floodplain rejuvenation, Jos van Alphen, Ministry of Transport, Public Works and Water management Directorate Eastern Netherlands December, 2001</li> <li>11. Wetland Restoration: A Handbook for NZ Freshwater Systems, Native Fauna, Corinne Watts, Monica Peters and Alastair Suren.</li> <li>12. Wetland Restoration: A Handbook for NZ Freshwater Systems, Wetland Protection, Monica Peters.</li> <li>13. Lessons learned from ecological, Vimukthi Weeratunga Biodiversity Coordinator, IUCN Sri Lanka Country Office restorations in Sri Lanka.</li> <li>14. Successful Ecological Restoration of Mangroves published by Mangrove Action Project - Yogyakarta, Indonesia. 2006.</li> <li>15. Principles and Guidelines for ecological restoration in Canada's Protected Natural Areas, Compiled by</li> </ol> |                                                                                                                                                                                                                                                                                                                                                                              |  |  |  |
| <p><b>Model Questions</b></p> <p>Short Type: (Minimum 8)</p> <ol style="list-style-type: none"> <li>1. What is the primary difference between ecological restoration and ecological reclamation?</li> <li>2. Define the term 'phytoremediation' and provide one example of a plant used in this process.</li> <li>3. Why is establishing a 'reference ecosystem' crucial before beginning a restoration project?</li> <li>4. Name two physical engineering techniques used to control soil erosion in degraded grasslands.</li> <li>5. How do invasive alien species disrupt the natural ecological succession of a habitat?</li> <li>6. State two primary objectives of integrated watershed management.</li> <li>7. What role do Geographic Information Systems (GIS) play in monitoring restored wetlands?</li> <li>8. What is the difference between active restoration and passive restoration?</li> </ol> <p>Long Type:</p> <ol style="list-style-type: none"> <li>1. Discuss the foundational principles of ecological restoration. Explain how an understanding of primary and secondary ecological succession helps an environmental manager design an effective restoration blueprint for a highly degraded landscape.</li> <li>2. Critically evaluate the roles of bioremediation and phytoremediation in reclaiming industrial brownfields contaminated with heavy metals. Compare the advantages, limitations, and specific biological mechanisms of both techniques.</li> <li>3. Explain how modern geospatial tools, specifically Remote Sensing (RS) and Geographic Information Systems (GIS), are utilized in mapping, planning, and long-term monitoring of large-scale environmental restoration projects</li> <li>4. "No ecological restoration project can succeed in the long term without the involvement of local communities." Debate this statement by analyzing the roles of joint forest management, indigenous knowledge, and international frameworks (like the Ramsar Convention) in sustainable ecosystem management.</li> </ol>                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                              |  |  |  |
| <p><b>MCQ</b></p> <ol style="list-style-type: none"> <li>1. Which term describes the process of returning a degraded ecosystem to its exact pre-disturbance structure, function, and species composition?<br/>A) Reclamation, B) Rehabilitation, C) Ecological Restoration, D) Remediation</li> <li>2. <b>In restoration ecology, a "reference ecosystem" serves as a:</b><br/>A) Laboratory control group with zero biodiversity B) Model or target to guide and evaluate restoration success, C) Highly degraded site used to test chemical interventions, D) Legal document defining environmental fines</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                              |  |  |  |

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| 3. | if an environmental manager relies entirely on nature's natural healing potential and ecological succession without active intervention, they are practicing:<br>A) Active restoration, B) Bioremediation, C) Passive restoration, D) Phytoremediation                                                                                               |
| 4. | <b>Which of the following is a primary biological method used to control invasive alien plant species during habitat restoration?</b><br>A) Prescribed burning of the entire ecosystem, B) Introduction of host-specific natural insect predators, C) Application of broad-spectrum chemical herbicides, D) Bulldozing the topsoil layer             |
| 5. | <b>Mangrove restoration projects generally fail if managers ignore which critical environmental factor?</b><br>A) Atmospheric nitrogen levels, B) Hydrology and daily tidal flushing patterns ,C) Introduction of exotic fish species, D) Application of chemical fertilizers to the mudflats                                                        |
| 6. | <b>The use of hyperaccumulating plants like <i>Brassica juncea</i> to extract and concentrate heavy metals from contaminated soil into their harvestable parts is known as:</b><br>A) Phytostabilization B) Phytoextraction, C) Phytodegradation, D) Rhizofiltration.                                                                                |
| 7. | <b>In biostimulation techniques used for oil spill remediation, which substances are typically added to the contaminated environment?</b><br>A) Genetically engineered synthetic microbes, B) Strong chemical oxidizing agents<br>C) Nutrients like nitrogen and phosphorus to boost native microbes, D) Detergents to dissolve the oil permanently, |
| 8. | <b>Which remote sensing index is most commonly used by environmental managers to monitor the recovery of vegetation cover over time at a restoration site?</b><br>A) Normalized Difference Vegetation Index (NDVI), B) pH and Electrical Conductivity Index (PECI), C) Biochemical Oxygen Demand (BOD), D) Geographic Information Overlay (GIO)      |

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| I                   | SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI<br><b>Internal Assessment for Lab Work</b><br>B.Sc.III (Environmental Science) SEMESTER– VI (NEP) |               |
| Course Code: 114235 | <b>Lab: Elective-4:</b> Environmental Restoration & Management                                                                                  | Max Marks: 25 |
| <b>Sr. No.</b>      | <b>Assessment Criteria</b>                                                                                                                      | <b>Marks</b>  |
| 1                   | Active Participation and Performance of Practical                                                                                               | 10            |
| 2                   | Attendance                                                                                                                                      | 05            |
| 3                   | Field Visit Report / Assignment                                                                                                                 | 05            |
| 4                   | MCQ Test                                                                                                                                        | 05            |
|                     | Total                                                                                                                                           | 25            |

**Practical-Elective-4:: Environmental Restoration & Management**

| Level | Course Code | Semester | Course Name                                                     | Credit | Teaching Hours | Exam Duration | Max. Marks         |
|-------|-------------|----------|-----------------------------------------------------------------|--------|----------------|---------------|--------------------|
| 5.5   | 114236      | VI       | Practical-Elective-4:<br>Environmental Restoration & Management | 02     | 60             | 04            | Ext.25+<br>Int. 25 |

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| Course Objectives | <ol style="list-style-type: none"><li>To develop practical knowledge of environmental restoration techniques and ecosystem management practices.</li><li>To train students in field and laboratory methods for assessing environmental quality and ecological health.</li><li>To provide hands-on experience in soil, water, and biodiversity assessment techniques.</li><li>To enhance skills in identifying environmental degradation and planning restoration measures.</li><li>To develop competency in the use of GIS, remote sensing, and environmental monitoring tools.</li><li>To promote understanding of sustainable resource management and conservation practices.</li><li>To encourage scientific observation, data collection, analysis, and interpretation of environmental parameters.</li><li>To familiarize students with watershed management, afforestation, wetland restoration, and habitat rehabilitation practices.</li><li>To develop teamwork, field survey, reporting, and environmental audit skills.</li><li>To create awareness regarding community participation and environmental stewardship in restoration activities.</li></ol> |
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| Course Outcome                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <p>After the completion of course, student will be able to-</p> <p>CO-1 Conduct field and laboratory assessments of environmental quality and ecosystem conditions.</p> <p>CO-2 Analyze soil, water, vegetation, and biodiversity data using standard ecological methods.</p> <p>CO-3 Identify causes of environmental degradation and recommend suitable restoration strategies.</p> <p>CO-4 Apply practical techniques for afforestation, habitat restoration, waste management, and watershed conservation.</p> <p>CO-5 Use GIS, remote sensing, and environmental monitoring tools for restoration planning and management.</p> <p>CO-6 Prepare environmental restoration plans, survey reports, and ecological assessment documents.</p> <p>CO-7 Demonstrate skills in ecological monitoring, sampling, and interpretation of environmental data.</p> <p>CO-8 Evaluate the effectiveness of restoration and management practices in different ecosystems.</p> <p>CO-9 Work effectively in teams during field surveys, restoration activities, and environmental projects.</p> <p>CO-10 Develop environmentally responsible attitudes and contribute to sustainable ecosystem management practices.</p> |
| List of Experiment/ Exercise                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <p><b>Environmental Restoration</b></p> <ol style="list-style-type: none"> <li>Study on nature's healing potential (rejuvenation after fire in forest), agricultural system.</li> <li>Analysis of soil for organic carbon and inorganic carbon</li> <li>Demonstration on nursery system (seed collection, preparation of pot)</li> <li>Observation and study of effects of aquatic weeds</li> <li>Study of soil fertility by lab/survey methods</li> <li>Qualitative analysis of wasteland soil parameter.</li> <li>Qualitative analysis of wet land sediments</li> <li>Qualitative analysis of wetland water</li> <li>Studies on restoration of non mineral exploited hills or plains for i. Soil analysis ii. Remedial measures</li> <li>Analysis of waste land for fertility studies.</li> <li>Studies on restoration of lakes (Case Study)</li> <li>Comparative analysis of river water quality before and after recreation activities viz. bathing, washing cloths and washing domestic animals.</li> <li>Studies and demonstration on carbon sequestration of plants/vegetation</li> <li>Draw the design of green belt development by the road sides and industries</li> <li>Survey of local biodiversity communities involved in protection of trees in your areas.</li> <li>Demonstration/ Documentation survey on restoration of flood areas.</li> <li>Demonstration of on gene campaign in India t. i. Collection of indigenous seeds ii. Discussion with people iii. Preparation of herbarium (digital)</li> <li>Draw map and parameter for space design for vegetation in urban areas/rural</li> <li>Case studies on man animal conflict in your area.</li> </ol> <p><b>Field visit to :</b> Wetland , Forest nursery (seed collection, preparation of plots), NGO's activities about restoration , degraded forest areas , waste lands survey</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <p><b>References :E-Contents / E-Books/Digital Resources / Web Links</b></p> <p><b>Environmental Restoration Practical Manuals &amp; Field Guides</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

- ## Laboratory & Field Experiment Resources

- ## GIS, Mapping & Environmental Monitoring Tools

- ## Biodiversity & Ecological Assessment Resources

- ## Open Research & Academic Resources

### Assessment Rubric for Internal Assessment for Practical

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|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|---------------|
| I              | SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI<br><b>Internal Assessment for Lab Work</b><br>B.Sc. III (Environmental Science) SEMESTER –VI (NEP) |                                                                             |               |
|                | Course Code:114236                                                                                                                               | <b>Lab</b> /Practical-Elective-4:<br>Environmental Restoration & Management | Max Marks: 25 |
| <b>Sr. No.</b> | <b>Assessment Criteria</b>                                                                                                                       |                                                                             | <b>Marks</b>  |
| 1              | Active Participation and Performance of Practical                                                                                                |                                                                             | 10            |
| 2              | Attendance                                                                                                                                       |                                                                             | 05            |
| 3              | Field Visit Report / Assignment                                                                                                                  |                                                                             | 05            |
| 4              | MCQ Test                                                                                                                                         |                                                                             | 05            |
|                | Total                                                                                                                                            |                                                                             | 25            |

**Assessment Rubric for External Assessment for Practical**

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| E                      | <b>SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI</b><br><b>External Assessment for Lab Work</b><br><b>B.Sc.III (Environmental Science) SEMESTER – VI (NEP)</b> |                                   |
| Course Code:<br>114236 | <b>Lab /Practical-Elective-4:</b><br>Environmental Restoration & Management                                                                                    | Max Marks:<br>25, Time:<br>4Hours |
| <b>Sr. No.</b>         | <b>Assessment Criteria</b>                                                                                                                                     | <b>Marks</b>                      |
| 1                      | Any one major experiment                                                                                                                                       | 07                                |
| 2                      | Any two minor experiment                                                                                                                                       | 10                                |
| 3                      | Practical Record / Lab Journal                                                                                                                                 | 04                                |
| 4                      | Viva-Voce                                                                                                                                                      | 04                                |

**Minor Theory- Environmental Education and Awareness**

| Level | Course Code | Semester | Course Name                                                | Credit | Teaching Hours | Exam Duration | Max. Marks       |
|-------|-------------|----------|------------------------------------------------------------|--------|----------------|---------------|------------------|
| 5.5   | 114237      | VI       | <b>Minor Theory- Environmental Education and Awareness</b> | 02     | 30             | 02            | Ext-30<br>Int-20 |

|                   |                                                                                                                                                                                                                                                                                                                                                                                                               |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                              |
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| Course Objectives | 1. Understand the concept, goals, and objectives of environmental education.<br>2. Explain the principles, scope, and need for environmental education.<br>3. Identify different stages and types of environmental education.<br>4. Develop awareness and positive attitudes toward environmental conservation.<br>5. Participate effectively in environmental awareness and sustainability programs.         |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Course Outcome    | CO-1 Define environmental education and explain its importance.<br><br>CO-2 Describe the principles and stages of environmental education.<br><br>CO-3 Explain various environmental training methods and awareness programs.<br><br>CO-4 Analyse the role of mass media in promoting environmental awareness.<br><br>CO-5 Understand the present status and development of environmental education in India. |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Unit System       | Content                                                                                                                                                                                                                                                                                                                                                                                                       | Workload Allotted (Hrs) | Weightage of marks allotted | Incorporation of Pedagogies                                                                                                                                                                                                                                                                                                                                                                                                  |
| Unit-I            | Introduction to Environmental Education                                                                                                                                                                                                                                                                                                                                                                       | 8                       | 8                           | <input type="checkbox"/> Classroom Lectures and ICT-Enabled Teaching<br><input type="checkbox"/> Group Discussion, Seminar and Interactive Learning<br><input type="checkbox"/> Laboratory Practical, Demonstration and Field Visit<br><input type="checkbox"/> Project-Based, Experiential and Inquiry-Based Learning<br><input type="checkbox"/> Environmental Awareness Activities, Campaigns and Community Participation |
|                   | 1.1 Environmental Education: Introduction, Goals and Objectives                                                                                                                                                                                                                                                                                                                                               |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                              |
|                   | 1.2 Principles of Environmental Education                                                                                                                                                                                                                                                                                                                                                                     |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                              |
|                   | 1.3 Scope and need for Environmental Education                                                                                                                                                                                                                                                                                                                                                                |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                              |
|                   | 1.4 Stages of Environmental Education                                                                                                                                                                                                                                                                                                                                                                         |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Unit-II           | Types and Methods of Environmental Education                                                                                                                                                                                                                                                                                                                                                                  | 7                       | 7                           |                                                                                                                                                                                                                                                                                                                                                                                                                              |
|                   | 2.1 Types of Environmental Education: Formal Environmental Education                                                                                                                                                                                                                                                                                                                                          |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                              |
|                   | 2.2 Non – Formal Environmental Education                                                                                                                                                                                                                                                                                                                                                                      |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                              |
|                   | 2.3 Methods of Environmental Education: Experimental methods                                                                                                                                                                                                                                                                                                                                                  |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                              |
|                   | 2.4 Methods of Environmental Education: Interactive and inquiry based methods                                                                                                                                                                                                                                                                                                                                 |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Unit-III          | Environmental Training and Awareness                                                                                                                                                                                                                                                                                                                                                                          | 8                       | 8                           |                                                                                                                                                                                                                                                                                                                                                                                                                              |
|                   | 3.1 Environmental Training and Types of Training                                                                                                                                                                                                                                                                                                                                                              |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                              |
|                   | 3.2 Concept of Environmental Awareness                                                                                                                                                                                                                                                                                                                                                                        |                         |                             |                                                                                                                                                                                                                                                                                                                                                                                                                              |

|                                                                                                                        |                                                                                                        |   |   |  |
|------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|---|---|--|
|                                                                                                                        | 3.3 Methods of Environmental Awareness                                                                 |   |   |  |
|                                                                                                                        | 3.4 Role of Environmental Education in awareness program                                               |   |   |  |
| Unit-IV                                                                                                                | Environmental Organizations and Current Status                                                         | 7 | 7 |  |
|                                                                                                                        | 4.1 Role of NGO's in Environmental education                                                           |   |   |  |
|                                                                                                                        | 4.2 Environmental awareness through mass media                                                         |   |   |  |
|                                                                                                                        | 4.3 Environmental Organisations and agencies (International: UNEP and IUCN; National: MoEFCC and CPCB) |   |   |  |
|                                                                                                                        | 4.4 Current Status of Environmental Education in India                                                 |   |   |  |
| References                                                                                                             |                                                                                                        |   |   |  |
| Books                                                                                                                  |                                                                                                        |   |   |  |
| Bharucha, E. (2013). <i>Environmental Studies</i> . Universities Press.                                                |                                                                                                        |   |   |  |
| Palmer, J. A. (1998). <i>Environmental Education</i> . Routledge.                                                      |                                                                                                        |   |   |  |
| Wright, R. T., & Boorse, D. F. (2011). <i>Environmental Science: Toward a Sustainable Future</i> . Pearson Education.  |                                                                                                        |   |   |  |
| Masters, G. M., & Ela, W. P. (2008). <i>Introduction to Environmental Engineering and Science</i> . Pearson Education. |                                                                                                        |   |   |  |
| Kaushik, A., & Kaushik, C. P. (2010). <i>Perspectives in Environmental Studies</i> . New Age International.            |                                                                                                        |   |   |  |
| International Organisations                                                                                            |                                                                                                        |   |   |  |
| United Nations Environment Programme. (n.d.). Environmental education and awareness resources.                         |                                                                                                        |   |   |  |
| UNESCO. (1977). Tbilisi Declaration on Environmental Education.                                                        |                                                                                                        |   |   |  |
| World Health Organization. (n.d.). Environmental health publications.                                                  |                                                                                                        |   |   |  |
| International Union for Conservation of Nature. (n.d.). Conservation education materials.                              |                                                                                                        |   |   |  |
| World Wide Fund for Nature. (n.d.). Environmental awareness resources.                                                 |                                                                                                        |   |   |  |
| National Organisations (India)                                                                                         |                                                                                                        |   |   |  |
| Ministry of Environment, Forest and Climate Change. (n.d.). Environmental education policies.                          |                                                                                                        |   |   |  |
| Central Pollution Control Board. (n.d.). Pollution awareness and reports.                                              |                                                                                                        |   |   |  |
| National Environmental Engineering Research Institute. (n.d.). Environmental training and research.                    |                                                                                                        |   |   |  |
| Wildlife Institute of India. (n.d.). Wildlife education materials.                                                     |                                                                                                        |   |   |  |
| Botanical Survey of India. (n.d.). Plant biodiversity resources.                                                       |                                                                                                        |   |   |  |
| Model Questions                                                                                                        |                                                                                                        |   |   |  |
| Short Type:                                                                                                            |                                                                                                        |   |   |  |
| 1. State the objectives of environmental education.                                                                    |                                                                                                        |   |   |  |
| 2. Explain the principles of environmental education.                                                                  |                                                                                                        |   |   |  |
| 3. Write the need for environmental education.                                                                         |                                                                                                        |   |   |  |
| 4. What is formal environmental education? Explain.                                                                    |                                                                                                        |   |   |  |
| 5. What is non-formal environmental education? Explain.                                                                |                                                                                                        |   |   |  |
| 6. Explain environmental training.                                                                                     |                                                                                                        |   |   |  |
| 7. Differentiate between formal and non-formal education.                                                              |                                                                                                        |   |   |  |
| 8. Write short notes on awareness campaigns.                                                                           |                                                                                                        |   |   |  |
| 9. Explain the importance of public participation.                                                                     |                                                                                                        |   |   |  |
| 10. Name any four environmental organizations.                                                                         |                                                                                                        |   |   |  |
| 11. Write a short note on environmental education in India.                                                            |                                                                                                        |   |   |  |
| Long Type:                                                                                                             |                                                                                                        |   |   |  |
| 1. Describe the principles and stages of environmental education.                                                      |                                                                                                        |   |   |  |
| 2. Discuss formal and non-formal environmental education in detail.                                                    |                                                                                                        |   |   |  |
| 3. Discuss the role of environmental education in awareness programs.                                                  |                                                                                                        |   |   |  |
| 4. Explain different training methods used in environmental education.                                                 |                                                                                                        |   |   |  |
| 5. Discuss the role of NGOs in environmental education and conservation.                                               |                                                                                                        |   |   |  |
| 6. Explain the importance of mass media in environmental awareness.                                                    |                                                                                                        |   |   |  |
| 7. Describe national and international environmental organizations and agencies.                                       |                                                                                                        |   |   |  |
| 8. Describe the methods of environmental education.                                                                    |                                                                                                        |   |   |  |
| MCQ                                                                                                                    |                                                                                                        |   |   |  |
| 1. Which of the following is a principle of environmental education?                                                   |                                                                                                        |   |   |  |

|                                                                                                                                                                         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| a) Learning by memorization ,b) Awareness and participation, c) Commercialization, d) Competition                                                                       |
| 2. The scope of environmental education includes:<br>a) Only schools ,b) Only industries, c) Society and environment, d) Only forests                                   |
| 3. Environmental education provided in schools and colleges is called:<br><br>a) Informal education b) Non-formal education,c) Formal education.4) Technical education, |
| 4. Environmental training helps in:<br><br>a) Pollution increase ,b) Skill development. c) Deforestation, d) Industrial waste generation                                |
| 5. Which method is commonly used for environmental awareness?<br><br>a) Campaigns,b) Seminars, c) Posters, d) All of these                                              |
| 6. Environmental education programs mainly develop:<br><br>a) Environmental responsibility, b) Pollution, c) Deforestation, d) Urban migration                          |
| 7. NGOs work for:<br><br>a) Profit making, b) Environmental conservation and social welfare, c) Political campaigns only<br>d) Industrial production                    |
| 8. Which media is most effective for environmental awareness?<br><br>a) Television, b) Radio, c) Social media, d) All of these                                          |

| Rubric for Internal Assessment for Theory Paper<br>SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI<br><b>Internal Assessment</b><br>B.Sc- IIISEMESTER – VI (NEP) |                                                     |               |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|---------------|
| Code:<br>114237                                                                                                                                                | Paper: Minor-(Environmental Education and Awareness | Max Marks: 20 |
| Sr. No.                                                                                                                                                        | Assessment Criteria                                 | Marks         |
| 1                                                                                                                                                              | Attendance                                          | 05            |
| 2                                                                                                                                                              | Class Assignments                                   | 05            |
| 3                                                                                                                                                              | Unit Test - MCQ                                     | 05            |
| 4                                                                                                                                                              | Overall Performance / Seminar / Case Study          | 05            |

| Minor Practical: Environmental Education and Awareness |             |          |                                                        |        |                |               |                 |
|--------------------------------------------------------|-------------|----------|--------------------------------------------------------|--------|----------------|---------------|-----------------|
| Level                                                  | Course Code | Semester | Course Name                                            | Credit | Teaching Hours | Exam Duration | Max. Marks      |
| 5.5                                                    | 114238      | VI       | Minor Practical: Environmental Education and Awareness | 02     | 60             | 04            | Ext.25+ Int. 25 |

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course Objectives | 1. To develop fundamental understanding of environmental education, environmental awareness and sustainable development concepts.<br>2. To create awareness about environmental problems, conservation of natural resources and ecological balance.<br>3. To impart knowledge regarding methods, principles and approaches of environmental education and awareness programs.<br>4. To develop practical skills in environmental survey, auditing, biodiversity assessment and community-based environmental activities.<br>5. To encourage active participation and responsible behaviour for environmental protection and sustainable living. |
| Course Outcome    | After the completion of this course. Student will be able to –<br>CO – 1 Explain the concepts, principles and importance of environmental education and environmental awareness.<br>CO-2 Identify major environmental issues and evaluate methods for environmental conservation and sustainable development.<br>CO-3 Apply different approaches and pedagogical methods used in environmental education and awareness programs.                                                                                                                                                                                                                |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                          |
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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <p>CO-4 Perform environmental surveys, audits, biodiversity studies and awareness activities using practical and analytical skills.</p> <p>CO-5 Demonstrate responsible environmental behaviour and participate effectively in community-based environmental protection initiatives.</p> |
| <p><b>List of Experiment/ Exercise</b></p> <p><b>Experiments on Environmental Education and Awareness</b></p> <ol style="list-style-type: none"> <li>1. Survey of local communities to document dependency on regional water resources and forest cover.</li> <li>2. Study of Current Status of Environmental Education at School Level: A survey study.</li> <li>3. Role of Television Channels in Environmental Awareness.</li> <li>4. Collection and preservation of Plant Seeds (Seed Bank).</li> <li>5. Visit to Social Forestry Nursery (Data Collection).</li> <li>6. Environmental literacy survey of local area.</li> <li>7. Preparation of environmental awareness posters and charts</li> <li>8. Awareness campaign on plastic pollution in community area.</li> <li>9. Collection and submission of newspaper cuttings related to environmental education.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                          |
| <p><b>1. References</b></p> <ol style="list-style-type: none"> <li>2. Environmental Education, K. K. Sharma, Pragati Prakashan, Meerut.</li> <li>3. Environmental Studies, Tata McGraw Hill Education Pvt. Ltd., New Delhi.</li> <li>4. Environmental Science, Universities Press (India) Pvt. Ltd., Hyderabad.</li> <li>5. Textbook of Environmental Studies, S. Chand Publishing, New Delhi.</li> <li>6. Environmental Education, Oxford University Press, New Delhi.</li> <li>7. Environmental Studies: From Crisis to Cure, Oxford University Press, New Delhi.</li> <li>8. Environmental Science and Engineering, Pearson Education.</li> <li>9. Perspectives in Environmental Studies, New Age International Publishers.</li> <li>10. Environmental Education and Sustainable Development, Deep and Deep Publications, New Delhi.</li> <li>11. Environmental Awareness, Pointer Publishers, Jaipur.</li> <li>12. United Nations Educational, Scientific and Cultural Organization (UNESCO). <i>Tbilisi Declaration on Environmental Education</i>, 1977.</li> <li>13. United Nations Environment Programme (UNEP). Environmental Education and Awareness Reports.</li> <li>14. Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India. Environmental Education and Awareness Programmes.</li> <li>15. National Council of Educational Research and Training (NCERT). Environmental Education Resource Materials.</li> <li>16. University Grants Commission (UGC). Guidelines for Environmental Studies Courses in Higher Education.</li> <li>17. Journal of Environmental Education.</li> <li>18. Indian Journal of Environmental Education.</li> <li>19. <a href="#">UNESCO Official Website</a></li> <li>20. <a href="#">UNEP Official Website</a></li> <li>21. <a href="#">MoEFCC Official Website</a></li> <li>22. <a href="#">CPCB Official Website</a></li> </ol> |                                                                                                                                                                                                                                                                                          |

**Assessment Rubric for Internal Assessment for Practical**

|                     |                                                                                                                                                                |               |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| I                   | <p>SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI</p> <p><b>Internal Assessment for Lab Work</b></p> <p>B.Sc.III (Environmental Science) SEMESTER– VI (NEP)</p> |               |
| Course Code: 114238 | <b>Minor Lab:</b> Environmental Education and Awareness                                                                                                        | Max Marks: 25 |
| <b>Sr. No.</b>      | <b>Assessment Criteria</b>                                                                                                                                     | <b>Marks</b>  |
| 1                   | Active Participation and Performance of Practical                                                                                                              | 10            |
| 2                   | MCQ Test                                                                                                                                                       | 05            |
| 3                   | Field Visit Report / Assignment                                                                                                                                | 05            |
| 4                   | Attendance                                                                                                                                                     | 05            |
|                     | Total                                                                                                                                                          | 25            |

### Assessment Rubric for External Assessment for Practical

|                        |                                                                                                                                                 |                                   |
|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|
| E                      | SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI<br><b>External Assessment for Lab Work</b><br>B.Sc .III(Environmental Science) SEMESTER– VI (NEP) |                                   |
| Course Code:<br>114238 | <b>Minor Lab:</b> Environmental Education and Awareness                                                                                         | Max Marks:<br>25, Time:<br>4Hours |
| <b>Sr. No.</b>         | <b>Assessment Criteria</b>                                                                                                                      | <b>Marks</b>                      |
| 1                      | Any one experiment on Environmental Education                                                                                                   | 08                                |
| 2                      | Any one experiment on Environmental Awareness                                                                                                   | 08                                |
| 3                      | Practical Record / Lab Journal                                                                                                                  | 04                                |
| 5                      | Viva-Voce                                                                                                                                       | 05                                |
| Total                  |                                                                                                                                                 | 25                                |

### VSC – Hands-on Environmental Auditing

| Level | Course Code | Semester | Course Name                           | Credit | Teaching Hours | Exam Duration | Max. Marks |
|-------|-------------|----------|---------------------------------------|--------|----------------|---------------|------------|
| 5.5   | 114279      | VI       | VSC – Hands-on Environmental Auditing | 02     | 60             | 02            | INT-50     |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
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| Course Objectives                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <ol style="list-style-type: none"> <li>Understand the concept, importance, principles, and scope of environmental audit.</li> <li>Develop knowledge about environmental laws, standards, policies, and regulatory requirements related to environmental auditing.</li> <li>Identify and evaluate environmental impacts associated with industrial, institutional, and municipal activities.</li> <li>Apply methods and techniques for conducting environmental audits in different sectors.</li> <li>Analyze resource consumption, waste generation, pollution control measures, and environmental management practices.</li> <li>Prepare environmental audit reports and recommend corrective and preventive measures for sustainable environmental management.</li> </ol>                                               |
| Course Outcome                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <p>After the completion of this course student will be able to -</p> <p>CO-1 Explain the concepts, principles, objectives, and importance of environmental auditing.</p> <p>CO-2 Identify environmental issues, impacts, and risks associated with various industrial and developmental activities.</p> <p>CO-3 Interpret environmental laws, standards, regulations, and compliance requirements related to environmental audits.</p> <p>CO-4 Conduct environmental audits using appropriate methods, tools, and monitoring techniques.</p> <p>CO-5 Analyze environmental performance related to energy use, water consumption, waste management, and pollution control.</p> <p>CO-6 Prepare and present environmental audit reports with suitable recommendations for corrective actions and sustainable practices.</p> |
| <p><b>Exercise: Perform : Water/ Solid waste/ Green/ Environmental / Safety Audit of College Lab/ College Campus/Gram Panchayat/ municipal Council/ Hotel/ Home etc. Identification of air, water, soil, noise, and biological components of local area.</b></p> <ol style="list-style-type: none"> <li>Designing checklist for environmental inspection.</li> <li>Survey of pollution sources in local area/industry.</li> <li>Compliance audit/waste audit/energy audit/biodiversity audit/carbon audit.</li> </ol> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

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| <ol style="list-style-type: none"> <li>4. Structure and documentation of audit system.</li> <li>5. Collection of environmental records and legal documents.</li> <li>6. Designing audit agenda and audit team responsibilities.</li> <li>7. Simulated environmental audit in institution/campus.</li> <li>8. Field inspection of environmental practices.</li> <li>9. Basic sampling methods for water, air, soil, and noise.</li> <li>10. Preparation of field notes, checklists, and observation records.</li> <li>11. Detection of environmental violations and unsafe practices.</li> <li>12. Drafting executive summary, findings, and recommendations.</li> <li>13. Case-based discussion on ethical environmental auditing.</li> <li>14. Role play involving industries, local communities, NGOs, and authorities.</li> <li>15. Monitoring implementation of corrective actions.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                     |
| <p><b>Pedagogies:</b></p> <p><input type="checkbox"/> <b>Classroom Lectures</b> – Used to explain the concepts, objectives, types, procedures, and importance of environmental audit.</p> <p>• <b>ICT Enabled Teaching</b> – Audio-visual tools, digital presentations, and online resources will support effective teaching and learning of environmental auditing concepts.</p> <p>• <b>Case Study Method</b> – Helps students understand industrial, hospital, green, and carbon audit practices through real-life examples.</p> <p>• <b>Field Visits and Environmental Audit Demonstration</b> – Provide practical exposure to environmental monitoring, audit procedures, and environmental management practices.</p> <p>• <b>Project-Based Learning – Enhances analytical, reporting, teamwork, and environmental problem-solving skills among students.</b></p> <p>• <b>Interactive Teaching and Question–Answer Sessions</b> – Encourage active participation, critical thinking, and better understanding of environmental audit methodology and decision-making processes.</p>                                                                                                                                                                                               |
| <p><b>Skills Developed:</b></p> <p>• <b>Environmental Auditing Skills:</b> Students will develop the ability to conduct environmental audits, identify environmental issues, and evaluate environmental performance.</p> <p>• <b>Environmental Monitoring and Assessment Skills:</b> Students will learn environmental monitoring techniques, data collection methods, sampling procedures, and environmental impact assessment practices.</p> <p>• <b>Analytical and Problem-Solving Skills:</b> Students will gain the ability to analyze environmental data, identify environmental risks, and suggest suitable corrective and preventive measures.</p> <p>• <b>Audit Reporting and Documentation Skills:</b> Students will acquire skills in preparing environmental audit reports, maintaining documentation, and presenting audit findings effectively.</p> <p>• <b>Decision-Making and Management Skills:</b> Students will understand environmental decision-making processes, transparency practices, stakeholder participation, and audit follow-up procedures.</p> <p>• <b>Communication and Teamwork Skills:</b> Students will improve communication, teamwork, presentation, and field-based learning abilities through case studies, projects, and audit activities.</p> |

**Rubric for Internal Assessment for VSC Course**

|                        |                                                                                                                                           |              |
|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| I                      | SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI<br><b>External Assessment for VSC</b><br>B.Sc .III(Environmental Science) SEMESTER–VI (NEP) |              |
| Course Code:<br>114279 | <b>Vocational Skill Course (VSC):<br/>Hands-on Environmental Auditing</b>                                                                 | Max Marks:50 |
| <b>Sr. No.</b>         | <b>Assessment Criteria</b>                                                                                                                | <b>Marks</b> |
| 1.                     | Field Visit and Environmental Observation                                                                                                 | 10           |
| 2.                     | Environmental Audit Checklist Preparation                                                                                                 | 10           |
| 3.                     | Data Collection and Documentation                                                                                                         | 10           |
| 4.                     | Environmental Audit Report Writing                                                                                                        | 10           |
| 5.                     | Presentation                                                                                                                              | 10           |

**Internship/ Apprenticeship corresponding to Major: On Job Training**

| Level                     | Semester                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Course Code | Course Name                                        | Credits | Teaching Hours | Credits allotment                                                                                                                                                                |
|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|----------------------------------------------------|---------|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5.5                       | VI                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 114239      | Environmental Science: Internship/ On job training | 4       | 120 Hrs.       | When the student provided the Certificate of attendance “On job training” for 120 Hrs. will be given 4 credits and as for the less attendance, proportionally given the credits. |
| <b>Course Objectives:</b> | <ol style="list-style-type: none"> <li>To provide practical exposure to environmental management practices in industries, laboratories, NGOs, municipalities, and environmental agencies.</li> <li>To develop skills in environmental monitoring, sampling, data collection, and analysis related to air, water, soil, and waste management.</li> <li>To familiarize students with environmental laws, safety standards, pollution control measures, and sustainability practices at workplaces.</li> <li>To enhance problem-solving, technical, communication, and teamwork skills through real-life environmental assignments and field activities.</li> <li>To train students in the use of environmental instruments, tools, documentation procedures, and reporting techniques.</li> <li>To promote awareness of occupational health, environmental ethics, and sustainable development practices in professional environments.</li> </ol> |             |                                                    |         |                |                                                                                                                                                                                  |
| <b>Course Outcomes:</b>   | <p>After successful completion of the Environmental Science On-the-Job Training, students will be able to:</p> <p>CO-1: Apply theoretical knowledge of environmental science to practical workplace situations and environmental management activities.</p> <p>CO-2: Perform basic environmental monitoring, sampling, and analytical procedures using standard methods and instruments.</p> <p>CO-3: Identify environmental issues related to pollution, waste management, resource conservation, and workplace safety.</p> <p>CO-4: Prepare technical reports, field records, environmental audit notes, and project documentation professionally.</p> <p>CO-5: Demonstrate professional ethics, teamwork, communication skills, and safe work practices in environmental sectors.</p> <p>CO-6: Suggest suitable environmental protection and sustainability measures for industries, institutions, and communities.</p>                      |             |                                                    |         |                |                                                                                                                                                                                  |