SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI

TWO YEAR POSTGRADUATE PROGRAMME

M.Sc. ENVIRONMENTAL SCIENCE

FACULTY: SCIENCE AND TECHNOLOGY

Revised Curriculum

(Effective from Academic Year 2024-2025)

SYLLABUS

INDEX

TWO YEAR POSTGRADUATE DEGREE PROGRAMME

M.Sc. ENVIRONMENTAL SCIENCE

FACULTY: SCIENCE AND TECHNOLOGY

Sant Gadge Baba Amravati University

FACULTY: Science and Technology

Preamble

The Post Graduate Program in Environmental Science at M.Sc. level is meticulously designed to impart a profound understanding of environment system sciences, combining rigorous theoretical frameworks with extensive practical applications and research-oriented learning. The curriculum aims to cultivate a holistic perspective on key components of environmental sustainability, encompassing areas from the natural to anthropogenic alterations in the environment. This comprehensive approach ensures that students are well-prepared to address contemporary challenges in field of Environment.

This program emphasizes the integration of cutting-edge scientific research with practical skills, fostering innovation and critical thinking. By covering a wide range of topics including Environmental Pollution, Natural resources, Ecology, Environmental Geology, Environmental microbiology, biotechnology and toxicology, Environmental Impact Assessment, Audit and Environmental Management Systems, Industrial Hygiene and Safety, Applications of Remote Sensing and GIS in Environmental management and Conservation, Environmental legislation, biostatistics, modelling etc, students will develop a versatile skill set.

A unique feature of this program is its focus on the applications of Environmental technical skill and knowledge to identify and to solve environmental problems. Courses on Remote sensing, GIS, Industrial Safety highlight the practical implications in field and industries, and environmental management. The knowledge and acquired skills are helpful to solve ecological problems in environment for its conservation. Furthermore, the curriculum includes an essential component on intellectual property rights (IPR), preparing students to navigate the ethical and legal landscapes of botanical research and innovation.

Prospects of the Program

Job Opportunities:

Government Departments:

- In Governmental Organizations - Central and Maharashtra Pollution Control Board (CPCB/MPCB), appointed as Regional, Sub-Regional and Field Officer/ Scientific Officer, Municipal Corporations, mining sector etc.
- Teaching Field: Lecturer at Junior Colleges and after completion of NET/SET in subject, able to Asst. Professor at Senior College / Institutions
- Research Scientist: Positions in government research institutions, universities, and private sector research labs.

Self-Employment:

- **Environmental Auditor**: Assess the environmental operations and procedures for businesses, governments, or utility companies.
- Environmental Management Systems Auditor/Lead Auditor: Environmental management system audits in accordance with ISO 14001, they address the needs of organizations worldwide by providing a common framework for managing environmental issues in Industries.
- Environmental Journalist: Environmental Advocacy- Presenting information on nature and environmental issues that is decidedly opinionated and encourages its audience to adopt more environmentally sensitive attitudes, often more biocentric worldviews.
- Expertise Services: As s subject expert, provides services to Environment Impact Assessment of National Mega Projects; mining sector, Dam, Transportation routes, power plants etc.
- Ecologist: Working with environmental agencies and NGOs to study and manage ecosystems.
- Conservation Biologist: In National Parks, Wild Life Sanctuaries, Reserved Forest provides a service as Conservation Biologist.
- Freelance Researcher: Conducting independent research projects and contributing to scientific publications.

- Establishment of NGO: Environmental NGOs typically take up causes related to the environment such as Climate Change, Air Pollution, Deforestation, Ozone Layer Depletion, Waste Management, Biodiversity, and Environmental degradation. NGOs typically rely on donations, grants, and other forms of funding to support their operations and pay salaries to their employees.

Entrepreneurship:

- Environmental Consultant: Offering expert advice on Control of water, air pollution, solid waste treatment, management of natural resources, and other environment related issues to National Mega projects, industries, corporations etc.
- Startup Founder: Establishing ventures of Environmental Consultancies, providing services to industries, institutions, Municipal Corporations and Councils.

This program equips graduates with the skills and knowledge to excel in various professional paths, fostering a new generation of Environmentalist who can contribute significantly to scientific research, environmental conservation, and innovative industries.

Core Competencies:

1. **Advanced Understanding of Environmental Pollution:** Gain in-depth knowledge of causes protection and control measures of environmental pollution.
2. **Focus on Global Environmental Issues:** Major current environmental issues may include climate change, pollution, global warming ozone depletion, environmental degradation, and resource depletion. Act on to understand and to solve these issues by public participation.
3. **Understanding of Environmental Problems:** Understanding global environmental problems is vital for protecting human health, ensuring economic stability, maintaining ecosystem services, promoting global security, and securing a sustainable future for future generations.
4. **Management of Natural Resources:** Understand the importance, renewability potential of natural resources and adapt sustainable use, and protection from pollution and its conservation.
5. **Research and Analytical Skills:** Develop robust research methodologies, including experimental design, data analysis, and interpretation.
6. **Ecology and Environmental Dynamics**: Analyze ecological interactions, environmental dynamics, and the impact of human activities on plant ecosystems.
7. **Intellectual Property and Ethical Practices**: Understand the principles of intellectual property rights and their application in Environmental research and commercialization.

Curriculum Framework

The M.Sc. Environmental Science program offers a robust and comprehensive curriculum designed to provide students with a profound understanding of plant sciences. Major courses, categorized as Discipline Specific Core (DSC), cover essential topics such as Interdisciplinary Approach of Environmental Science, Geodynamics and Energy Resources, Ecology and Biodiversity, Environmental Microbiology, Toxicology and Biotechnology, Air, water and Noise Pollution, Solid Waste Management, Remote Sensing, GIS& Computer Application, Environmental Engineering and Technology, Environmental Statistics and Modelling. Environmental Impact Assessment & Environmental Audit and Environmental Policies and Legislation

To cater to diverse interests and career aspirations, the program offers six Discipline Specific Elective (DSE) courses. These are Industrial Hygiene and Safety, Fire Prevention and Protection, Industrial and Chemical and Process Safety and Environmental Management System and Life Cycle Assessment.

The curriculum emphasizes the development of research skills and attributes essential for scientific inquiry. Courses such as Research Methodology and IPR in the first semester and Technological Advancements in Environmental Research in the third semester are specifically designed to enhance students' research capabilities. These courses equip students with the necessary tools to design and conduct independent research projects, analyze data, and understand the ethical and legal aspects of botanical research and intellectual property rights.

A significant component of the program is the Research Project, which is initiated in the third semester (Phase I) and completed in the fourth semester (Phase II). This project provides students with the opportunity to apply their knowledge and research skills to real-world problems,

culminating in a thesis or dissertation. The research project fosters critical thinking, problem-solving, and innovation, preparing students for careers in academia, research institutions, and industry.

To bridge the gap between academic knowledge and practical experience, the program includes on-job training, internships, apprenticeships, and field projects totaling 120 hours. These practical experiences allow students to gain hands-on experience, develop professional skills, and build industry connections. Engaging in real-world projects enhances employability and provides valuable insights into potential career paths.

In addition to the rigorous academic curriculum, the program incorporates co-curricular courses aimed at promoting holistic development. Activities in health and wellness, yoga education, sports and fitness, cultural activities, NSS/NCC, and fine/applied/visual/performing arts are integrated into the curriculum across all semesters. These activities not only foster physical and mental well-being but also encourage creativity, teamwork, and leadership skills, ensuring that graduates are well-rounded individuals ready to excel in their professional and personal lives.

This curriculum framework is designed to attract students seeking comprehensive career development in botanical sciences. By offering a blend of theoretical knowledge, practical experience, research opportunities, and co-curricular activities, the program prepares graduates for diverse career opportunities, including research, teaching, industry roles, self-employment, and entrepreneurship. The holistic approach ensures that students are not only experts in their field but also equipped with the skills necessary to thrive in a dynamic and evolving job market.

Graduate Attributes

Graduates of the M.Sc. Environmental Science program will emerge as well-rounded, knowledgeable, and skilled professionals who are equipped to tackle complex challenges in plant sciences. They will possess a blend of theoretical knowledge, practical experience, research capabilities, and soft skills that are essential for success in various professional arenas. These attributes ensure that graduates are not only experts in their field but also capable of contributing positively to society and the environment.

Critical Thinking and Problem-Solving: Graduates will have the ability to critically analyze scientific data, identify key issues, and develop innovative solutions to complex problems in Environment sciences. They will be adept at applying logical reasoning and scientific methods to address challenges.

Research Proficiency: Graduates will be skilled in designing, conducting, and managing independent research projects. They will be proficient in using modern laboratory techniques and tools, analyzing data, and presenting their findings clearly and effectively.

Technical Expertise: Graduates will have a strong command of contemporary techniques and technologies in botanical research, including molecular biology, biotechnology, and plant physiology. Their technical expertise will enable them to excel in various scientific and industrial roles.

Ethical Awareness and Responsibility: Graduates will understand the ethical implications of their work and the importance of intellectual property rights. They will be committed to conducting research and professional activities with integrity and responsibility.

Effective Communication: Graduates will possess excellent communication skills, enabling them to convey complex scientific concepts to diverse audiences, including peers, professionals, and the general public. They will be proficient in both written and oral communication.

Lifelong Learning and Adaptability: Graduates will be committed to continuous learning and professional development. They will be adaptable to new technologies and methodologies, ensuring they remain at the forefront of advancements in their field.

Teamwork and Leadership: Graduates will be capable of working collaboratively in multidisciplinary teams and taking on leadership roles when required. They will have the skills to manage projects, mentor peers, and contribute effectively to team objectives.

Environmental and Social Responsibility: Graduates will be aware of the environmental impact of their work and the importance of sustainable practices. They will be prepared to contribute to the conservation and sustainable use of plant resources, promoting biodiversity and ecological balance.

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entrepreneurship. The holistic approach ensures that students are not only experts in their field but also equipped with the skills necessary to thrive in a dynamic and evolving job market.

Program Outcomes

Program Outcomes for an Post Graduate in Environmental Science Program, especially one with a comprehensive curriculum like the one, involves articulating the specific knowledge, skills, and attitudes students are expected to possess upon graduations. Following is the Program Outcomes:

1. Mastery of Core Concepts: Graduates will have a thorough understanding of the core concepts in Environment and Environmental Ecology, pollution, Biodiversity, Environmental Microbiology and Environment, Health and Industrial Safety.
2. Application of Knowledge: Graduates will be able to apply their knowledge to solve practical problems in Environmental Science; related fields and industries.
3. Research Competence: Graduates will be capable of designing and conducting independent research, utilizing appropriate methodologies and analytical tools.
4. Technological Innovation: Graduates will be proficient in using advanced technologies in Environmental research and applications.
5. Control pf Environmental Pollution: Graduates will understand and act to solve problem of Environmental Pollution.
6. Biodiversity and Conservation: Graduates will understand the importance of biodiversity, conservation, and the sustainable use of plant resources.
7. Environmental Stewardship: Graduates will be able to assess and address the impacts of environmental changes and human activities on plant ecosystems.
8. Professional and Ethical Responsibility: Graduates will be aware of their professional and ethical responsibilities, including the protection of intellectual property.

Programme Specific Objectives (PSOs):

After completion of this Programme successfully, students would be able to –

1. Apply the basic concepts of physical, chemical, mathematical, and biological sciences appropriately to the discipline of environmental science.
2. Use state-of-the-art techniques, tools and skills necessary for accurate analysis of environmental samples.
3. Demonstrate knowledge and understanding of the environmental principles and apply these to his own work, as member and/or leader in a team, to execute multidisciplinary projects.
4. Gain Advanced knowledge of fundamentals of Environmental Science with enhanced command over modern scientific methods, techniques and chemical processes equipped with environment safety measures.
5. Communicate complex technical information related to Environmental Science in a clear and concise written and verbal manner as oral presentations and compilation in the form of scientific reports.
6. Protect Natural Resources

TWO YEAR POSTGRADUATE PROGRAMME

M.Sc. ENVIRONMENTAL SCIENCE Under FACULTY: SCIENCE AND TECHNOLOGY

Board of Studies in Botany (Including Environmental Science and Seed Technology)

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

TWO YEAR POSTGRADUATE PROGRAMME

M.Sc. ENVIRONMENTAL SCIENCE

UNDER FACULTY: SCIENCE AND TECHNOLOGY

Subcommittees Constituted by BoS for Curriculum Development

Subcommittee for Preparation of the Scheme of Teaching, Learning, Examination and Evaluation for PG (Environmental Science) in alignment of the Recent Guidelines of NEP - ????

Objectives:

1. To prepare the Scheme of Teaching, Learning, Examination and Evaluation for PG (Environmental Science).
2. To decide all the DSC Titles for Four Semesters (Twelve Papers)
3. To decide Course Codes for DSC (Twelve) and DSE (Four)
4. To prepare suggestive outline of the Course Contents
5. To Prepare SOPs for Internal Assessment for Theory and Practical

Constitution of the Sub Committee:

1. **Dr. Dinesh Khedkar (Chairman, BoS),**
   Shri Shivaji Science College,
   Amravati.

2. **Dr. Vijay S. Mangle (Convener), Member**
   Arts, Science & Commerce College, Chikhaldara.

3. **Dr. Sangita P. Ingole (Convener), Member,**
   Shri Shivaji Science College, Amravati.

4. **Dr. Vaishali U Narnaware (Convener),**
   Member, Narasamma's Arts, Science & Commerce, College, Amravati

5. **Dr. Sachin K. Tippat, Member,**
   Narasamma's Arts, Science & Commerce College, Amravati.

6. **Prof. Gajanan D. Muratkar, Member,**
   Arts, Science & Commerce College Chikhaldara.

7. **Dr. D.L. Bhade, Member,**
   D. M. Burungale College, Shegaon, Dis. Buldhana.

8. **Dr. R.B. Barabde, Member,**
   D.M. Burungale College, Shegaon, Dis. Buldhana.

9. **Dr. K.J. Gawai,**
   Shri Shivaji Science College, Amravati.

10. **V.D. Bute,**
    Shri Shivaji Science College, Amravati.

Contribution of Ad-hoc/ CHB Teachers:

1. Dr. Aruna U. Kakade, APJ Kalam, College, Rahatgaon, Amravati
2. Dr. Shrikant Warhekar, Narasamma's Arts, Science & Commerce College, Amravati
3. Dr. Manisha A Jane, Shri Shivaji Science College, Amravati.
4. Gayatri Pathak, Narasamma's Arts, Science & Commerce College, Amravati
5. Pandit L. Gawande, D.M. Burungale College, Shegaon, Dis. Buldhana,
6. Sagar S. Bambal, Arts, Science & Commerce College Chikhaldara

Sub-Committees for Preparation of the Detailed Curriculum of Core and Elective Courses for Four Semesters

Discipline Specific Core (DSC)		
SEMESTER-I		
Sr. No	Title of Paper	Member
1	Research Methodology and IPR	1. V.D. Bute 2. Dr. Shrikant Warhekar.
2	Environmental Science – An Interdisciplinary Approach	1. Dr. Rahul B. Barabde 2. Dr. Shrikant Warhekar 3. Pandit L. Gawande
3	Geodynamics and Energy Resources	1. Vikrant D. Bute 2. Dr. Shrikant Warhekar
4	DSC-III.1 Concept of Ecology and Biodiversity.	1. Dr. Rahul B. Barabde 2. Vikrant D. Bute 3. Pandit L. Gawande
SEMESTER-II		
5	Environmental Microbiology, Toxicology and Biotechnology	1. Dr. Rahul B. Barabde 2. Dr. Shrikant Warhekar 3. Pandit L. Gawande
6	Air and Noise Pollution	1. Dr. Vijay S. Mangle 2. Sagar S. Bambal
7	Water Pollution	1. Dr. Vijay S. Mangle 2. Sagar S. Bambal
SEMESTER-III		
8	Contemporary Applied Technological Advancements in Research.	1. Vikrant D. Bute 2. Dr. Shrikant Warhekar
9	Solid Waste Management	Vikrant D. Bute
10	Remote Sensing, GIS& Computer Application.	1. Dr. Sangita P. Ingole 2. Dr. Aruna U. Kakade
11	Environmental Impact Assessment & Environmental Audit.	Dr. K.J. Gawai
SEMESTER-IV		
12	Environmental Engineering and Technology	1. Dr. Vaishali U. Narnaware 2. Gayatri Pathak
13	Environmental Statistics and Modelling.	1. Dr. Sangita P. Ingole 2. Dr. Aruna U. Kakade 3. Dr. Manisha A Jane
14	Environmental Policies and Legislation.	1. Dr. Sangita P. Ingole 2. Dr. Aruna U. Kakade
Discipline Specific Elective (DSE)		
15	Industrial Hygiene and Safety	Dr. Vijay S. Mangle
16	Fire Prevention and Protection.	Dr. Vijay S. Mangle
17	Industrial and Chemical and Process Safety.	Dr. Vijay S. Mangle
18	Environmental Management System and Life Cycle Assessment.	Dr. Vijay S. Mangle
Lab/Practical/ Exercise		
19	Lab-1: DSC-I. Lab Environmental Science – An Interdisciplinary Approach + DSC-II.1 Geodynamics and Energy Resources.	1. Dr. Rahul B. Barabde 2. Vikrant D. Bute 3. Dr. Shrikant Warhekar 4. Pandit L. Gawande

20	Lab-2: DSC-III.1 Concept of Ecology and Biodiversity. + DSE-I.1-Industrial Hygiene and Safety.	1. Dr. Vijay Mangle 2. Dr. Rahul B. Barabde 3. Vikrant D. Bute 4. Pandit L. Gawande
21	Lab-3: DSC-I.2 Environmental Microbiology + DSC-II.2 Air and Noise Pollution.	1. Dr. Vijay S. Mangle 2. Dr. Rahul2 B. Barabde 3. Dr. Shrikant Warhekar 4. Pandit L. Gawande 5. Sagar S. Bambal
22	Lab-4: DSC-III.2 Water Pollution + DSE-II.2 Industrial and Chemical and Process Safety.	1. Dr. Vijay S. Mangle 2. Sagar S. Bambal
23	Lab-5: DSC-I..3- Sold Waste Management + DSC-II.3- Remote Sensing, GIS& Computer Application.	1. Dr. Sangita P. Ingole 2. Vikrant D. Bute 3. Dr. Aruna U. Kakade
24	Lab-6: DSC-III.3 -Environmental Impact Assessment & Environmental Audit + /DSE-III Fire Prevention and Protection.	1. Dr. Vijay S. Mangle 2. Dr. K.J. Gawai
25	Lab-7: 1. DSC-I.4 Environmental Engineering and Technology 2. DSC-II.4 – Environmental Statistics and Modelling. + 3. DSC- III.4 Environmental Policies and Legislation 4. DSE-IV.4 Environmental Management System and Life Cycle Assessment	1. Dr. Vijay S. Mangle 2. Dr. Sangita P. Ingole 3. Dr. Vaishali U. Narnaware 4. Vikrant D. Bute 5. Dr. Shrikant Warhekar 6. Dr. Aruna U. Kakade 7. Gayatri Pathak 8. Dr. Manisha A Jane

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Sant Gadge Baba Amravati University, Amravati
FACULTY: SCIENCE
Scheme of Teaching, Learning, Examination & Evaluation leading to Two Years PG Degree Master of Science in Environmental Science following Three Years UG Programme wef 2023-24
(Two Years- Four Semesters Master's Degree Programme- NEPv23 with Exit and Entry Option
M. Sc. (ENVIRONMENTAL SCIENCE) First Year Semester- I [Level- 6.0]

Note: The fourth year (Semester VII and Semester VIII) of Four years Honors UG degree and Four years honors with Research UG degree shall be identical in structure to the First year (Semester I and Semester II) of two-year PG programmes offered after three-year UG programmes.

S. N.	Subject	Type of Course	Subject Code	Teaching & Learning Scheme							Duration Of Exam Hours	Examination & Evaluation Scheme							
				Teaching Period Per Week				Credits				Maximum Marks					Minimum Passing		
												Theory		Practical		Total Marks			
				L	T	P	Total	L/T	Practical	Total		Theory+ MCQ Internal	Theory External	Internal	External		Marks Internal	Marks External	Grade
0	*Pre-Requisite Course(s) if applicable/MOOC/Internship/Field Work cumulatively If students wish to opt Minor Course of UG as Major for PG, balance 12 Credits Course will have to be completed (As and when applicable)	Th-Prq		0	0	0	0	Additional Credits to be earned = (1) minus (2) (1). Credits from Major DSC Courses in UG (minus) (2). The Credits already earned from the Course as Minor at UG, now to be opted as Major at PG			2	20	30			50	08	12	P
1	Research Methodology and IPR	Th-Major	EVS/RM-1	2			2	2		2	2	40	60			100	16	24	P
2	DSC-I.1 Environmental Science – An Interdisciplinary Approach	Th-Major	EVS-101	4			4	4		4	3	40	60			100	16	24	P
3	DSC-II.1 Geodynamics and Energy Resources	Th-Major	EVS-102	4			4	4		4	3	40	60			100	16	24	P
4	DSC-III.1 Concept of Ecology and Biodiversity.	Th-Major	EVS-103	3			3	3		3	3	40	60			100	16	24	P
5	MOOC/ DSE-I -Industrial Hygiene and Safety	Th-Major Elective	EVS-104	3			3	3		3	3	40	60			100	16	24	P
																	Minimum Passing Marks		Grade
5	Lab-1: DSC-I. Lab Environmental Science – An Interdisciplinary Approach + DSC-II.1 Geodynamics and Energy Resources.	Pr-Major Lab-1	EVS 105 (DSCI.1+ DSC II.1)			4	4		2	2	6			50	50	100	50		P
6	Lab-2: DSC-III.1 Concept of Ecology and Biodiversity. + DSE-I.1-Industrial Hygiene and Safety.	Pr-Major Lab-2	EVS 106 (DSCIII.1+ DSE1.1)			4	4		2	2	6			50	50	100	50		P
7	# On Job Training, Internship/ Apprenticeship; Field projects Related to Major @ during vacations	Related to DSC		120 Hours cumulatively during vacations of Semester I and Semester						4*									P*
	Cumulatively			II															

8	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 and IV	Generic Optional		90 Hours Cumulatively From Sem I to Sem IV													

L: Lecture, T: Tutorial, P: Practical/Practicum

Pre-requisite Course mandatory if applicable: Prq, Theory: Th, Practical/Practicum: Pr, Faculty Specific Core: FSC, Department Specific Core: DSC, Department Specific Elective: DSE, Laboratory: Lab, OJT: On Job Training: Internship/ Apprenticeship; Field projects: FP; RM: Research Methodology; Research Project: RP, Co-curricular Courses: CC

Note : # On Job Training, Internship/ Apprenticeship; Field projects Related to Major (During vacations of Semester I and Semester II) for duration of 120 hours mandatory to all the students, to be completed during vacations of Semester I and/or II. This will carry 4 Credits for learning of 120 hours. Its credits and grades will be reflected in Semester II credit grade report.

Note: Co-curricular Courses: In addition to the above, CC also include but not limited to Academic activities like paper presentations in conferences, Aavishkar, start-ups, Hackathon, Quiz competitions, Article published, Participation in Summer school/ Winter School / Short term course, Scientific Surveys, Societal Surveys, Field Visits, Study tours, Industrial Visits, online/offline Courses on Yoga (Yoga for IQ development, Yoga for Ego development, Yoga for Anger Management, Yoga for Eyesight Improvement, Yoga for Physical Stamina, Yoga for Stress Management, etc.). These can be completed cumulatively during Semester I, II, III and IV. Its credits and grades will be reflected in semester IV credit grade report.

Sant Gadge Baba Amravati University, Amravati
FACULTY: SCIENCE
Scheme of Teaching, Learning, Examination & Evaluation leading to Two Years PG Degree Master of Science in Environmental Science- following Three Years UG Programme wef 2023-24
(Two Years- Four Semesters Master's Degree Programme- NEPv23 with Exit and Entry Option
M.Sc. (Environmental Science) First Year, Semester -II [Level -6.0]

Note: The fourth year (Semester VII and Semester VIII) of Four years Honors UG degree and Four years honors with Research UG degree shall be identical in structure to the First year (Semester I and Semester II) of two-year PG programmes offered after three-year UG programmes.

S. N.	Subject	Type of Course	Subject Code	Teaching & Learning Scheme							Duration Of Exam Hours	Examination & Evaluation Scheme							
				Teaching Period Per Week				Credits				Maximum Marks					Minimum Passing		
												Theory		Practical		Total Marks			
				L	T	P	Total	L/T	Practical	Total		Theory+MCQ Internal	Theory External	Internal	External		Marks Internal	Marks External	Grade
1	DSC-I.2 Environmental Microbiology, Toxicology and Biotechnology	Th-Major	EVS-107	4			4	4		4	3	40	60			100	16	24	P
2	DSC-II.2 Air and Noise Pollution	Th-Major	EVS-108	3			4	4		4	3	40	60			100	16	24	P
3	DSC-III.2 Water Pollution	Th-Major	EVS-109	3			3	3		3	3	40	60			100	16	24	P
4	MOOC/ DSE-II.2 Industrial , Chemical and Process Safety	Th-Major Elective	EVS-110	3			3	3		3	3	40	60			100	16	24	P
																	Minimum Passing Marks		
5	Lab-3: DSC-I.2 Environmental Microbiology + DSC-II.2 Air and Noise Pollution.	Pr-Major Lab-3	EVS-111			4	4		2	2	6			50	50	100	50		P
6	Lab-4: DSC-III.2 Water Pollution + DSE-II.2 Industrial and Chemical and Process Safety	Pr-Major Lab-4	EVS-112			4	4		2	2	6			50	50	100	50		P
7	# On Job Training, Internship/ Apprenticeship; Field projects Related to Major @ during vacations cumulatively	Related to Major		120Hours cumulatively during vacations of Semester I and Semester II						4*									P*
8	Co-curricular Courses: Health and wellness, Yoga Education, Sports and Fitness, Cultural Activities,NSS/NCC,VFine/Applied/isual/Performing Arts During Semester I, II, III and IV	Generic Optional		90 Hours Cumulatively From Sem I to Sem IV															
				Exit Option with a PG Diploma with 4 Credits On-the-job training/internship in the respective Major subject-Student has to earn Total minimum 4 Credits cumulatively during Vacations of Semester I and Semester II from internship in order to exit after First Year with PG Diploma (42-44 Credits) after Three Year UG Degree															

L: Lecture, T: Tutorial, P: Practical/Practicum
Pre-requisite Course mandatory if applicable: Prq, Theory : Th, Practical/Practicum: Pr, Faculty Specific Core: FSC, Department Specific Core: DSC, Department Specific Elective: DSE, Laboratory: Lab, OJT: On Job Training: Internship/ Apprenticeship; Field projects: FP; RM: Research Methodology; Research Project: RP, Co-curricular Courses: CC

Note : # On Job Training, Internship/ Apprenticeship; Field projects Related to Major (During vacations of Semester I and Semester II) for duration of 120 hours mandatory to all the students, to be completed during vacations of Semester I and/or II. This will carry 4 Credits for learning of 120 hours. Its credits and grades will be reflected in Semester II credit grade report.

Note: Co-curricular Courses: In addition to the above, CC also include but not limited to Academic activities like paper presentations in conferences, Aavishkar, start-ups, Hackathon, Quiz competitions, Article published, Participation in Summer school/ Winter School / Short term course, Scientific Surveys, Societal Surveys, Field Visits, Study tours, Industrial Visits, online/offline Courses on Yoga (Yoga for IQ development, Yoga for Ego development, Yoga for Anger Management, Yoga for Eyesight Improvement, Yoga for Physical Stamina, Yoga for Stress Management, etc.). These can be completed cumulatively during Semester I, II, III and IV. Its credits and grades will be reflected in semester IV credit grade report.

Sant Gadge Baba Amravati University Amravati
FACULTY: SCIENCE
Scheme of Teaching, Learning, Examination & Evaluation leading to Two Years PG Degree Master of Science in Environmental Science following Three Years UG Programme wef 2023-24
(Two Years- Four Semesters Master's Degree Programme- NEPv23 with Exit and Entry Option
M.Sc. (Environmental Science) Second Year, Semester -III [Level -6.5]

S. N.	Subject	Type of Course	Subject Code	Teaching & Learning Scheme							Duration Of Exam Hours	Examination & Evaluation Scheme							
				Teaching Period Per Week				Credits				Maximum Marks					Minimum Passing		
												Theory		Practical		Total Marks			
				L	T	P	Total	L/T	Practical	Total		Theory+ MCQ Internal	Theory External	Internal	External		Marks Internal	Marks External	Grade
1	Contemporary Applied Technological Advancements in Research	Th-Major	EVS/ RM-2	2			2	2		2	2	40	60			100	16	24	P
	DSC-I..3- Solid Waste Management		EVS- 113	4			4	4		4	3								
2	DSC-II.3- Remote Sensing, GIS& Computer Application	Th-Major	EVS- 114	4			4	3		4	3	40	60			100	16	24	P
2	DSC-III.3 -Environmental Impact Assessment & Environmental Audit	Th-Major	EVS- 115	3			3	3		3	3	40	60			100	16	24	P
3	MOOC/DSE-III.3 Fire Prevention and Protection	Th-Major Elective	EVS- 116	4			3	3		3	3	40	60			100	16	24	P
																	Minimum Passing Marks		
4	Lab-5: DSC-I..3- Sold Waste Management + DSC-II.3- Remote Sensing, GIS& Computer Application.	Pr-Major Lab-5	EVS- 117			4	4		2	2	6			50	50	100	50		P
5	Lab-6: DSC-III.3 -Environmental Impact Assessment & Environmental Audit + /DSE-III Fire Prevention and Protection.	Pr-Major Lab-6	EVS- 118			4	4		2	2	6			50	50	100	50		P
7	Research Project Phase-I Internal	Major	EVS-119	-		6	6	2	2	4	-			50	--	50	25		P
8	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 and IV	Generic Optional		90 Hours Cumulatively From Sem I to Sem IV															
	TOTAL			18	0	16	26	18	4	22		160	240	150	100	650			

L: Lecture, T: Tutorial, P: Practical/Practicum
Pre-requisite Course mandatory if applicable: Prq, Theory: Th, Practical/Practicum: Pr, Faculty Specific Core: FSC, Department Specific Core: DSC, Department Specific Elective: DSE, Laboratory: Lab, OJT: On Job Training: Internship/ Apprenticeship; Field projects: FP; RM: Research Methodology; Research Project: RP, Co-curricular Courses: CC
Note: Co-curricular Courses: In addition to the above, CC also include but not limited to Academic activities like paper presentations in conferences, Aavishkar, start-ups, Hackathon, Quiz competitions, Article published, Participation in Summer school/ Winter School / Short term course, Scientific Surveys, Societal Surveys, Field Visits, Study tours, Industrial Visits, online/offline Courses on Yoga (Yoga for IQ development, Yoga for Ego development, Yoga for Anger Management, Yoga for Eyesight Improvement, Yoga for Physical Stamina, Yoga for Stress Management, etc.). These can be completed cumulatively during Semester I, II, III and IV. Its credits and grades will be reflected in semester IV credit grade report.

Sant Gadge Baba Amravati University, Amravati
FACULTY: SCIENCE
Scheme of Teaching, Learning, Examination & Evaluation leading to Two Years PG Degree Master of Science in Environmental Management following Three Years UG Programme wef 2023-24
(Two Years- Four Semesters Master's Degree Programme- NEPv23 with Exit and Entry Option
M.Sc. (Environmental Science) Second Year, Semester -IV [Level -6.5]
M. Sc. Second Year Semester- IV [Level 6.5]

S. N.	Subject	Type of Course	Subject Code	Teaching & Learning Scheme							Duration Of Exam Hours	Examination & Evaluation Scheme							
				Teaching Period Per Week				Credits				Maximum Marks					Minimum Passing		
												Theory		Practical		Total Marks			
				L	T	P	Total	L/T	Practical	Total		Theory+ MCQ Internal	Theory External	Internal	External		Marks Internal	Marks External	Grade
1	DSC-I.4 Environmental Engineering and Technology	Th-Major	EVS- 120	4			4	4		4	3	40	60			100	16	24	P
2	DSC-II.4 – Environmental Statistics and Modelling.	Th-Major	EVS- 121	4			4	4		4	3	40	60			100	16	24	P
3	DSC- III.4 Environmental Policies and Legislation	Th-Major	EVS- 122	4			4	3		3	3	40	60			100	16	24	P
4	MOOC/ DSE-IV- 4 Environmental Management System and Life Cycle Assessment.	Th-Major Elective	EVS- 123	3			3	3		3	3	40	60			100	16	24	P
																	Minimum Passing Marks		
5	Lab-7: 1. DSC-I.4 Environmental Engineering and Technology 2. DSC-II.4 – Environmental Statistics and Modelling. + 3. DSC- III.4 Environmental Policies and Legislation 4. DSE-IV.4 Environmental Management System and Life Cycle Assessment.	Pr-Major Lab-7	EVS-124	-	-	4	4	-	4	4	6	-	-	50	50	100	50		P
9	Lab-8: Research Project Phase-II	Project	EVS-125					-	-	6				75	75	150	75		P
10	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 and IV	Generic Optional		90 Hours Cumulatively From Sem I to Sem IV						3									

L: Lecture, T: Tutorial, P: Practical/Practicum
Pre-requisite Course mandatory if applicable: Prq, Theory : Th, Practical/Practicum: Pr, Faculty Specific Core: FSC, Department Specific Core: DSC, Department Specific Elective: DSE, Laboratory: Lab, OJT: On Job Training: Internship/ Apprenticeship; Field projects: FP; RM: Research Methodology; Research Project: RP, Co-curricular Courses: CC
Note: Co-curricular Courses: In addition to the above, CC also include but not limited to Academic activities like paper presentations in conferences, Aavishkar, start-ups, Hackathon, Quiz competitions, Article published, Participation in Summer school/ Winter School / Short term course, Scientific Surveys, Societal Surveys, Field Visits, Study tours, Industrial Visits, online/offline Courses on Yoga (Yoga for IQ development, Yoga for Ego development, Yoga for Anger Management, Yoga for Eyesight Improvement, Yoga for Physical Stamina, Yoga for Stress Management, etc.). These can be completed cumulatively during Semester I, II, III and IV. Its credits and grades will be reflected in semester IV credit grade report

Table: Comprehensive Credits distribution amongst the type of Courses over Two Years (Four Semesters) PG Programme and Minimum Credits to be earned for PG Degree [Master in Faculty of Science ,Major - Environmental Science]

Sr. No.	Type of Course		Total Credits Offered	Minimum Credits Required
1	MAJOR			
	i. DSC	56		56
	ii. DSE	16		16
	TOTAL		72	72
2	Research Methodology and IPR (FSC/DSC: Major)	04	04	04
2	On Job Training, Internship/ Apprenticeship; Field projects Related to Major	04	04 for 120 Hours OJT/FP cum.	02 (Minimum 60 Hours OJT/FP is mandatory)
3	Research Project	10	10	10
	OPTIONAL			
4	Co-Curricular Courses (offline and/or online as applicable): Co- curricular Courses: Health and wellness, Yoga Education, Sports and Fitness, Cultural Activities, NSS/NCC, Fine/Applied/Visual/Performing Arts, CC also include but not limited to Academic activities like paper presentations in conferences, Aavishkar, start-ups, Hackathon, Quiz competitions, Article published, Participation in Summer school/ Winter School / Short term course, Scientific Surveys, Societal Surveys, Field Visits, Study tours, Industrial Visits, online/offline Courses on Yoga (Yoga for IQ development, Yoga for Ego development, Yoga for Anger Management, Yoga for Eyesight Improvement, Yoga for Physical Stamina, Yoga for Stress Management, etc.).		Limited to Maximum 03 only (For 90 Hours of CC cumulatively)	00
	TOTAL			
	TOTAL		93	88

Table A: Comprehensive Credit Distribution for CC

S. N.	Activities (offline/online as applicable)	Credits at Levels						Letter Grade
		College	University	State	Zone if exist	National	International if exist	
1	Health and wellness, Yoga* Competitions *If a Course (online/offline) on Yoga is completed for 60 Hours, 2 credits will be awarded to the student (1 Credit = 30 Hours)	1	2	3	4	5	6	P (Pass)
2	Unnat Bharat Abhiyan [UBA]	1	2	3	4	5	6	P (Pass)
3	Sports and fitness activities (see separate Table B)	1	1 / 2	2 / 3	3 / 4	4 / 5	5 / 6	P (Pass)
4	Cultural activities, Fine/Applied/Visual/Performing Arts	1	2	3	4	5	6	P (Pass)
5	N.S.S. activities Camps	1	2	3	4	5	6	P (Pass)
6	Academic activities like Research Paper/Article/Poster presentations, Aavishkar, start-up, Hackathon, Quiz competitions, other curricular, co-curricular activities, students exchange programme etc. Research Paper/Article published	1 --	2 1	3 2	4 -	5 4	6 6	P (Pass) P (Pass)
7	Participation in Summer school/ Winter School / Short term course (not less than 30 hours 1 or 2 weeks duration) (not less than 60 hours 2 or 3 weeks duration) Scientific Surveys, Societal Surveys Field Visits, Study tours, Industrial Visits,	2 Credits 4 Credits 2 Credits 1 Credit						P (Pass) P (Pass) P (Pass) P (Pass)
8	NCC Activities	As given in Table C						

Table B: Credit Distribution for Sports and Fitness

Sr. No.	Particulars of Sports Status (Individual/ Team)	Credits	Letter Grade
1	College Level Participation	1	P (Pass)
2	University Level Participation	1	P (Pass)
3	University Level Rank 1, 2, 3	2	P (Pass)
4	State Level Participation	2	P (Pass)
5	State Level Rank 1, 2, 3	3	P (Pass)
6	Zonal Level Participation	3	P (Pass)
7	Zonal Level Rank 1, 2, 3	4	P (Pass)
8	National Level Participation	4	P (Pass)
9	National Level Rank 1, 2, 3	5	P (Pass)
10	International Level Participation	5	P (Pass)
11	International Level 1,2,3	6	P (Pass)

Table C: Credit Distribution for NCC activities

Sr. No.	Particulars of NCC Activities	Credits	Letter Grade
1	Participation in NCC activities	1	P (Pass)
2	'B' Certificate obtained	2	P (Pass)
3	'C' Certificate obtained	3	P (Pass)
4	State Level Participation	4	P (Pass)
5	National level Participation	5	P (Pass)
6	International Level Participation	6	P (Pass)

Sant Gadge Baba Amravati University, Amravati
FACULTY: Science and Technology
Detailed Curriculum of leading to Two Year PG Degree of Master of Environmental Science
(Two Years - Four Semesters Master's Degree Programme- NEPv23 with Exit and Entry Option)

Note: The fourth year (Semester VII and Semester VIII) of Four years Honors UG degree and Four years honors with Research UG degree shall be identical in structure to the First year (Semester I and Semester II) of Two-Year PG Programmes offered after Three-Year UG programmes.

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
6.0	I	EVS/RM-1	Research Methodology and IPR	2	60 (10 per Unit)	2 Hrs	40 (Int)+ 60 (Ext)

Course Objectives:

1. Objective 1: To understand the role of research methodology in Engineering/Science
2. Objective 2: To understand Research Design
3. Objective 3: To learn various Literature Survey
4. Objective 4: To create awareness about intellectual property rights and patents

Course Outcomes:

After the completion of this course, student will be able to-

CO 1: Demonstrate the ability to choose methods appropriate to research aims and objectives
CO 2: Understand the limitations of particular research methods
CO 3: Develop skills in qualitative and quantitative data collation
CO 4: Develop skills in writing of patents

Detailed Curriculum:

Unit – I: Science and Foundations of Research.

1.1 : What is Science? Characteristics of Science, Technology and techno-science
1.2 Meaning of Research
1.3 Characteristics and types of research, Importance of research activities
1.4 Principles of quality research work
1.5 Problems in research, Scientific attitude and temper, Qualities of good researcher
1.6 Non-science and Scientific realism.

Unit – II: Design and Criteria of Scientific Research:

2.1 Introduction, Research planning and design, Selection of research topic,
2.2 Criteria for good research problem, Source of research Idea, Principles of good research,
2.3 Criteria of good research, Guidelines for research skill and awareness, Research validity and reliability
2.4 Scientific methodology: Rules and principles of scientific methods,
2.5 Research methods versus methodology,
2.6 Hypothesis and testing of hypothesis.

Unit – III: Literature Survey:

3.1 Literature review, Approaching the literature, Scholarly literature,
3.2 Data provenance and evaluation,
3.3 Intellectual property
3.4 Sources of information: Primary, Secondary, Tertiary sources, Patents, Journals (Print and ejournal), Type of Journals
3.5 Understanding of literature: Reading A Scientific Paper, Abstracts, Current titles, Reviews, Books, Current contents,
3.6 Tools for Digital Literature Survey: Scientific databases, e-journals, Shodsindhu, Shodhganga, Google/Google Scholar, ResearchGate, PubMed, finding and citing Information.

Unit – IV: Research Ethics, IPR and Publishing

4.1 : Ethics: Ethical issues related to publishing,
4.2 Plagiarism and Self-Plagiarism
4.3 : IPR: intellectual property rights and patent law
4.4 : Techniques of writing a Patent, filing procedure,
4.5 Technology transfer, copy right, royalty
4.6 : Trade related aspects of intellectual property rights

Proposed Pedagogies:

1. **Teaching Methodologies**:

Self-study, Gamification – Engagement through play and the pedagogies of games, Embodied learning – Capitalizing on creativity and emotions, Multiliteracies and discussion-based teaching – Fostering critical thinking and questioning

2. **Learning Methodologies**:

Action research involving critical reflection and reflexivity on current practice, Real world projects, Experiential learning

3. **Evaluation Methodologies**:

Theory paper at university level, class room test, group discussion, seminar

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16. Ram Ahuja, "Research Methods", (2001), Rawat Publications, New Delhi.
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Model Questions:

1. Write in details Characteristics and types of research and Importance of research activities
2. Explain Criteria of good research, Guidelines for research skill and awareness.
3. Discuss the all Sources of information available in research.
4. Write down the intellectual property right in details
5. Write a note on Problems in research and Scientific attitude and temper
6. Write a note on Research methods versus methodology.
7. Explain the concept of Literature review and approaching the literature
8. Discuss Plagiarism and Self-Plagiarism
1. Write down the principles of quality research work
2. Write a note on Qualities of good researcher
3. Explain Non-science and Scientific realism
4. Write a note on Research planning and design
5. What is Hypothesis
6. Write principles of good research
7. Write a note on Data provenance and evaluation
8. Write a note on tools for Digital Literature Survey any two
9. Explain meaning of scholarly literature
10. Write a note on ethical issues related to publishing
11. What is plagiarism
12. What is copy right in research publication

Rubric for Internal Assessment for Theory Paper

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI Internal Theory Assessment M.Sc. I (Environmental Science), SEMESTER – I (NEP)		
EVS/RM-1	Title: Research Methodology and IPR	Max Marks: 40
S.N.	Assessment Criteria	Marks
1.	Attendance	05
2.	Class assignments	05
3.	Unit Test (MCQ)	20
4.	Participation in activity/Field visit	05
5.	Overall Performance	05

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
6.0	I	EVS-101	DSC-I-1, Environmental Science- An Interdisciplinary Approach	4	60 (10 per Unit)	2 Hrs	40 (Int)+ 60 (Ext)

Course Objectives:

1. Understand and evaluate the global scale of environmental problems.
2. Analyze role of Plate Tectonics in various Earth Surface Processes.
3. Create in student's ability to understand about changes in Earth's history with time.
4. Get acquainted with different types of resources and their distribution.
5. Develop scientific, interpretive and creative thinking skills.
6. Create knowledge and improve thinking ability for sustainable development.

Course Outcomes:

Upon completion of this Course successfully, students would be able to-
CO 1: Study of fundamental concepts of socio-environmental aspects
and problems. CO 2: Understand earth and environmental systems.
CO 3: Acquire knowledge about Geo-
environmental aspects. CO 4: Understand the
detailed concept of urban environment.
Co 5: Understanding the concept of Minerals, environment and environmental economics
CO 6: To expand capacities of the learners on various theoretical and practical aspects of sustainable development.

Detailed Curriculum:

Unit – I: Basic issues in environmental sciences
1.1 : Definition and principle,
1.2 : scope of environmental science,
1.3 : environmental attitudes of individuals and society
1.4 : concept of human population and growth
1.5 : concept of urbanization, sustainability – definition and approach, types
1.6 : carrying capacity, a detailed concept

Unit – II: Earth as a system
2.1 : Introduction to Environmental unity,
2.2 : Earth as a system, concept and types
2.3 : mass and energy transfer across various interfaces,
2.4 : material balance in earth system,
2.5 : relationships in environment, earth and life
2.6 : first and second law of thermodynamics.

Unit – III: Environmental geo-science and geo-chemistry
3.1 : Basic environmental problems with respect to geoscience
3.2 : Theories of evolution of earth
3.3 : Concept of plate tectonics, major plates and boundaries.
3.4 : Major trace elements and classification of trace elements,
3.5 : Mobility of trace elements,
3.6 : Biogeochemical factors in environmental health.

Unit – IV: Urban environment
4.1 : Introduction to urban environment
4.2 : Urban environmental and social stresses
4.3 : City as a system; Influence of city life on city planning and environment
4.4 : Urban ecosystems: Concept and Definition, Types and Significance
4.5 : urban climatology (Concept, Definition and significance)
4.6 urban forestry :(Concept, Definition and significance)

Unit – V: Minerals, environment and environmental economics
5.1 : Introduction to Importance of minerals in environment, agriculture, industry and life,
5.2 : threats to mineral resources and reserves in India
5.3 : environmental economics: basics, Importance
5.4 : Strategies and challenges in Environmental Economics
5.5 : cost benefit analysis (CBA),
5.6 : Economic Instrument for Environmental Policy.

Unit – VI: Sustainability science 6.1 : Sustainability science Concepts and Characteristics 6.2 : Domains Of Sustainability, Concept 6.3 : Types (Domains of Sustainability), Productivity). 6.4.: Economic, Environment, Human Condition and Social

6.5 : 17 GOALS of Sustainable Development 6.6 : Applications of Sustainability Science
Proposed Pedagogies: **Teaching Methodologies**: Black board Teaching, PPT Presentation, Group discussion, Chart, Model, Field visit, project writing, etc. Directed Discussion, instruction, RBPT, **Learning Methodologies:** Assignments, MCQ, Seminars, Group discussions, Participative, experiential and project based, etc. **Evaluation Methodologies:** Test, Assignment, Seminar, Project, etc.
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Model Questions:

Long Type for 10 Marks:

Q1 Define environmental science Scope and principles of it.
Q2 Right about Earth as an ecosystem And energy transfer in various interfaces.
Q3What is meant by minerals and focus on their importance.
Q4 Discuss about plate tectonics and its boundaries.
Q5 Discuss about Urban Environment And its components.
Q6 Write on account with Fertilizers and its effects on soil.

Long Type for 05 Marks: At least ONE on Each Unit

Q1 What are the consequences of human population growth.
Q2 Explain about First and second law of thermodynamics and their role in the environment.
Q3 Explain about biogeochemical Factors in Environmental Health.
Q4 Explain the concept of waste Disposal And management.
Q5 Write about Resources and Reserves.
Q6 Describe the Use of agrochemicals In agriculture.

Short Type for 3/4Marks:
Q1 Explain about urbanization.
Q2 Explain about sustainability.
Q3 What is meant by carrying capacity.
Q4 Write about Energy transfer.
Q5 Write about the heat transfer Process.
Q6 Write about Earth as an ecosystem.
Q7 Define geoscience and its factors.
Q8 Write about the concept of plate tectonics.
Q9 What are the basic environmental problems.
Q10 Explain the City as a system.
Q11 Write about Sustaining living resources.
Q12 What is the concept of Waste Management.
Q13 What is a resource.
Q14 What is the importance of environmental economics.
Q15 What is Cost-benefit analysis.
Q16 Explain methods of pest control.
Q17 Explain the effects of fertilizers on soil.
Q18 Explain integrated pest management.

Rubric for Internal Assessment for Theory Paper

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI Internal Assessment M.Sc. I (Environmental Science), SEMESTER – I (NEP)		
Course Code: EVS-101 DSC-I.1	Title: (Environmental Science- An Interdisciplinary Approach)	Max Marks: 40
S.N.	Assessment Criteria	Marks
1	Attendance	05
2	Class assignments	05
3	Unit Test (MCQ)	20
4	Participation in activity/Field visit	05
5	Overall Performance	05
Total: -		40

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
6.0	I	EVS-102	DSC-II. I-Geodynamics and Energy Resource	4	60 (10 per Unit)	2 Hrs	40 (Int)+ 60 (Ext)

Course Objectives:

1: Understand the principal and concepts of ecosystem dynamics and energy flow through ecosystems. Acquire knowledge about structure and functions of ecosystem.
2: Students also learn about the concept of Biomass
3: Students can understand fundamental concept of environmental geology
4: Students will gain the knowledge about geologic hazards & risks
5: Understand conventional and non-conventional energy resources
6: Acquire the knowledge about important of non-conventional energy resources and its type

Course Outcomes:

Upon completion of this Course successfully, students would be able to

CO 1: Acquire knowledge of how material, energy flows in to the ecosystems
CO 2: Acquire knowledge of how material, energy floes in to the ecosystems
CO 3: Understand the concept of geo environment
CO 4: Understand types of geological hazard and their possible, effects.
CO 5: Demonstrate conventional energy resources.
CO 6: Demonstrate non-conventional energy resources

Detailed Curriculum:

Unit – I: Ecosystem dynamics:

1.1 Definition, classification of ecosystems.
1.2 Levels of ecology.
1.3 Fundamental concepts and structure ecosystem.
1.4 Functions of ecosystem.
1.5 Energy flow through ecosystems: Ecological energetic.
1.6 Carrying capacity.

Unit – II: Biomass productivity:

2.1 Concepts of biomass.
2.2 Food chains and food web with advantages and disadvantages.
2.3 Ecological pyramids.
2.4 Methods of measurement of biomass and primary productivity.
2.5 Ecological efficiencies and Biotic Interaction.
2.6 Bioaccumulation and biomagnifications.

Unit – III: Geo-environment:

3.1 Introduction, fundamental concept of environmental geology.
3.2 The concept of earth system.
3.3 The rock cycles.
3.4 Earth's thermal environment and seasons.
3.5 Indian monsoon and droughts.
3.6 El-Nino and La-Nina.

Unit – IV: Geological hazards

4.1 Assessing geologic hazards & risks
4.2 Types of hazards - earth quakes, volcanic eruptions, subsidence, landslides,
4.3 Soil erosion, floods and desertification.
4.4 Hazardous of ocean and weather- sea water intrusion,
4.5 Tsunami and its effects
4.6 Tropical cyclones.

Unit – V: Conventional energy resources

5.1 Conventional energy resources and mechanism of utilization
5.2 Wood, Coal
5.3 Oil and natural gas
5.4 Nuclear energy
5.5 Advantages and disadvantages of conventional energy resources
5.6 Indian scenario of energy requirement

Unit – VI: Non-conventional energy resources:

6.1 Biogas energy - Energy from biomass, anaerobic digestion
6.2 Ocean thermal energy, wind wave energy, tidal energy,
6.3 Hydropower plant, wind energy
6.4 Geothermal energy
6.5 Energy from wastes
6.6 Solar energy: Photovoltaic, solar cooker, solar water heater, Solar ponds.

Proposed Pedagogies:

1. Teaching Methodologies:

By using PPT, chock and board method, video

2. Learning Methodologies:

Real world projects, Experiential learning, identification of rock and minerals

3. Evaluation Methodologies: Theory paper at university level, class room test, group discussion, seminar

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Model Questions:

1. Explain the structure and function of ecosystem
2. Describe methods of measurement of biomass and primary productivity
3. Discuss the concept of El-Nino and La-Nina
4. Describe the earth quakes and volcanic eruptions in details.
5. Write down the mechanism of formation and advantages of nuclear energy
6. Describe the concept of solar energy along with Solar energy: Photovoltaic and solar cooker.
1. Explain ecological energetic
2. Write a note on Bioaccumulation
3. Describe in short The concept of earth system
4. Write a note on tsunami
5. Write a note on wood and Coal as a sources of energy
6. Explain only mechanism of formation of Ocean thermal energy
1. Explain Carrying capacity of ecosystem
2. Give the classification of ecosystem
3. Describe abiotic components of forest ecosystem.
4. Discuss food chains along with advantages and disadvantages
5. Discuss food web along with advantages and disadvantages
6. Write a note on primary productivity
7. Explain rock cycle
8. Write a note on Earth's thermal environment
9. Write a note on Indian monsoon
10. Write down the types of floods
11. Explain the effects of landslides
12. Write a note on tropical cyclones
13. Write a note on Oil and natural ga
14. Write a note on coal and its types
15. Explain the concept of conventional energy resources
16. Working mechanism of hydropower plant
17. Advantages and disadvantages of geothermal energy
18. Advantages and disadvantages of hydropower plant

Rubric for Internal Assessment for Theory Paper

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI Internal Assessment M.Sc. I (Environmental Science), SEMESTER – I (NEP)			
Paper: DSCII.1	Course Code: EVS-102	Title: Geodynamics and Energy Resources	Max Marks: 40

S.N.	Assessment Criteria	Marks
1.	Attendance	05
2.	Class assignments	05
3.	Unit Test (MCQ)	20
4.	Participation in activity/Field visit	05
5.	Overall Performance	05

Lab/Pr Based on DSCi.1 and DSC II.1: (Any 15 Exercise)

MAJOR EXERCISES:

1. To determine Productivity of Terrestrial Ecosystem.
2. Exercises on satellite imagery/photo interpretation
3 Study of resource maps.
4 Study of seismic and flood-prone areas in India.
5. Study properties of minerals and their Identification.
6 Determination of energy contents of biomass.
7 Study of soil profile and determination of soil texture.
8 Determination productivity of terrestrial ecosystem.
9 Determination productivity of aquatic ecosystem.
10 Study of local Monsoon pattern
11 To identify carbonate rocks by acid test.
12 To study the characteristics of different soils.

MINOR EXERCISES:

1. Demonstration of non-conventional energy sources.
2. Natural Hazard Identification- Landslides, subsidence, flood, forest fires etc.
3. To demonstrate the process of soil erosion.
4. To determine energy properties of wood. (Density, Moisture content,
5. Volatile matter, Percentage of fixed carbon, and Percentage of ash content).
6. Identification of drainage patterns.

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Rubric for Internal/External Assessment for Practical

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI Internal Practical Assessment M.Sc. I (Environmental Science) SEMESTER – I (NEP)		
Course Code- EVS-105	DSC-I.1 Lab Environmental Science – An Interdisciplinary Approach + DSC-II.1 Geodynamics and Energy Resources. LAB-1	Max Marks: 50
S.N.	Assessment Criteria	Marks
1	Attendance	10
2	Field Visit-Survey Report/ Assignment	10
3	Active participation in activities	10
4	Submission of practical record	10
5	Internal examiner viva-voce	10

Rubric for External Assessment for Practical

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI External Practical Assessment M.Sc. I (Environmental Science), SEMESTER – I (NEP)		
Course Code- EVS-105 Paper- DSC- I-1 and DSC II.1	Lab/Pr -1: 1 DSC-I. Lab Environmental Science – An Interdisciplinary Approach + DSC-II.1 Geodynamics and Energy Resources.	Max Marks: 50 Time: Six.Hrs.
Question No.	Experiment/ Activity	Marks
1	Major experiment based on-1 (DSC-I.1)	15
2	Major experiment based on-2 (DSC I.2)	15
3	Minor experiment based on-1 (DSC-I.1)	05
4	Minor experiment based on-2 (DSC I.2)	05
5	Viva-voce	10

Sant Gadge Baba Amravati University, Amravati

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
6.0	I	EVS – 103	DSC-III.1 Concept of Ecology and Biodiversity	4	60 (10 per Unit)	2 Hrs	40 (Int)+ 60 (Ext)

Course Objectives:

1. Understand the meaning of history, types, and their relevance to the sciences of ecology.
2. To discuss the scientific principal and level of population ecology.
3. Understand the complex mechanism community ecology and dynamics of ecological.
4. Analyze the basic concept of ecosystem.
5. Understand biodiversity and importance of biodiversity
6. Aware of different techniques of biodiversity conservation

Course Outcomes:

After completion of this course, student s able to-

CO1: Describe the level and principles of ecology.
CO2: Describe different population catachrestic of ecology
CO3: Sensitize students about community ecology and dynamics
CO4: Apply learning skills to identify the biotic and abiotic factors of ecosystem.
CO5: Identify global, national and local levels of biodiversity.
CO6: Develop problem-solving abilities in the conservation of biodiversity.

Detailed Curriculum:

Unit – I: Concept of Ecology

1.1 : Introduction: Definition, objective and principles of ecology
1.2 : Levels of organization of ecology
1.2 : scope of ecology
1.3 : Historical background of ecology
1.4 : Basic concept of ecology
1.5 : Types of ecology
1.6 : relation to other sciences, relevance to civilization, levels of organization

Unit – II: Population ecology

2.1 : Introduction and concept population ecology
2.2 : Population characteristics
2.3 : characteristic features: Population size and density, age structure, migration, natality and mortality
2.4 : Population dynamics
2.5 : Human ecology and climate change
2.6 : Ecological carrying capacity

Unit – III: Community Ecology and Dynamics

3.1 : Definition and characteristics of a community
3.2 : Composition and structure of ecology
3.3 : Origin and development of a community
3.4 : Succession- Introduction and causes of succession
3.5 : Trends and basic types of succession
3.6 : General process of succession

Unit – IV Ecosystem

4.1 : Concept of ecosystem
4.2 : Structural of ecosystem – Abiotic and Biotic components
4.3 : Functions of ecosystem – Productivity, Decomposition
4.4 : Physical - Energy flow and Biological – Food chain, food web with types and advantages
4.5 : Ecological pyramids
4.6 : Biogeochemical cycle

Unit – V: Biodiversity

5.1 : Introduction and concept of biodiversity
5.2 : Levels of biodiversity
5.3 : Values of biodiversity
5.4 : Biodiversity at global, national and local levels
5.5 : India as a mega diversity nation
5.6 Indian hot spot of biodiversity

Unit – VI: Biodiversity Conservation

6.1 : Threats to biodiversity – Habitat loss, poaching of wildlife, Man –wildlife conflicts
6.2 : Endangered and endemic species of india – Common plant and animal species
6.3 : Needs of biodiversity conservation
6.4 : Conservation of biodiversity – In-situ and Ex-situ
6.5 : The Biological Diversity Act 2002 and Biological Diversity Rules 2004.
6.6 : The Convention on biological diversity

Proposed Pedagogies:

1. Teaching Methodologies:

Blackboard Teaching, PPT Presentation, Group discussion, Chart, Model, Field visit, project writing, etc.

2. Learning Methodologies:

Assignments, MCQ, Seminars, Group discussions, etc.

3. Evaluation Methodologies: Test, Assignment, Seminar, Project, etc.

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3. Mishra, R. (Year). Manual for Field Ecology.
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7. Publisher: Year. Biodiversity Conservation: Global Agreements and National Concerns. RAMSAR Sites
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Model Questions:
Long Type for 10 Marks:
Q1 Define ecology and state scope and principles.
Q2 Define population ecology and its characteristic features.
Q3 Define ecological succession, mechanism, and causes of succession
Q4 Describe structural of ecosystem with example.
Q5 What is meant by biodiversity hotspot? state the regions in India.
Q6 Discuss biodiversity conservation and its types 10
Long Type for 05 Marks:
Q1 What are types of ecology focus on it.
Q2 Describe the size and distribution of the population.
Q3 Discuss trends of succession.
Q4 Explain food chain and food web with example.
Q5 Discuss loss of biodiversity.
Q6 Describe ex-situ conservation.
Short Type for 3/4Marks:
Q1 Explain the scope of ecology.
Q2Explain subdivisions of ecology.
Q3Discuss the relevance of civilization and levels of organism.
Q4Explain prey-predator relationship.
Q5 Discuss natality and mortality.
Q6Explain density and age distribution.
Q7Explain trends in ecological succession.
Q8Explain characteristics of community.
Q9Explain the structure of community.
Q10 Write a note on carbon cycle.
Q11 Describe ecological pyramids anyone.
Q12Explain energy flow in ecosystem.
Q13Explain the need for biodiversity conservation.
Q14 write a note on strategies for the conservation of biodiversity.
Q15Explain convention on biodiversity.
Q16 Describe objective of CBD.
Q17Explain Biodiversity Act 2002.

Rubric for Internal Assessment for Theory Paper

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI Internal Assessment M.Sc. - I (Environmental Science), SEMESTER – I (NEP)			
Paper: DSCIII.1	Course Code: EVS-103	Concept of Ecology and Biodiversity	Max Marks: 40
S.N.	Assessment Criteria		Marks
1.	Attendance		05
2.	Class assignments		05
3.	Unit Test (MCQ)		20
4.	Participation in activity/Field visit		05
5.	Overall Performance		05
Total			40

Sant Gadge Baba Amravati University, Amravati

Level	Semester	Course Code	Course Name	Credits	Teaching Hours/week	Exam Duration	Max Marks
6.0	I	EVS-104	DSEI.1 Industrial Hygiene and Safety	4	60 Hours	2 Hrs	40 (Int)+ 60 (Ext)

Course Objectives:

1. To know causes investigation process and control of accident in industries.
2. To determine industrial health hazards.
3. To determine specific Occupational diseases in specific industry.
4. Study of Personal Protective Equipment used in industries.
5. To understand the concept and Importance of Industrial Safety.

Course Outcomes:

After the completion of this course, student is able to-

CO 1: By the end of this lesson, the student will be able to acquire knowledge, regulations, responsibilities, participation and awareness of Industrial safety.

CO 2: By the end of this lesson, the student will be able to identify accident investigation technique.

CO 4: By the end of this lesson, the student will be able to identify various industrial hazards.

CO 3: By the end of this lesson, the student will be able to understand concept of Industrial Hygiene.

CO 4: By the end of this lesson, the student will be able to acquire knowledge, regulations, responsibilities, participation and awareness of Industrial safety.

CO 5: By the end of this lesson, student will ensure need, types and importance of safety in Industrial Environment.

Detailed Curriculum:

Unit – I: Introduction to Industrial Safety

1.1 : Basics of safety and its importance in industrial settings, History and development of Safety Movement.

1.2 : Need for safety, Safety policy: safety Organizations; their responsibilities and Authorities of Different levels.

1.3 : Role of Management in Industrial safety;

1.4 Employees participation in safety;

1.5 Role of safety committee and its formation, Safety awareness programme: motivation, Education and training.

1.6 Evolution of safety practices and regulations, Safety Legislation.

Unit – II: Accident & Risk Assessment

2.1 : Accident: Accident Sequence Theory, Causes of accidents,

2.2 Job Safety Analysis and Investigation of accidents,

2.3 : Accident prevention and control techniques, Plant safety inspections.

2.4 : Fault Tree Analysis, Event Tree analysis, General outline of DOW index,

2.5 : Risk estimation and management, Major hazard control,

2.6 On-site and Offsite emergency preparedness.

Unit – III: Industrial Hazards

3.1 Identification of hazard, machine guarding, safety with hand tools/ portable power tools,

3.2 Risk assessment and management: Checklist procedure, Preliminary Hazard Analysis, What if analysis.

3.3 Failure Mode Effect Analysis, Hazard and Operability (HAZOP) Study, Hazard analysis Techniques.

3.4 Pressure Vessel hazards and their control, Safety in material handling: hazards and safe Practices, Safety with storage of materials.

3.5 Electrical hazards: classification, safety work practices.

3.6 Chemical hazards: laboratory safety, bulk handling of chemicals.

Unit – IV: Industrial hygiene

4.1 Environmental stresses: physical, chemical, biological and ergonomic stresses,

4.2 Principles of industrial hygiene, Overview of control measures. Permissible limits. Stress,

4.3 Exposures to heat, Heat balance, Effects of heat stress, Control Measures.

4.4 Chemical agents, IS/UN classification, Flammables, Explosives, Water sensitive chemicals, Oxidants, Gases under pressure.

4.5 Chemicals causing health hazards: irritants, asphyxiates, anesthetics, systemic poisons and Carcinogens.

4.6 Chronic and acute exposure, Routes of entry, Occupational exposure limits.

Unit – V: Occupational health:

5.1 History of occupational health.

5.2 Concept of occupational health.

5.3 Occupational work-related diseases and their characteristics

5.4 Essentials of occupational health service.

5.5 Levels of prevention
5.6 Principle and types of ventilation

Unit – VI: Personal Protective Equipment.

6.1 Introduction, Selection guidelines for Respiratory Personal Protective Equipment.
6.2 Non-Respiratory Personal Protective (NRPPE): Head Protection, helmet, types and characteristic.
6.3 Eye and face protection: Safety goggles and face shield.
6.4 Hand protection: Gloves gauntlets.
6.5 Foot and leg Protection: Safety Buts, Body Protection: Aprons & Jackets.
6.6 Respiratory Personal Protective Equipment (RPPE) : Air purifying respirator, mechanical respirator, chemical respirator and air suppling respirator.

Proposed Pedagogies:

1- Teaching Methodologies:

- Interactive Lecture
- Group Discussion

2- Learning Methodologies:

- Lecture-based learning
- Case-based Learning
- Technology-based learning

3- Evaluation Methodologies:

- Case studies.
- Home Alignments.
- Unit Test
- Class Seminars
- Group Discussions

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11. IS 14489: 2018: Occupational Health and Safety Audit — Code of Practice (First Revision) By Bureau of Indian Standards.
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Model Questions:

Long answer Type questions for 10 Marks:

1. Discuss need, objective and importance of Industrial Safety and give features of Safety Committee.
2. Discuss causes prevention and control of accidents in industries.
3. Discuss mechanical, electrical and chemical industrial hazards.
4. Discuss Industrial environmental stresses.
5. Explain occupational health and diseases.
6. Discuss types, advantages and significance of personal protective equipment.

Short answer Type questions for 05 Marks:

1. Explain formation and role of safety committee in industries.
2. Describe any five advantages of plant safety inspection.
3. Explain hazards of pressure vessel and give its control measures.
4. Explain workplace stress give its causes.
5. Describe occupational disease with suitable example.
6. Explain types and need of personal protective equipment in industries.

Short Type for 3/4Marks:

1. What is the role of safety committee?
2. Explain importance of safety committee.
3. State importance of participation of employ in safety awareness.
4. Explain the need of, Plant safety inspections.
5. Describe measures to control industrial Accident.
6. State the stratégies to prevent industrial accidents.
7. What is HAZOP? Give its significance.
8. How electrical hazard can be prevented?
9. Explain hazard analysis techniques.
10. What do you understand by Environmental stress?
11. Give effects of heating stress.
12. Explain concept of ergonomic stress.
13. Describe occupational health.
14. Explain characteristics of occupational diseases.
15. Describe occupational health and disease.
16. Give advantages respirators.
17. What are the face shield?
18. Differentiate RPPE and NRPPE.

Rubric for Internal Assessment for Theory Paper

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI Internal Assessment M.Sc. I (Environmental Science) SEMESTER – I (NEP)			
Paper: DSE-I-1	Course Code: DSE-104	Title: Industrial Hygiene and Safety	Max Marks: 40
S.N.	Assessment Criteria		Marks
1	Attendance		05
2	Class assignments		05
3	Unit Test (MCQ)		20
4	Participation in activity/Field visit		05
5	Overall Performance		05

Lab/ Experiment based on: DSC-III.1 Concept of Ecology and Biodiversity. + DSE-I.1-Industrial Hygiene and Safety. (Any 15 Exercise)

A. Lab/ Experiment based on: DSC-III.1 Concept of Ecology and Biodiversity MAJOR EXERCISES:

1. Determination of minimum size of quadrate by Species Area-Curve method
2. Determination of minimum number of quadrates to be laid down in the field understudy
3. To compare the biomass of ungrazed and grazed grassland.
4. Measurement of Primary productivity in aquatic ecosystem by light and dark bottle method.
5. To study abiotic and biotic components–pH, temperature, turbidity and light penetration in pond ecosystem

MINOR EXERCISES:

1. To study biotic and abiotic components of forest ecosystem.
2. Qualitative and quantitative estimation of planktons in freshwater.

3. To study the ecological adaptation sin Flora and Fauna.

B. Lab/ Experiment based on: DSE-I-Industrial Hygiene and Safety. LAB-2 MAJOR EXERCISES:

1. Study of hazard controlling and its identification by different control measures by models.
2. To observe ergonomical effect on human body by different types of job.
3. Study of Carbon Foot Print of Product.
4. RSPM
5. Major5: SOX NOX
6. Study of different types of occupational health hazards.
7. Study of Safety measures in industry.
8. Define Standard Operating Procedure for -Welding
9. Static Electricity and its hazard.

MINOR EXERCISES:

1. Study pf PPE from head to toe.
2. To measure human stress by Blood Pressure using B.P. Apparatus.
3. To measure Noise Level by Sound Level Meter or Dosimeter.
4. To measure illumination by Lux meter.
5. To measure heat stress by Dry and Wet Bulb thermometer

Rubric for Internal/External Assessment for Practical

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI Internal Practical Assessment M.Sc. I (Environmental Science) SEMESTER – I (NEP)		
Course Code- EVS-106	DSC-III.1 Concept of Ecology and Biodiversity. + DSE-I.1-Industrial Hygiene and Safety.	Max Marks: 50
S.N.	Assessment Criteria	Marks
1	Attendance	10
2	Field Visit-Survey Report/ Assignment	10
3	Active participation in activities	10
4	Submission of practical record	10
5	Internal examiner viva-voce	10

Rubric for External Assessment for Practical

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI External Practical Assessment M.Sc. I (Environmental Science), SEMESTER – I (NEP)		
Course Code- EVS-106 Paper- DSC- III-1 and DSE I.1	Lab/Pr: 2 DSC III.1-Concept of Ecology and Biodiversity and DSE-I.1 -Industrial Hygiene and Safety	Max Marks: 50 Time: Six.Hrs.
Question No.	Experiment/ Activity	Marks
1	Major experiment based on-1 (Ecology & Biod)	15
2	Major experiment based on-2(IHS)	15
3	Minor experiment based on-1(Ecology & Biod)	05
4	Minor experiment based on-2 (IHS)	05
5	Viva-voce	10

Sant Gadge Baba Amravati University, Amravati
FACULTY: Science and Technology
Detailed Curriculum of leading to Two Year PG Degree of Master of Environmental Science
(Two Years - Four Semesters Master's Degree Programme- NEPv23 with Exit and Entry Option)

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
6.0	II	EVS- 107	DSC I.2 Environmental Microbiology, Toxicology and Biotechnology	4	60 (10 per Unit)	2 Hrs	40 (Int)+ 60 (Ext)

Course Objectives:

1. Understand the fundamental concepts of microorganism and the environment.
2. Use the basic concepts in microbiology of air and soil.
3. understanding of the concept of Environmental Chemistry and Environmental Toxicology.
4. summarize the most relevant terms, principles, and methods in Environmental toxicology.

Course Outcomes:

After completion of this course, student will able to-

CO1: Acquire knowledge of components of environmental microbiology.
CO2: Develop problem solving abilities in spreading and control of infection and diseases.
CO3: Understand toxicology and associated terms.
CO4: Learn about everyday toxic substances.
CO5: Describe the mode of entry of toxic substance and carcinogenicity in environment.
CO6: Demonstrate use of biotechnology for waste treatment.

Detailed Curriculum:

Unit – I: (Microbiology of Air)

1.1 : Distribution of microbes in air,
1.2 : Allergic disorders by air micro flora,
1.3 : Fungal and pollen allergens.
1.4 : Collection and enumeration of aeroallergens.
1.5 : Air borne diseases
1.6 : Control of air pollution by microbes.

Unit – II: (Microbiology of soil)

2.1 : Structure and Composition of soil,
2.2 : Formation of humus
2.3 : Microbes present in soil
2.4 : Biological nitrogen fixation
2.5 : Biogeochemical cycle (Gaseous nutrient cycle C,O_2 and N_2)
2.6 : Sedimentary nutrient cycle phosphorous and sulphur

Unit – III: (Introduction to toxicology)

3.1 : Scope and concepts of ecotoxicology and toxicology,
3.2 : clinical, environmental, economic toxicology;
3.3 : xenobiotic concentration and dose,
3.4 : calibration of Dose response curve, lethal, Lc 50 and threshold concentration,
3.5 : acute, sub-acute and chronic toxicity;
3.6 : bio concentration and bio magnifications, Toxicity Vs chemotherapy.

Unit – IV: (Classification and effects of toxicology)

4.1 : natural and synthetic toxins;
4.2 : chemicals classification and mode of action of pesticides.
4.3 : Recent trends in the use of pesticides.
4.4 : Plant toxins; Affla- toxins, ergots, pyrethroids.
4.5 : Heavy metal pollution caused by lead, arsenic, mercury, cadmium and chromium,
4.6 : their effect on human health.

Unit – V: Environmental Biotechnology-I

5.1 : Role of environmental biotechnology; Scope for use,
5.2 : Market for environmental biotechnology, modalities and local influences
5.3 : Integrated approach in environmental biotechnology;
5.4 : Immobilization, Degradation or Monitoring of Pollutants from a Biological Origin
5.5 : Metabolic Pathways of Particular Relevance to Environmental Biotechnology,
5.6 : Biodegradation of macromolecules; biodegradation of geno biotics;

Unit – VI: Environmental Biotechnology-II

6.1 : Fermentation in environmental biotechnology (Fermentation technology (Bioreactors).

6.2 : Introduction to Vermiculture technology, definition, meaning and history,
6.3 : Economic importance of Vermiculture, their value in soil texture.
6.4 : Bioremediation of metal contaminated soils, spilled oil and grease deposits and synthetic pesticides.
6.5 : Biosensors to detect environmental pollutants.
6.6 : Biological treatment of waste gas (polluted air): biofilters, bio scrubbers, membrane bioreactors, bio trickling filters.

Proposed Pedagogies:

Teaching Methodologies:

Blackboard Teaching, PPT Presentation, Group discussion, Chart, Model, Field visit, project writing, etc.

Learning Methodologies:

Assignments, MCQ, Seminars, Group discussions, etc.

Evaluation Methodologies:

Test, Assignment, Seminar, Project, etc.

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Rubric for Internal Assessment for Theory Paper

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI Internal Theory Assessment M.Sc. - I (Environmental Science), SEMESTER – II (NEP)			
Paper: DSC I.2	Course Code: EVS-107	Title: - Environmental Microbiology, Toxicology and Biotechnology	Max Marks: 40
S.N.	Assessment Criteria		Marks
1	Attendance		05
2	Class assignments		05
3	Unit Test (MCQ)		20
4	Participation in activity/Field visit		05
5	Overall Performance		05
Total			40

Level	Semester	Course Code	Course Name	Credits	Teaching Hours/week	Exam Duration	Max Marks
6.0	II	EVS-108	DSC II.2 AIR & NOISE POLLUTION	4	4	2 Hrs	40 (Int)+ 60 (Ext)

Course Objectives:

1. To understand the sources and types of air pollutants.
2. To know the global impact associated with air pollutants their causes and effects.
3. To study the behavior of emitted air pollutant in to atmosphere based in wind direction and velocity and ambient temperature.
4. To study monitoring techniques and quality standards.
5. To understand properties, sources, and effects of noise.
6. To study effect of air contaminants on human, vegetation and material.

Course Outcomes:

After completion of this course successfully, students would be able to

CO 1: Apply the concepts related with air pollution.

CO 2: Appreciate the concepts related with global air pollution problems.

CO 3. Use air monitoring instruments

CO 4. Understand the concepts of air pollution meteorology.

CO 5. Compares the different measured noise levels to given standard.

CO 6: Demonstrate the plume behavior model from single emissions point.

Detailed Curriculum:

UNIT-I Air pollution:

1.1 : Definition, natural and man-made sources and sink of air pollutants. Stationary and mobile sources.

1.2 : Classification of air pollutants; Primary and secondary pollutants, gaseous and particulates and its types.

1.3. Emission and ambient standards, , Vehicular pollution and urban air quality. transport and diffusion of pollutants,

1.4 : Air pollutants: Sulfur oxides (SOx); nitrogen oxides (NOx), carbon monoxide, total suspended particulate matter, respirable& particulates.

1.5 : Photochemical oxidants, specific pollutants (Hydrogen sulphide, particulate fluoride, formaldehyde and volatile organic compounds).

1.6 : Chemical composition of SPM photochemical smog, per-oxy acyl nitrates (PAN), benzo-a- pyrene (BAP)formations, atmospheric sinks.

UNIT-II Global air pollution Issues:

2.1. Greenhouse effect; greenhouse gases: CO2, CH4, N2O, CFC's, water vapor concentration, alternatives for CFC's, fire extinguishers.

2.2. Global warming: History causes and effects.

2.3 climate change: Concept, past climate, present change, Drivers of climate change; causes effects and international efforts to control. IPCC.

2.4. Ozone layer depletion, ozone depleting processes, ozone hole, environmental effects and strategies for ozone layer protection.

2.5. Smog; Types and Process its formation, effects, Asian Brown Cloud (ABC), Air pollution problem in Indian Metropolitan cities.

2.6. Acid rain: Concept, mechanism, causes, effects and control.

UNIT-III Air pollution Meteorology:

3.1. Wind speed, direction and their vertical profiles,

3.2. turbulence (mechanical and thermal), atmospheric stability characteristics and classes,

3.3. Plume behavior, wind-valley effects, stability and mixing height

3.4 land/sea breeze-effects, heat island effect, mixing height-boundary layer definition,

3.5. temperature inversions, factors affecting on dispersion of air pollutants

3.6. Urban and rural wind circulations: Urban heat Island

UNIT-IV: Air Monitoring & Effects of Air Pollution on Environment

4.1. Purpose and importance of air monitoring. Stack monitoring,

4.2 National Ambient Air Quality Standards (NAAQS), parameters of ambient air quality and its standards.,

4.3 Air Quality Inex: Concept, Criteria pollutants and Scale, Base line condition of Un polluted air.

4.4. Impact on human-Air born lead, Carbon monoxide, odor, SOx, and particulates (PM2.5, smog) on Blood circulation and lung system.

4.5Effects on Vegetation and Animals: Injury Versus Damage due to particulates and gases.

4.6 Effects on Material: Effects on metal, stone, fabric and dyes, leather paper and rubber.

UNIT- V Indoor air pollution, vehicular pollution and international efforts.

5.1. Indoor Air Pollution Management: Common air pollutants, Source Control, Ventilation, Use cooking vents, rugs and carpets clean.

5.2. Auto exhaust: Emission composition, Vehicular emissions in India and World.

5.3. Steps to reduce emissions.

5.4. EURO and BS-IV and VI Engines, Ethanol blending, National Hydrogen mission.

5.5. International efforts: WHO and UNEP policies,

5.6. Carbon Trading, Carbon footprint.

UNIT-VI Noise pollution- Sound level meters Noise pollution:

6.1 Sound and Noise, Physical Properties of sound waves,

6.2- Types of Sources of Noise, Transport Noise, Neighbourhood Noise Industrial Noise

6.3- Effects of noise on human beings, hearing mechanism, audiometric tests, , effects on human performance, ,

6.4- noise standards and guidelines, permissible noise levels for occupational exposures,

6.5 Noise control in transmission path, noise barriers, enclosers and silencers, protection of receiver noise pollution control and abatement measures.

Proposed Pedagogies:

Teaching Methodologies:

- Interactive Lecture
- Group Discussion

Learning Methodologies:

- Lecture-based learning
- Field Visits.
- Case-based Learning
- Technology-based learning

Evaluation Methodologies:

- Case studies.
- Home Alignments.
- Unit Test
- Class Seminars
- Group Discussions

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http://nptel.iitm.ac.in/courses-contents/IIT Kanpur and IIT Madras.

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https://www.ncbi.nlm.nih.gov/books/n/iarcmono109/

https://books.google.com/books/about/Air_Pollution_and_Control.html?id=XJoDEAAAQBAJ

https://books.google.com/books/about/Air_Pollution_and_Control.html?id=XJoDEAAAQBAJ

Model Questions:

Long Type for 10 Marks:

1. What are the principal chemical reactions that take place in the chemosphere to give it its name? How do they influence stratospheric and tropospheric chemical reactions?
2. What do the terms “dispersion” and “diffusion” have in common? How do they differ?
3. What situation of emission has the potential to produce the greatest local problem? 2. What are the two types of air pollution problems found in urban areas? 3. What are the two primary gaseous pollutants that transform to fine-particle form during long-range transport?
4. If the concentration of CO2 in the atmosphere increases to 500 ppm, what will happen to the pH of rain? Where might the biggest effects from such an increase be felt?
5. What are two global issues and how might they best be addressed?
6. How is particle deposition and removal from the lung influenced by the size of the particles?

Long Type for 05 Marks:

1. What functions do the stomates serve in gas exchange with the atmosphere?
2. Distinguish between air pollution damage and injury
3. Why is it so difficult to establish a baseline of clean air?
4. What are the source and nature of the condensable organic vapors in unpolluted air?
5. Give classification of air pollutant based on its formation process.
6. Explain effects of Carbon monoxide on human circulatory system.

Short Type for 3/4Marks:

1. List examples of air pollution effects on plants that cannot be detected by visual symptoms.
2. What types of trace gases are released to the atmosphere by forest ecosystems?
3. Define air pollution.
4. With the help of example explain secondary air pollutant.
5. Which are the criteria air pollutants of AQI in India?
6. Which are the greenhouse gases?
7. What is the terrestrial radiation?
8. Give brief explanation of Climate Change.
9. Explain effects associated with acid rain.
10. What is the plume of air?
11. Explain fanning plume.
12. Explain any one psychological effect of noise on human.
13. Explain dB scale.
14. Describe measures to control vehicular noise.
15. Explain causes of sulphurous smog formation.
16. Explain thermochemical reaction in atmosphere.
17. What is Dobson Unit?
18. Give causes of global warming.

Rubric for Internal Assessment for Theory Paper

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI Internal Assessment M.Sc. I (Environmental Science) SEMESTER – II (NEP)			
Paper: DSC-II.2	Course Code: EVS-108	Major: Air and Noise Pollution	Max Marks: 40
S.N.	Assessment Criteria		Marks
1.	Attendance		05
2.	Class assignments		05
3.	Unit Test (MCQ)		20
4.	Participation in activity/Field visit		05
5.	Overall Performance		05

Lab/Practical/Activities based on paper- DSC-I.2 Environmental Microbiology, Toxicology and Biotechnology and DSC-II. 2 Air and Noise Pollution (Any 15 Exercise)

Experiments on Environmental Microbiology:

MAJOR

Protocol for Microbiological Laboratory.

1. Study of staining techniques- Grahm positive, negative, monochrome and special staining.
2. Staining of bacterial suspension by Hooker's modification orby Gram's staining.
3. Preparation and sterilization of microbial media
4. Isolation of bacteria from water, soil, decaying matter.
5. Study of allergenic and non-allergenic pollen grains.
6. Study of preparation of sterilization of culture media
7. Determination of MPN from drinking water resource for potability
8. Identification and classification of bacteria.
9. Estimation of total viable counts in water and soil samples.

Minor

1. Study of laboratory instruments used for microbiological study.
   a) Study components of and use of Microscope.
   b) Study of operation of Autoclave.
   c) Laminar Flow.
   d) Inoculating Needle.

2. Determination of hydrogen sulfide (H2S) from sewage sample.
3. Study of staining techniques- Grahm positive, negative, monochrome and special staining.
4. Staining of bacterial suspension by Hooker's modification orby Gram's staining

Experiments on AIR/ Noise - Pollution-

Major

Experiments

1. Determination of NOx from ambient air.
2. Determination of SOx from ambient air.
3. Determination of RPM and TSPM from ambient air.
4. Measurement of Settlable dust concentration in study region.
5. Study of effect of air pollutant on vegetation.
6. Determination of comparative concentration of CO_2 in Indoor and ambient environment.

MINOR EXERCISES:

1. To study principle, components and working operation of Respirable dust sampler.
2. Preparation of Windrose diagram.
3. Study of Micrometeorological equipment- Anemometer, Hygrometer, Psychrometer.
4. Sampling of air pollutant by grab sampling method (Evacuated Round Bottom Flask)
5. Measurement of Noise levels in different criteria.
6. Instrumentation of Noise Level Meter.
7. Study of Hearing Mechanism of man.

Rubric for Internal Assessment for Practical Paper

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI Internal Practical Assessment M.Sc. I (Environmental Science) SEMESTER – II (NEP)			
Paper: DSC II-2 and DSC II.3	Course Code: EVS-111	DSC-I.2 Environmental Microbiology, Toxicology and Biotechnology and DSC-II.2 Air and Noise Pollution	Max Marks: 50
S.N.	Assessment Criteria		Marks
1	Attendance		10
2	Field Visit-Survey Report/ Assignment		10
3	Active participation in activities		10
4	Submission of practical record		10
5	Internal examiner viva-voce		10

Rubric for Internal Assessment for Practical

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI External Practical Assessment M.Sc. I (Environmental Science), SEMESTER – II (NEP)		
Course Code- EVS-111 Paper: DSC II-2 and DSC II.3	Lab/Pr : 3 DSC-I.2 Environmental Microbiology, Toxicology and Biotechnology and DSC-II.2 Air and Noise Pollution	Max Marks: 50 Time: Six.Hrs.

Question No.	Experiment/ Activity	Marks
1	Major experiment based on-1(Env. Microbiology)	15
2	Major experiment based on-2(Air and Noise Pollution)	15
3	Minor experiment based on-1 (Air and Noise Pollution)	05
4	Minor experiment based on-2 Env. Microbiology)	05
5	Viva-voce	10

Level	Semester	Course Code	Course Name	Credits	Teaching Hours/week	Exam Duration	Max Marks
6	II	EVS-109	DSC III.2 WATER POLLUTION	4	4	2 Hrs	40 (Int)+ 60 (Ext)

Course Objectives:

1. The course aims to establish a strong understanding of water resources, Its quality deterioration and its conservation.
2. Explain the role of water for humans and plants.
3. To understand the basic water quality parameters of water.
4. To build understanding of water quality parameters and their relation to public health and environment.
5. To understand waste water characteristic of sewage as well as industrial waste water.
6. To know the National policy to conserve water resources .

Course Outcomes:

By the end of this lesson, the student will be able to have -

CO 1: Communicate effectively, understand water resource deterioration, its pollution and its sustainability utility issues

CO 2: Investigate the concept of interaction of polluted water in receiving water body.

CO 3: Understand types of pollutants, how to segregate pollutions, their effects, sources, and behavior on humans, animals and ecosystem

CO 4: Examine source, nature and type of water pollutant entering in to water body.

CO 5: Demonstrate the drinking and waste water quality parameters prescribed by National agencies.

CO 6: Aware of National policies and strategies for conservation of Water Resources.

Detailed Curriculum:

UNIT-I

1.1. Global distribution of water resources, water need and consumption; Threats to surface water resources;
1.2. Principles and approaches to surface water management.
1.3. Types of water: surface, ground water, brackish and marine water,
1.4. Introduction, Water Pollution, Causes of water pollution.
1.5. Water quality modelling
1.6. Global water balance

UNIT-II

2.1 : Water quality Parameters- Physical, chemical and microbiological
2.2 : Characteristic of Natural Waters, Aquatic Environment.
2.3 : Self- purification property of water and concerned parameters.
2.4 : Types of Water Pollution- Physical, Chemical and Biological.
2.5 : Waste Water- Domestic, Industrial and Agricultural discharge and Effects on receiving water bodied.
2.6 : Sewage/ Industrial Waste water Characteristics: BOD, COD, DO,

UNIT-III

3.1 : Water Pollutants in waste water: Oxygen demanding, metals and non-metals,
3.2 : Acids, nutrients, pesticides, thermal, salts, oils and radioactive.
3.3 : Sources of water pollution from urban, industrial, agricultural and natural waters,
3.4 : Interaction in aquatic system, Biodegradation, Bioaccumulation. Transport cycle of pollutants in environment.
3.5 : sources of marine pollution: Hotels, beaches, Municipal waste water, flood water, Ships, Oil spillages.
3.6 : Coastal Management.

UNIT-IV

4.1 : Criteria for disposal of treated water in river and marine water (CPCB)
4.2 : Drinking water quality parameters (BIS/ISI and WHO)
4.3 : Water quality indices: definition, types, applications and significance.
4.4 : Consequences of water pollution: , vegetation, animals and human health,
4.5 : Eutrophication – mechanism and effects.
4.6 : Bio-indicators: Specific pollutants in aquatic system.

UNIT-V Pollution potential of industrial effluents

5.1 : Process, sources and Effluent characteristics- Nuclear/thermal power stations, agriculture,
5.2 : Sugar, food processing,
5.3 : Tanneries, pulp and paper,
5.4 : oil and petroleum,
5.5 : textile and electroplating industries.

UNIT-VI National River Action Programme;

6.1 : Water catastrophes:

6.2 : River linking project- concept advantages and draw back.

6.3 : National River Conservation Programme (NRCP)- Objectives and measures.

6.4 : Ganga Action Plan-Objectives and phases and achievement.

6.5 : Conservation and restoration of lakes in India.

6.6 : Ground water Conservation-Causes of depletion and conservation.

Proposed Pedagogies:

Teaching Methodologies:

- Interactive Lecture
- Group Discussion

Learning Methodologies:

- Lecture-based learning
- Field Visits.
- Case-based Learning
- Technology-based learning

Evaluation Methodologies:

- Case studies.
- Home Alignments.
- Unit Test
- Class Seminars
- Group Discussions

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https://smartnet.niua.org/sites/default/files/resources/Lake_Conserv-Manage_India.pdf

https://mohua.gov.in/upload/uploadfiles/files/Advisory%20on%20Urban%20Water%20Bodies.pdf

https://nrcd.nic.in/

Model Questions:

Long Type for 10 Marks:

1. Discuss the account of global distribution water and different threats to global water resources.
2. Discuss water quality parameters.
3. Discuss the of self-purification mechanism of flowing water.
4. Discuss mechanism of eutrophication of water bodies.
5. Explain the effluent sources and characteristics of Sugar and Thermal power industries.
6. Discuss causes of ground water level deletion and suggest control measures.

Long Type for 05 Marks:

1. Give account of global water balance.
2. Describe BOD and its significance.
3. Explain thermal pollution and its effects on aquatic biota.
4. Give Drinking Water Quality standards given by BIS.
5. Give effluent characteristics of Paper and Pulp Industries.
6. Give features of Ganga Action Plan.

Short Type for 3/4Marks:

1. What is brackish water?
2. Give common sources of water pollution.
3. Give account of distribution of fresh water over the globe.
4. Define COD.
5. Which are the microbiological water quality parameters?
6. Which are sewage water characteristics?
7. Explain oxygen demanding waste in waste water.
8. Explain bioaccumulation of water pollutant?
9. Explain concept of heavy metals as water pollutants.
10. Describe concept of water quality indices.
11. Explain effects of heavy metals on human body.
12. Give waste water quality standards for disposal of water.
13. Which are the unit sources of waste water in Sugar Industries?
14. Explain black liquor in Paper and Pulp Industry.
15. Describe effluent and influent.
16. Give objectives of National River Conservation Programme.
17. Give causes of ground water deletion.

Rubric for Internal Assessment for Theory Paper

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI Internal Theory Assessment M.Sc. I (Environmental Science) SEMESTER – II (NEP)			
Paper: DSE-III.2	Course Code: EVS-109	Major: Water Pollution	Max Marks: 40
S.N.	Assessment Criteria		Marks
1.	Attendance		05
2.	Class assignments		05
3.	Unit Test (MCQ)		20
4.	Participation in activity/Field visit		05
5.	Overall Performance		05

Level	Semester	Course Code	Course Name	Credits	Teaching Hours/week	Exam Duration	Max Marks
6.0	II	EVS– 110	DSE II.3-Industrial, Chemical and Process Safety	4	3 and Total 60 (10 per Unit)	2 Hrs	40 (Int)+ 60 (Ext)

Course Objectives:

1. To understand the programs to prevent workplace injuries, illnesses, and deaths, as well as the suffering and financial hardship these events can cause for workers, their families, and employers.
2. To familiar with practices use a proactive approach to managing workplace safety and health.
3. To prevent incidents and accidents during large scale manufacturing of chemicals and pharmaceuticals.
4. Introduction to Functional safety management in industries and in development of projects.
5. Understanding of Functional safety standards.
6. Supporting work processes for functional safety.
7. To identify hazards and & techniques like HAZOP, Event Trees, Fault Trees.

Course Outcomes:

Completion of this course, student will be able to-

CO1: Understand chemical hazards and control measures.
CO2: Learn technique of Hazard Operability.
CO3: Classify hazardous Substances on the basis of properties.
CO4: Learn to Handling and storage of hazardous material.
CO5: Identify chemical process hazards. CO6: Performs safety audit.

Detailed Curriculum:

Unit-I

1.1 Recognition and control of chemical hazards.
1.2 Monitoring of chemical hazards; Personal, biological, environmental.
1.3 Airborne Contaminants; Dust, fumes, smoke, mist vapors and gases.
1.4 Physical Stresses, health risk & prevention.
1.5 Noise vibrations heat and illumination.
1.6 Chemical Stresses health risk & prevention; Painting, surface coating, welding.

Unit-II Hazardous chemicals

2.1 Introduction to Hazardous chemicals; classification-Explosive, gases, flammable liquids
2.2 Flammable solids, oxidizing agents, organic peroxides, Toxic substances.
2.3 Radioactive material, corrosives
2.4. Miscellaneous dangerous substances.
2.5. Transportation rules & guidelines
2.6 Emergency information Panel

Unit-III Storage and Handling of Hazardous substances.

3.1 Indicative criteria; Toxic chemicals, Flammable chemicals and explosives.
3.2 Fire precautions, Maintenance and examination, storage inspection
3.3 Safety in explosives; Characteristics and classification of explosives.
3.4 Precautions during storage of explosives.
3.5 Pipeline Safety; Introduction, risk assessment, monitoring system
3.6 Stress corrosion cracking, pipeline spill, protection against corrosion pipeline

Unit-IV Chemical Process Safety

4.1 Chemical process and chemical process hazards.
4.2 Chemical reactors and reaction hazards- Nitration, polymerization,
4.3 Oxidation, halogenation, hydrogenation.
4.4Operational deviations
4.5 Need of technical report in chemical safety; Installation, process.
4.6 Description of hazardous substances, safety relevant units, hazard assessment.

Unit-V Hazard Analysis studies.

5.1 Introduction and concept, guidelines, purpose objectives.
5.2 Guidelines for using procedure& preparation for study.
5.3 HAZOP techniques preliminary hazard analysis.
5.4 Success and failure of study.
5.5 Emergency preparedness; On-site & Off-site
5.6 On-site and Off-site Emergency plan

Unit-VI Safety Audit

6.1 Introduction, statutory requirement
6.2 Auditing in classified areas
6.3 Auditing team and procedure
6.4 Post Audit Work
6.5 Safety Report
6.6 Auditing benefits.

Proposed Pedagogies:
Teaching Methodologies: Interactive Lecture and Group Discussion.
Learning Methodologies: Lecture-based learning, Case-based Learning, Technology-based learning
Evaluation Methodologies: Case studies, home Assignments, Unit Test , Class Seminars and Group Discussions

Bibliography:
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1. Donald G. Cros (1998) Environmental Toxicology and Chemistry: by Oxford University Press, USA.
2. Frank Lees Book on loss prevention in processing Industry, vol.1&2.
3. Ian C. Shaw and John Chadwick (1998): Principals of Environmental Toxicology:,Taylor and Francis, USA
4. Peter Calow (1998): Handbook of Environmental Risk Assessment and Management: Black well Science Ltd. USA .

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1. https://www.freesunpower.com
2. https://www.instructable.com
3. https://www.learn.adafruit.com/collins-lab-solar
4. https://www.science.direst.com/
5. https://www.energy.gov/energysaver.wate-heating/solar-water-heaters

Model Questions:
Long Type for 10 Marks:

1. Discuss monitoring measures to control chemical hazards.
2. Discuss classification and hazards of popular hazardous chemicals.
3. Discuss the measures during handling and storage of explosives and flammables.
4. Discuss the hazards associated with chemical processes like polymerization and Oxidation.
5. Discuss HAZOP Techniques.
6. Discuss the outlie of methodology used in Safety Audit.

Long Type for 05 Marks:

1. Explain chemical stress and effects associated withit.
2. Give the objectives and scope of Industrial Hygiene.
3. Explain heat stress and its effects.
4. Describe chemical process hazards.
5. Explain technique to monitor physical hazard.
6. Describe hazards of flammables and explosives.

Short Type for 3/4Marks: Explain hazards of gases.

1. Give classification of explosives.
2. Give indicative criteria for explosives.
3. Explain precautions to be taken during storing of explosives.
4. Explain concept of operational deviations.
5. Describe concept of hazard assessment.
6. What is HAZOP technique.
7. Give the need of Technical Report in chemical safety.
8. Explain need of Safet Audit.
9. Give the Features of Emergency Preparedness.
10. explain significance HAZOP Test.
11. Explain objectives of Safety Audit
12. What is On-site Emergency Plan.
13. Explain benefits of Safety Audit.
14. Explain significance of Off-site Emergency plan.
15. Give the hazards of Chemical Reactors.
16. Explain monitoring safety for pipeline safety.
17. Give Statutory requirement for Safety Audit.
18. Give the Stress associated with corrosion.

Rubric for Internal Assessment for Theory Paper

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI Internal Theory Assessment M.Sc. I (Environmental Science) SEMESTER – II (NEP)			
Paper: DSE II-3	Course Code: EVS-110	Industrial , Chemical and Process Safety (ICPS)	Max Marks: 40
S.N.	Assessment Criteria		Marks
1.	Attendance		05
2.	Class assignments		05
3.	Unit Test (MCQ)		20
4.	Participation in activity/Field visit		05
5.	Overall Performance		05

Lab/ Practical / Exercise based on papers- DSC-III.2 Water Pollution + DSE-II.2 Industrial and Chemical and Process Safety (ICPS)

Experiments based on Water Pollution: (Any 15 Exercise)

Major:

1. Determination of Inorganic Phosphorus in water.
2. Estimation of sulphate in water sample by turbidimetric method.
3. Estimation of ferric and ferrous ions present in water.
4. Estimation of Nitrate in water.
5. Determination of chemical oxygen demand (COD) in wastewater.
6. Determination of Biological Oxygen demand (BOD) of wastewater.

Minor:

1. Determination of oil / grease in water.
2. Estimation of chlorides in water sample by Mohr's method.
3. Estimation of Residual chlorine in water sample by iodometric method.
4. Determination of total acidity CO2 in Water.

Experiments based on DSE-II.2 Industrial and Chemical and Process Safety (ICPS)

Major Experiments

1. Determination of Air Pollution Index., gas cutting
2. Determination of Environment Pollution Index (EPI).
3. Methods of determination of hazardous characteristics of of solid waste
4. To observe effect of radiation on human body after exposing to radiation by chart / model.
5. Determine the toxic gases and hydrocarbons by using Gas Monitors or Gas Detector Tubes.
6. Prepare Checklist of safety based on ISI 4489 focusing on safety.
7. Preparation of On-site Emergency Plan.

MINOR EXERCISES:

1. Study of heart Blood circulatory and lungs respiratory system.
2. Calibration of Air Sampling Equipment.
3. Identification of physical and chemical hazards by chart.
4. Technique applying CPR by using manikin.
5. To measure vision Test by Snellen's Chart.
6. To measure hearing loss by Audiometer.
7. Measurement of Lung capacity by Spirometer (PFT Test).
8. Perform Safety Audit.

Rubric for Internal Assessment for Practical Paper

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI Internal Practical Assessment M.Sc. I (Environmental Science) SEMESTER – II (NEP)			
Paper: DSC III-2 and DSC II.2	Course Code: EVS-112	DSC-III.2 Water Pollution + DSE-II.2 Industrial, Chemical and Process Safety	Max Marks: 50
S.N.	Assessment Criteria		Marks
1	Attendance		10
2	Field Visit-Survey Report/ Assignment		10
3	Active participation in activities		10
4	Submission of practical record		10
5	Internal examiner viva-voce		10

Rubric for Internal Assessment for Practical

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI External Practical Assessment M.Sc. I (Environmental Science), SEMESTER – II (NEP)		
Course Code- EVS-112 Paper: DSC III-2 and DSC II.2	Lab/Pr : 4 DSC-III.2 Water Pollution + DSE-II.2 Industrial, Chemical and Process Safety	Max Marks: 50 Time: Six.Hrs.
Question No.	Experiment/ Activity	Marks
1	Major experiment based on-1(Water Pollution)	15
2	Major experiment based on-2(Fire Prevention and Protection)	15
3	Minor experiment based on-1 ((Water Pollution)	05
4	Minor experiment based on-2 (Fire Prevention and Protection)	05
5	Viva-voce	10

Sant Gadge Baba Amravati University, Amravati

FACULTY: Science and Technology

Detailed Curriculum of leading to

Two Year PG Degree of Master of Environmental Science

(Two Years - Four Semesters Master's Degree Programme- NEPv23 with Exit and Entry Option)

Note: The fourth year (Semester VII and Semester VIII) of Four years Honors UG degree and Four years honors with Research UG degree shall be identical in structure to the First year (Semester I and Semester II) of Two-Year PG Programmes offered after Three-Year UG programmes.

evel	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
6.5	III	EVS/RM-2	Contemporary Applied Technological Advancements in Research	2	60 (10 per Unit)	2 Hrs	40 (Int)+ 60 (Ext)

Course Objectives:

1. : To understand the Sampling techniques.
2. : To learn various statistical tools for data analysis
3. : To learn various statistical tools for Interpretation of Data and Paper Writing
4. : To understand the Use of Encyclopedia
5. : To learn various statistical tools / techniques for Research
6. : To understand the various Instrumental techniques in environmental analysis

Course Outcomes:

After completion of this course, students will be able to-

CO 1: Perform literature reviews using print and online databases

CO 2: Demonstrate knowledge of research processes (reading, evaluating, and developing).

CO 3: Employ American Psychological Association (APA) formats for citations of print and electronic materials

CO 4: Understand and comprehend the basics in research methodology and applying them in research

CO 5: Apply statistical methods to data for further decision making.

CO 6: Prepare Research Paper.

Detailed Curriculum:

Unit – I: Basics of Sampling

1.1 : Concepts of Statistical Population

1.2 : Sample, Sampling Frame, Sampling Error, Sample Size, Non Response

1.3 : Characteristics of a good sample

1.4 : Stratified Random Sample & Multi-stage sampling

1.5 : Determining size of the sample – Practical considerations in sampling and sample size.

Unit – II: Data Analysis

2.1 : Measures of central tendency - Arithmetic mean – Median – Mode

2.2 : Standard deviation

2.3 : Co-efficient of variation (Discrete serious and continuous serious) – Correlation

2.4 : Regression – Multiple Regression

2.5 : Univariate analysis (frequency tables, bar charts, pie charts, percentages)

2.6 : Bivariate analysis – Cross tabulations and Chi-square test including testing hypothesis of association

Unit – III: Interpretation of Data and Paper Writing

3.1 : – Layout of a Research Paper

3.2 : , Journals in Environmental Science, literature survey

3.3 : Impact factor of Journals

3.4 : When and where to publish?

Unit – IV: Use of Encyclopedia

4.1 : Use of Encyclopedia

4.2 : Research Guides, Handbook etc.

4.3 : Academic Databases for Environmental Science Discipline.

Unit – V: Use of tools / techniques for Research

5.1 : Methods to search required information effectively

5.2 : Reference Management Software like Zotero/Mendeley

5.3 : Software for paper formatting like LaTeX/MS Office, Software for detection of Plagiarism

Unit – VI: Instrumental techniques in environmental analysis

6.1 : Principle, working mechanism, Instrumentation, merits and demerits of techniques- spectrophotometry

6.2 : Atomic absorption spectrophotometry, flame photometry,

6.3 : Gas chromatography and High-Performance Liquid Chromatography

6.4 : High-Volume Air Sampler, noise level meter

Proposed Pedagogies:

1. Teaching Methodologies:

Self-study, Gamification – Engagement through play and the pedagogies of games, Embodied learning – Capitalizing on creativity and emotions, Multiliteracies and discussion-based teaching – Fostering critical thinking and questioning, hands on training,

2. Learning Methodologies:

Action research involving critical reflection and reflexivity on current practice, Real world projects, Experiential learning, Cooperative Learning

3. Evaluation Methodologies:

Theory paper at university level, class room test, group discussion, seminar

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Model Questions:

1. Explain in details Simple Random Sample and Systematic Sample.
2. Describe Regression and multiple Regression in details
3. Explain the difference between research communication and Review article
4. Write Principle, Instrumentation merits and demerits of Atomic absorption spectrophotometry
5. Discuss the concept of Sample, Sampling Frame and Sampling Error.
6. Write note on Arithmetic mean – Median – Mode.
7. Write note on Preparation of Poster and Oral Presentation
8. Write note on Lab as a safe place
9. Explain the concept of Statistical Population
10. Write a note on Stratified Random Sample
11. Describe Practical considerations in sampling and sample size
12. Write a note on Chi-square test
13. Write a note on bar charts and pie charts
14. Explain Standard deviation
15. Comments on Title, Abstracts and Keywords writing
16. How to write Results and discussion in research paper
17. Write a note on Research grant
18. Write Principle of high performance liquid chromatography
19. Write Principle of Ion exchange chromatography
20. Working mechanism of high volume air sampler

Rubric for Internal Assessment for Theory Paper

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI Internal Theory Assessment M.Sc. I (Environmental Science) SEMESTER – III (NEP)		
Course Code: EVS/RM-2	Contemporary Applied Technological Advancements in Research	Max Marks: 40

S.N.	Assessment Criteria	Marks
1	Attendance	05
2	Class assignments	05
3	Unit Test (MCQ)	20
4	Participation in activity/Field visit	05
5	Overall Performance	05

Sant Gadge Baba Amravati University, Amravati

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
6.5	III	EVS-113	DSC-I.3- Solid Waste Management	4	60 (10 per Unit)	2 Hrs	40 (Int)+ 60 (Ext)

Course Objectives:

1. Describes types and components of solid waste.
2. Understand basics of waste management
3. Acquire knowledge about waste treatment technologies
4. Know the need for integrated waste management
5. Get acquaintance with waste management systems
6. Explain different waste management rules.

Course Outcomes:

Upon completion of this Course successfully, students would be able to

CO 1: Classify types and composition of solid wastes

CO 2: Aware about methods of transportation of solid waste in urban area. CO

CO 3: Identify health hazards of typical solid waste.

CO 4: Understand major industries as source of solid waste.

CO 5: Manage type of treatment and disposal to be provided to specific solid waste. CO

CO6: Understand the role of Government agencies in management of solid waste.

Detailed Curriculum:

Unit – I: Sources, Classification and Characterization Of Solid Wastes

1.1 : Solid Waste definition and concept

1.2 : Classification of Solid Wastes – Source based classification – Residential, Commercial, Institutional, Industrial, Agricultural, Hospital etc.

1.3 : Type based classification – Garbage, ashes and residues. Combustible and non-combustible wastes. Biodegradable and non-biodegradable wastes.

1.4 : Physical properties of solid waste – Composition, Size, Density, moisture content.

1.5 : Chemical properties of solid waste - Volatile solid content, Ash content, Calorific value, Heavy metal content and Carbon (C), hydrogen (H), nitrogen (N), Sulphur (S), oxygen (O) content.

1.6 : Biological properties of solid waste; microbial contaminants.

Unit – II: Collection and Transportation of Solid Waste

2.1 : Collection Methods - Communal system, block Collection, kerbside/alley, door to door collection.

2.2 : Handling and segregation of solid waste at source.

2.3 : Methods of separation- Mechanical, magnetic and screening.

2.4 : Mode of Transportation of solid waste.

2.5 : Solid waste size reduction methods (compacting, shredding, pulping, granulating, etc.).

2.6 : Storage of solid waste (MSW/ Biomedical/Industrial)

Unit – III: Effects of Solid Waste

3.1 : Factors influence the quantity of solid wastes generated: Geographic location, Season of the year, Collection frequency,

3.2 : Characteristics of population, Extent of salvaging and recycling, Public attitudes, Legislation.

3.3 : Environmental Impact of solid waste – Air pollution, contamination of surface water,

3.4 : Contamination of ground water,

3.5 : Land degradation, global warming.

3.6 : Ocean dumping of solid waste. Social and aesthetic impacts of solid waste.

Unit – V: Treatment and disposal-II 4.1 : Biomedical Waste Management- Definition, Sources, classification of biomedical waste 4.2 : Management technologies for biomedical waste 4.3 : E-waste Management – Definition, varieties of E-waste. 4.4 : Recycling of E-waste 4.5 : Disposal of E-waste 4.6 : Hazardous Waste- Treatment and disposal.
Unit – IV: Treatment and disposal-I 5.1 : Solid waste management hierarchy and Solid waste prevention and reduction techniques 5.2 : Concept, principal and Factors affecting of composting of waste 5.3 : Method of composting – Manual composting, Mechanical composting 5.4 : Vermicomposting and Open dumping. 5.5 : Land fill method – Land fill, Sanitary- landfill, Trench method and Ramp method. Advantages and disadvantages of landfill method 5.6 : Incineration and pyrolysis – Flash, Multiple chamber incinerators and pyrolysis- Advantages and disadvantages.
Unit – VI: Industrial Solid Waste and Lagal Aspects 6.1 : Variety of Industrial solid waste 6.2 : Collection and disposal of industrial solid waste 6.3 : Control measures for industrial solid waste, Recycling of industrial solid waste 6.4 : Municipal Solid Waste Management rules, 2016. Biomedical Waste Management Rules, 2016. 6.5 : E- Waste Management Rules, 2016 6.6 : Role of Central Pollution Control Board and Maharashtra Pollution Control Board in Management of solid waste from various sources
Proposed Pedagogies: 6. Teaching Methodologies: Interactive Lectures: Use multimedia presentations, interactive slides, and animations to illustrate complex concepts. 7. Learning Methodologies: Problem-Solving Sessions: Organize regular problem-solving sessions where students can apply theoretical knowledge to solve problems. 8. Evaluation Methodologies: Regular Unit Test, Assignments, Seminars, Group Discussions.
Field Visit- Visit to Municipal Waste Yard.

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Model Questions:

Long Type for 10 Marks:

1. Discuss the classification of solid waste based on its type.
2. Discuss the methods of size reduction of solid waste.
3. Give the account of effects of solid waste on Environment.
4. Discuss components and methods of disposal of Biomedical waste.
5. Give features of Rules of Municipal, and Biomedical waste Management Rule-2016.
6. Discuss the method of land filling.

Long Type for 05 Marks:

1. Explain composition of garbage and refuse.
2. Describe methods of segregation of solid waste.
3. Explain effects of solid waste on ground water.
4. What is E-waste? Give its composition.
5. Explain Vermicomposting and its advantages.
6. Give features of E-waste management Rule-2016

Short Type for 3/4Marks

1. Explain Sources of agrochemical solid waste.
2. Describe the waste minimization technology in India.
3. Describe the solid waste management by physical methods
4. Describe the physical properties of solid wastes.
5. Explain Volatile Solids in solid waste.
6. Explain the need of size reduction of solid waste.
7. Explain how solid waste is also responsible for global warming?
8. Explain land degradation due to Solid Waste.
9. Is recycling of E-Waste possible? Explain.
10. Give characteristics of Hazardous waste.
11. Explain the factors that affects composting.
12. Give the significance of vermicomposting and its product.
13. How will you differentiate Landfill and Sanitary Landfill?
14. Explain conditions for incineration of solid waste.
15. Give significance of pyrolysis of solid waste.
16. Explain duties of CPCB over Management of Solid Waste.
17. With the help of example explain 3-Rfor waste management.
18. Explain dis advantages of open dumping.

Rubric for Internal Assessment for Theory Paper

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI Internal Theory Assessment M.Sc. II (Environmental Science), SEMESTER – III (NEP)		
DSC-I..3 EVS-113	Title: Solid Waste Management	Max Marks: 40

S.N.	Assessment Criteria	Marks
1	Attendance	05
2	Class assignments	05
3	Unit Test (MCQ)	20
4	Participation in activity/Field visit	05
5	Overall Performance	05
Total		40

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
6.5	III	EVS-114	DSC-II.3- Remote Sensing, GIS and Computer Applications	4	60 (10 per Unit)	2 Hrs.	40 (Int)+ 60 (Ext)

Course Objectives:

1. To learn about the optical, thermal and microwaves based Remote Sensing and applications for solving real life problems.
2. To disseminate basic concepts and applications of Electromagnetic Spectrum in Remote Sensing, Energy Balance and Data acquisition platforms, sensors and their characteristics.
3. To learn about the raster and vector data analysis and applications for solving real life problems.
4. To use basic concepts and applications of spatial and non-spatial database in GIS, concept of co-ordinate system in Geo-tagging any data.

Course Outcomes:

After the completion of this course, student will be able to-

CO1: Understand the basic concepts of Remote Sensing and Digital Image Processing and its application.

CO2: Describe different type of sensors and their characteristics, the principles of thermal and microwave satellites, sensors and their nature of the data.

CO3: Demonstrate the appropriate use of satellite data for applying it in different thematic studies.

CO4: Acquire knowledge of basic concepts of coordinate system and spatial and non-spatial database in GIS.

CO5: Explain the principles of various uses of raster and vector data overlay analysis.

CO6: Apply basic techniques to handle software on computer and computational simulations.

Detailed Curriculum:

Unit I: Introduction to Remote Sensing

1.1. Introduction: History of Remote Sensing, Remote sensing components, Sources of Energy, EMS and Radiation.

1.2. Types of remote sensing - Natural, artificial remote sensing, passive and active remote sensing

1.3. Basic concept of Black body

1.4. EMR concept, Interaction of EMR with Atmosphere Scattering, Refraction, absorption, Transmission, Atmospheric windows

1.5. Interaction of EMR with Earth Surface

1.6. Radiation Calculation, Spectral, Spatial, Temporal and Radiometric resolutions.

Unit – II: Platforms and Sensors

2.1. Platforms and Sensors: Orbital movement and Earth coverage.

2.2. Sun-synchronous and Geosynchronous satellites, Active and passive sensors, PAN, Multi High resolution and

2.3. Hyper spectral Sensors, Thermal and Microwave sensors,

2.4. Sensor characteristics. Satellites and their Specifications: LANDSAT

2.5. World View, Quick bird, GeoEye

2.4. Referencing scheme of satellite system (path/row calculation).

2.5. Fundamentals of Image Interpretation, Type of Imagery, elements of Interpretation, Techniques of Visual Interpretation

Unit – III: A Thermal and Microwave Remote sensing

3.1. Thermal and Microwave Remote sensing: Infrared Scanners, Scatter meter.

3.2. Thermal Properties of Terrain, Environmental Considerations, Thermal Scanners.

3.3. Microwave Remote sensing concepts: Backscattering, Range Direction,

3.4. Azimuth Direction, Incident Angle, Depression Angle.

3.5. Polarization, Dielectric Properties, Surface Roughness and Interpretation,

3.6. Applications of optical, thermal and microwave remote sensing.

Unit – IV: Geographical Information system (GIS)

4.1 Introduction to GIS: Spatial and Non-spatial Data, Basic Database Management System, Co-ordinate reference system, Spheroid, Datum, Projection.

4.2 Geographical data models: Raster Data Model, Vector Data Model
4.3 Data Structure: Attribute structuring - data storage strategies, Data indexing, Geometric structuring
4.4 Data Analysis: Buffer, Spatial Analysis, Overlay Analysis, Network Analysis
4.5 Applications in forestry, Mining, Hydrology
4.6 Applications In Water Resources Assessment and Management, Disaster Management, Human Settlement and Analysis

Unit – V Aerial Remote Sensing (SOES/RS/C001)

5.1. Introduction of Aerial Photography, Basic Principles of Aerial Photos
5.2. Introduction to Photogrammetry, Fundamentals of Photogrammetry:
5.3. Principles and fundamentals of Aerial photo interpretation and Digital Photogrammetry.
5.4. Introduction to Cartography, Classification of maps, Visual variables, Generalization, Symbolization
5.5. Digital Image Processing: Introduction, Image rectification, Restoration and Enhancement, Image classification
5.6. GPS and Global Navigation Satellite System: Basic concepts of GPS

Unit – VI Computer basics and applications:

6.1 Computer Programming: - Computer organization, computer generation and classifications,
6.2 Structure, Function, Capabilities and Limitations of Computers,
6.3 Computer Packages, DOS, Ms-Office (MS- Word, MS-PowerPoint, MS- Excel) For Data Input & Output
6.4 Development Of Different Environmental Models by Simple Computer Programming.
6.5 Internet access to generate the environmental data.
6.6 Learning Basics of C, Java and Coding, Auto CAD

Proposed Pedagogies:

1. Teaching Methodologies: narrative method, talk and chalk method, Kinesthetic Learning
2. Lectures: Theoretical concepts and case studies
3. Train students with tools and software's related to Environment, GIS, etc.
4. Seminars: Guest lectures and student presentations
5. Field Visits: Industry tours and site visits to environmental facilities.
6. Learning Methodologies Expeditionary learning

Experiential and Reflective Learning, Self-Directed Learning:

- Evaluation Methodologies: Assignments: Literature reviews, case studies, problem-solving exercises
- Laboratory Reports: Analysis of experimental data and results interpretation
- Examinations: Midterm and final exams covering theoretical concepts and applications
- Project Work: Research projects or Geo environmental mapping, image processing and GIS, topics

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Model Questions:

Long answer question 10 marks

1- Describe the Fundamentals concept of Black body and associated laws.
2- Explain in detail Platforms and Sensors.
3- What are Fundamentals of Image Interpretation; Add a note on Principles of Multispectral data analysis
4- Explain Photogrammetry in details.
5- Give detail Applications of GIS and remote sensing in forestry
6- Give detail Applications of GIS and remote sensing Applications In Mining

Short answer question 5 marks

.1 comment on Spectral reflectance curves
.2 Describe Referencing scheme of satellite system
3 Explain in detail Stefan-Boltzmann law/ Wien's law / Kirchhoff's law.
4 Explain Orbital movement and Earth coverage
.5 Discuss Thermal and Microwave sensors
.6 Describe Microwave Remote sensing concepts

Short Answer Questions 3 marks

1. Which are the components of Remote sensing?
2. What is EMR?
3. Explain Geosynchronous satellites.
4. Define GIS
5. Give Principles of Multispectral data analysis.
6. Describe Overlay Analysis
7. What is DOS?
8. Give advantages over MS word
9. What are the advantages of MS Office?
10. Give applications of MS Excel
11. What is remote sensing?
12. What is passive remote sensing?
13. Give characteristics of MSS.
14. Give types of platforms.
15. Explain Stereoscopy.
16. Explain Active remote sensing.
17. What is spectral signature.
18. What is geostationary orbit?

Rubric for Internal Assessment for Theory Paper

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI Internal Theory Assessment M.Sc. II (Environmental Science) SEMESTER – III (NEP)			
Paper: DSE II-3	Course Code: EVS-114	Remote Sensing, GIS and Computer Application.	Max Marks: 40
S.N.	Assessment Criteria		Marks
1.	Attendance		05
2.	Class assignments		05
3.	Unit Test (MCQ)		20
4.	Participation in activity/Field visit		05
5.	Overall Performance		05

Lab/ Practical / Exercise based on DSC-I..3- Solid Waste Management And DSC-II.3- Remote Sensing, GIS& Computer Application (Any 15 Exercise)

A. Experiments based on Solid Waste Management

1. EXERCISES:

1. Analysis of Physical Properties of Solid Waste (Size, Density Moisture content)
2. Analysis of Chemical characteristics of Solid Waste (Ash content, Volatile matter and Carbon
3. content)
4. Calculate the calorific value of biodegradable solid waste
5. Microbiological contaminants in solid waste.
6. Physical properties of Vermicompost (Moisture, texture, Organic matter, pH)
7. Determine bacteria count of vermicompost.
8. Study of Earth worm species.
9. Determine composition of solid waste.
10. Chemical Analysis of Vermicompost/ Underground soil of Solid Waste Yard.
11. Potassium, Nitrogen, Carbon, calcium and magnesium.

2. EXERCISES:

1: Submit your observation along with your comments on working of vermicomposting plant by viewing the relevant video/simulation.
2: Submit your observation along with your comments on solid waste management techniques by viewing the relevant video/simulation
3: Interpret the Municipal Solid Waste Management Rules, 2016 by viewing the relevant video/simulation 4: Interpret the Biomedical Waste Management Rules, 2016 by viewing the relevant video/simulation

EXERCISES:

Visit to Vermicomposting Site/ Waste Management Yard

B. Experiments based on Remote Sensing, GIS& Computer Application

List of Practical's:

1. Fundamentals of aerial photos and satellite image interpretation;
2. Introduction to ArcGIS tools.
3. Introduction to QGIS.
4. Introduction to Google Earth.
5. Georeferencing of Maps.
6. Digitization: Manual and automatic digitization.
7. Generations of Thematic maps.
8. Study of satellite image annotation,
9. Demarcation of contours & watershed using toposheets, Drainage Morphometric Analysis, Remote sensing applications: features extractions from remote sensing data,
10. Understanding of spectral response pattern of different landforms. Image Interpretation and Analysis.
11. Scale determination of aerial photograph
12. Identification and mapping of drainage patterns, landforms, analysis of relief and slope on aerial photos at different scales.
13. Preparation of geological maps using GIS techniques
14. Generation of DEM/DTM
15. Generation of TIN(Triangulated irregular network)
16. Study of aerial photographs/satellite data for evaluation of hydrologic elements.
17. Field exercise on GPS data collection in standalone mode. GPS & GIS data integration and output preparation.
18. Analysis of aerial photographs by using stereoscope

19. Interpretation of weather map
20. Structure query language
21. Excel Raw Data.
22. To download data from earth explorer
23. Rubric for Internal Assessment for Practical Paper

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI Internal Practical Assessment M.Sc. II (Environmental Science) SEMESTER – II (NEP)			
Paper: DSC I-3 and DSC II.3	Course Code: EVS-117	DSC-I..3- Sold Waste Management + DSC-II.3- Remote Sensing, GIS& Computer Application. LAB-5	Max Marks: 50
S.N.	Assessment Criteria		Marks
1	Attendance		10
2	Field Visit-Survey Report/ Assignment		10
3	Active participation in activities		10
4	Submission of practical record		10
5	Internal examiner viva-voce		10

Rubric for External Assessment for Practical

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI External Practical Assessment M.Sc. II (Environmental Science), SEMESTER – II (NEP)		
Course Code: EVS-117 DSC I-3 and DSC II.3	Lab-5: DSC-I.3- Sold Waste Management + DSC-II.3- Remote Sensing, GIS& Computer Application. LAB-5.	Max Marks: 50 Time: Six.Hrs.
Question No.	Experiment/ Activity	Marks
1	Major experiment based on-1(DSC-I.3)	15
2	Major experiment based on-2(DSC-II.3)	15
3	Minor experiment based on-1 ((DSC-I.3)	05
4	Minor experiment based on-2 (DSC-II.3)	05
5	Viva-voce	10

Sant Gadge Baba Amravati University, Amravati

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
6.5	III	EVS-115	DSC III.3-Environmental Impact Assessment and Environmental Audit	4	60 (10 per Unit)	2 Hrs.	40 (Int)+ 60 (Ext)

Course Objectives:

1. To understand the core concepts and principles of EIA.
2. To impart thorough and in-depth knowledge on techniques /tools to be adopted for sustainable development.
3. To acquire in depth understanding of components for environmental monitoring for EIA.
4. To prepare the students for scientific/technical drafting of EIA report.
5. To understand the concepts and principles of Environmental audit Study details of NEPA
6. To prepare the students for scientific/technical drafting of statutory environmental audit statement.

Course Outcomes:

After the completion of this course student is able to-

CO 1: Expertise in preparing protocols for environmental monitoring.
CO 2: Develop skills to work in EIA team to conduct EIA study for various Projects.
CO 3: Draft EIA report & can become EIA consultant.
CO 4: Understand component of environmental audit.
CO 5: Develop skills to work in Environmental Auditing team.
CO 6: Prepare a report on the industry's environmental management system and environmental audit.

Detailed Curriculum:

Unit I: Environmental impact assessment (EIA):

1.1 Definition and Introduction
1.2 History of EIA.
1.3 Scope and objectives of EIA.
1.4 EIA guidelines-1994 (Notification of Government of India) – Schedule I & II
1.5 EIA guidelines-1994 (Notification of Government of India) – Schedule III , IV&V
1.6 Procedure to review report of Environmental impact assessment.

Unit – II: Impact assessment methodologies:

2.1 Definition and concept of impact;
2.2 Types of impacts (Negative & Positive: Primary & Secondary; Reversible and Irreversible; Tangible and Intangible);
2.3 Impact identification;
2.4 Methods for impact identification:
2.5 Matrices, networks and checklists
2.6 Advantage & disadvantages of EIA methodologies.

Unit – III: Components of EIA:

3.1 Environmental Setting; Baseline data;
3.2 Prediction and evaluation of impacts;
3.3 Environmental management plan and monitoring,
3.4 Baseline information, Prediction,
3.5 evaluation and mitigation of impacts on socio-economic,
3.6 evaluation and mitigation of impacts on air water, soil and noise environment.

Unit – IV: Public participation in EIA:

4.1 Introduction, Basic Definitions and concepts
4.2 Advantages and disadvantages of public participation.
4.3 Objectives of public participation, Identification of Various Publics
4.4 Techniques of public participation,
4.5 Practical suggestions for public participation,
4.6 Steps in Weighted Ranking Technique, summary

Unit – V: Preparation and writing of EIA; NEPA 1969

5.1 Preparation and writing of EIAFor mining and Infrastructural projects
5.2 Preparation and writing of EIA For resources
5.3 Preparation and writing of EIA For noise
5.4 National Environmental Policy Act (NEPA, 1969)- History and Purpose of NEPA
5.5 National Environmental Policy Act (NEPA, 1969)- Process and implementation
5.6 NEPA - Procedural Requirements of NEPA

Unit – VI: Environmental auditing:
6.1 Notification and guidelines for Environmental audit;
6.2 Scope, applicability and objective of environmental audit;
6.3 Procedure of environmental auditing;
6.4 Water, raw material and energy balance;
6.5 Hazardous waste audit – case study
6.6 Applicability of Statutory Environmental Audit Statement.

Proposed Pedagogies:

- Case-Based Learning: Engage students with real-world EIA and audit case studies
- Field-Based Learning : Provide hands-on learning experiences through site visits and fieldwork.
- Simulation and Role-Playing : Simulate EIA and audit processes where students take on various stakeholder roles.
- Project-Based Learning: Students undertake comprehensive projects that involve EIA or audits.
- Guest Lectures and Workshops: Involve professionals from the field to provide insights and practical knowledge.
- Evaluation Methodologies: Project Assignments: Literature reviews, case studies, problem-solving exercises
- Laboratory Reports: Analysis of experimental data and results interpretation
- Examinations: Midterm and final exams covering theoretical concepts and applications

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- Mock EIA Scenarios: To conduct a mock EIA, including scoping, impact assessment, and preparation of an EIA report by creating hypothetical scenarios for proposed projects in various sectors (e.g., infrastructure development, industrial expansion).
- Stakeholder Consultation Simulation: Conduction of mock meetings or public hearings to discuss project proposals and potential environmental impacts.

Environmental Impact Assessment Tools and Software:

- Environmental Modeling Exercises: Developing models to simulate changes in air quality, water quality, or habitat suitability using environmental modeling software.
- Report Writing and Presentation:
- EIA Report Preparation: Preparation of comprehensive EIA reports based on the assessments and findings including documentation of methodologies, results, and recommendations.
- Presentation Skills Training: Presentation of EIA findings and recommendations to a panel of peers or professionals.

Model Questions:

Long answer question: 10 Marks

Q.1 Why environmental impact assessment is essential? Describe the procedure in detail and goals of EIA process.

Q.2 Describe various types of impact analysis methods. Highlight their specific features in brief.

Q.3 What are the basic steps for prediction and assessment of impact of air quality?

Q.4 Describe the various parameters essential to measure EIA of water pollution?

Q.5 Describe different methods of Environmental impact assessment.

Q.6 Define the objectives of public participation and how would you identify various publics for an EIA?

Short answer question: 5 Marks

Q.1 Write the basic contents of an impact statement.

Q.2 How 'Air pollution dispersal potential is measured?

Q.3 How would you identify 'known cultural resources' and 'potential cultural resources?

Q.4 Discuss techniques of public participation.

Q.5 What is the purpose of public participation?

Q.6 Discuss advantages and dis advantages of public participation

short answer question: 3 Marks

Q.1 Define the objectives of public participation.

Q.2 Give advantages of public participation disadvantages.

Q.3 What are importance of EIA?

Q.4 Describe the procedure of EIA in brief.

Q.5 Discuss in brief different parameters essential to measure water pollution.

Q.6How microscale impact calculations can be carried out conservative /non conservative pollutants?

Q.7 What are various water quality standards?

Q.8 Write components of EIA for dams.

Q.9 Write a note on 'checklists.

Q.10 Give objectives of EIA.

Q.11 Explain baseline data.

Q12 Explain importance of public participation in conducting EIA.

Q13 Describe compliance environmental audit.

Q14 Give the advantages of environmental audit.

Q.15 What is environmental management system audit.

Q16. Give objectives of Environmental Audit.

Q17 Give the features of NEPA.

Q18 What id Environmental Statement?

Rubric for Internal Assessment for Theory Paper

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI Internal Assessment M.Sc. II (Environmental Science), SEMESTER – III (NEP)			
Paper: DSC-III.3	Course Code: EVS- 115	Title: DSC-III.3 -Environmental Impact Assessment & Environmental Audit	Max Marks: 40
S.N.	Assessment Criteria		Marks
1.	Attendance		05
2.	Class assignments		05
3.	Unit Test (MCQ)		20
4.	Participation in activity/Field visit		05
5	Overall Performance		05

Sant Gadge Baba Amravati University, Amravati

Level	Semester	Course Code	Course Name	Credits	Teaching Hours/week	Exam Duration	Max Marks
6.5	III	EVS-116	DSE III.3 Fire Prevention and Protection	4	3	2 Hrs	40 (Int)+ 60 (Ext)

Course Objectives:

1. Unit is based on meaning types and stages in fire.
2. To understand dynamics of fire.
3. To learn properties of flammables.
4. To know types and process of combustion.
5. To learn categories of fire extinguishers and its proper use.
6. Unit is based on how to perform fire audit.

Course Outcomes:

CO1: By the end of this lesson, the student will be able to gain knowledge about fire dynamics.
CO2: By the end of this lesson, the student will be able to interpret types and the Reactions associated with combustion process.
CO3: By the end of this lesson, the student will be able to apply knowledge to save life property and environment.
CO4: By the end of this lesson, the student will be able to identify and select for proper fire extinguishing technique.
CO5: By the end of this lesson, the student will be able to performs fire audit.
CO6: By the end of this lesson, the student will be able to solve fire related problems by applying chemistry, physics of electricity.
CO7: By the end of this lesson, the student will be able to predicts hazard of fire.

Detailed Curriculum:

Unit – I: Fire Science-I

1.1 : Definition of fire, fire tringle
1.2 : Stages of fire.
1.3 : Classification of fire as per Indian standards.
1.4 : Common causes of fires and its prevention.
1.5 : Tetrahedron of fire
1.6 : Un -inhibition of fire.

Unit – II: Combustion-I

2.1 : Definition of combustion
2.2 : Types of combustion
2.3 : Flammability and its limit
2.4 : Oxidation reaction, Flash point, fire point ignition temperature, auto ignition.
2.5 : Exothermic and endothermic chemical reaction
2.6 : Explosive range.

Unit – III: Combustion-II

3.1 limits of flammability.
3.2 Flammable properties of combustible material
3.3 Basic combustion process
3.4 Specific surface and rate of combustion
3.5 Catalyst and inhibitors.
3.6 Effect of atmospheric temperature, pressure, Wind and humidity on combustion.

Unit – IV: Special Fire

4.1 Forest fire: Types and causes
4.2 Hazards and preventive measures.
4.3 Difficulties in rural and forest fire fightening and Environmental impact.
4.4 Electric Generation plant.
4.5 Petroleum Refinaries.
4.6 LPG bottling plant.

Unit – V: Fire Suppression Systems.

5.1 Water, CO2, DCP & foam flooding suppression system
5.2 Aerosol fixed fire suppression system (NOVEC, Inert gas, FE26, clean agents).
5.3 Water spray projection & water mist system.
5.4 Water curtain /drencher system
5.5 Types of Fire Extenguishers

5.6 Fire risk analysis.

Unit – VI: Fire Audit System & Reports

6.1 Fire Audit terms and definitions.

6.2 Required documentation as per legal provision.

6.3 NBC fire audit checklist.

6.4 Audit process, Pre-audit visit requirement

6.5. Document review, preparation, on site visit, Audit follow-up.

6.6 Audit Assessment and Report preparation.

Proposed Pedagogies:

1. Teaching Methodologies:

Interactive Lecture

Group Discussion

2. Learning Methodologies:

Lecture-based learning

Case-based Learning

Technology-based learning

Experiential Learining.

3. Evaluation Methodologies:

Case studies.

Home Alignments.

Unit Test

Class Seminars

Group Discussions

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Reference/Text Books/Research Articles,

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2. https://en.wikipidia.org/wiki/Fire_safety
3. https://www.udemy.com/course/fire-and-life-safety-concepts/
4. https://www.ife.org/uk

Model Questions:

Long Type for 10 Marks:

1. Discuss stages and classification of fire as per Indian standards and explain causes.
2. Discuss combustion types, reactions and properties of flammables.
3. Explain processes involved in combustion.
4. Describe Class A and Class B fire.
5. Discuss the causes of fire in rural areas and explain difficulties faced to extinguish it.
6. Discuss different fire suppression systems.
7. Discuss methodology adapted to perform fire audit.

Long Type for 05 Marks:

1. Explain stages of fire.
2. Describe flash point and flammability test of flammables.
3. Explain concept of basic combustion process.
4. Describe types of forest fires.
5. State categories of fire extinguishers.
6. Give the outline of Fire Audit.

Short Type for 3/4Marks:

1. Explain fire Tringle.
2. With the help of diagram describe tetrahedra of fire.
3. Which are the stages in fire?
4. Define combustion process.
5. Define spontaneous and explosive combustion.
6. Explain components of combustion.
7. What is the difference between flammable and inflammable.
8. What is catalytic combustion.
9. Explain effect of wind on combustion.
10. What is crown fire and ground fire in forest.
11. Explain causes of forest fire in India.
12. Explain hazards of forest fire.
13. Describe foam flooding suppression system.
14. Which material is used to extinguish petroleum fires.
15. Which are the fire suppression systems.
16. What is the fire extinguisher audit?
17. Explain preventive measure for forest fire.
18. How to prepare for fire audit.

Rubric for Internal Assessment for Theory Paper

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI Internal Theory Assessment M.Sc. I (Environmental Science) SEMESTER – II (NEP)			
Paper: DSE-III.3	Course Code: EVS-116	DSE III.3 Fire Prevention and Protection	Max Marks: 40
S.N.	Assessment Criteria		Marks
1	Attendance		05
2	Class assignments		05
3	Unit Test (MCQ)		20
4	Participation in activity/Field visit		05
5	Overall Performance		05

Lab / Practical/ Exercise based on- DSC-III.3 -Environmental Impact Assessment & Environmental Audit + /DSE-III.3. D Fire Prevention and Protection (Any 15 Exercise)

Exercise on DSC-III.3 -Environmental Impact Assessment & Environmental Audit:

- Preparation of flowcharts and network diagrams to carry out impact analysis.
- Identification of primary and secondary impacts of nearby ongoing developmental activity.
- Preparation of checklist of the activities and the impacts associated with it.
- Study of Environmental Audit of selected industrial unit with reference to environment protection act (Form V)
- Environmental survey based on questionnaire: A case study of construction site
- To understand structure of 'Form 1' for obtaining prior environmental clearance
- Preparation of outline of EIA report: A case study of dam/mining/construction/industrial site.
- Preparation of environmental management plan for a selected industry.
- Study of physical, chemical and biological analysis of the impact area based on soil and water parameters.
- Field visit to affected areas due to developmental activities and study EIA aspects in relation with EIA notification 2006.
- Collection of secondary data based on impacts and analysis by using online software's.
- Online questionnaire survey of the on-going developmental activity.
- Submission of video documentary of affected areas due to developmental activities.
- Problems based on impact assessment and prediction methodologies.
- Identification of impacts and reason associated with on nearby selected ecosystem due to urban
- Field-based Practical Exercises: Site Visit and Assessment: To observe and document existing environmental conditions, for assessing potential impacts of the proposed project on the environment.
- Data Collection and Sampling: To collect environmental samples (Air,water,soil sampling etc.) using appropriate equipment & analyze collected data and interpret results.
- Case Study Analysis: Review of EIA Reports: To critically analyze EIA reports for real-world projects, focusing on methodologies used, impact assessments, and proposed mitigation measures.

B. Experiments based on Fire Prevention and Protection.

Major:

1. Determine the flash point of given solvent.
2. Calculate the fire load of given area.
3. Study the properties of combustible material.
4. Determine the ignition temperature of given material.
5. Study of Breathing apparatus.
6. Study of Fire Extinguishers.

Minor:

1. Study of Forest fire.
2. First Aid Box.
3. List complete fire Protection System in Moll, Hall.
4. Study of sprinkler system.
5. Study of fire hydrant system.
6. Draw Fire Tringle.
7. Preparation of Fire Tetrahedron

Rubric for Internal Assessment for Practical Paper

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI Internal Practical Assessment M.Sc. II (Environmental Science) SEMESTER –VI (NEP)			
	Course Code: EVS- 118	DSC-III.3 -Environmental Impact Assessment & Environmental Audit + /DSE-III .3 DSE III.3 Fire Prevention and Protection	Max Marks: 50
S.N.	Assessment Criteria		Marks
1	Attendance		10
2	Field Visit-Survey Report/ Assignment		10
3	Active participation in activities		10
4	Submission of practical record		10
5	Internal examiner viva-voce		10

Rubric for External Assessment for Practical

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI External Practical Assessment M.Sc. II (Environmental Science), SEMESTER – II (NEP)		
Course Code: EVS-118 DSC III-3 and DSE III.3	LAB-6: DSC-III.3 -Environmental Impact Assessment & Environmental Audit + /DSE-III.3 DSE III.3 Fire Prevention and Protection	Max Marks: 50 Time: Six.Hrs.
Question No.	Experiment/ Activity	Marks
1	Major experiment based on-1(DSC III.3)	15
2	Major experiment based on-2(DSE III.3)	15
3	Minor experiment based on-1 (DSC III.3)	05
4	Minor experiment based on-2 (DSE III.3)	05
5	Viva-voce	10

Research Project Phase II: EVS-119 Sem-III Level 6.5

Code of Course	Title of Course	Hours / Week
EVS -119	Research Project Phase -I Lab-	6

Course Outcome:
At the end of course, student will be able to-

CO-1 Identify research problem and carry out research survey.

CO-2 Analyze the research gap and formulate the problem.

CO-3 Interpret the data and synthesize the research findings.

Research Project Phase – I
It should be based on rigorous literature survey, finding research gaps, preparation of research proposal to be executed in next semester. There will be presentation on the topic selected to research project. Student need to submit synopsis of the proposed research work.

Modalities:
1. Individual or group projects can be taken up.

2. Involved in literature survey in chosen field.

3. Use Science and Engineering principles to solve identified issues.

4. Adopt relevant well defined / innovative methodologies to fulfil specified objectives.

5. Submission of scientific report in specified format.

Internal Examination: EVS- 119 Research project Phase -I

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI Internal Research Project Phase-I Assessment M.Sc. II (Environmental Science) SEMESTER –IV (NEP)		
Course Code: EVS-119		Max Marks: 50
S.N.	Assessment Criteria	Marks
1	Submission of Research Proposal Synopsis	25
2	Presentation of Research Proposal Synopsis	15
3	Work in Progress	10
Total		50

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
6.5	IV	EVS-120	DSC-I.4- Environmental Engineering and Technology	4	60 (10 per Unit)	2 Hrs.	40 (Int)+ 60 (Ext)

Course Objectives:

To understand the core concepts and principles of environmental engineering.

2. To develop advanced analytical and advanced problem-solving skill.
3. To acquire in depth knowledge of advanced technology and methodologies used in environmental engineering.
4. To encourage research and innovation in environmental engineering.
5. To give an experience in the implementation of environmental engineering concept.
6. To present the foundation of many basic concepts related to environmental engineering.

Course Outcomes:

After the completion of this course, student is able to-

CO 1: Analyze and assess components of environmental by engineering and technology.

CO 2: Understand the principles of environmental engineering and their application to address environmental challenges.

CO 3: Analyze and design engineering solutions for the treatment and management of water, wastewater and air.

CO 4: Apply advanced technologies and techniques for pollution prevention, control, and remediation.

CO 5: Critically assess environmental regulations, policies, and ethical considerations in engineering.

CO 6: Develop effective problem-solving skills to address environmental challenges.

Detailed of Curriculum

Unit I: Particulate and gaseous emissions control

1.1 Electrostatic precipitators (ESP): principles, operation, design and efficiency.

1.2 Baghouse filters: types, selection criteria, and maintenance practices.

1.3 Cyclone Separator: working principles and applications.

1.4 Scrubbers: principles of operation, types (e.g., wet scrubbers, dry scrubbers), and applications.

1.5 Absorption techniques: overview of gas absorption processes and equipment.

1.6 Catalytic converters: role in reducing emissions of nitrogen oxides (NOx) and volatile organic compounds (VOCs).

Unit – II: Air pollution control techniques and Strategy

2.1 Source control strategies: process modification, substitution of raw materials, and cleaner production techniques.

2.2 End-of-pipe control strategies: pollution capture and treatment before release into the atmosphere.

2.3 Selective catalytic reduction (SCR) and selective non-catalytic reduction (SNCR) for NOx control.

2.4 Activated carbon adsorption for VOC control.

2.5 Advanced oxidation processes (AOPs) for the treatment of industrial effluents containing hazardous air pollutants.

2.6 Solar Detoxification process: Mechanism and its applications.

Unit – III: Waste water treatment

3.1 Concept and need for waste water treatment

3.2 : Primary treatment: Screening, Grit removal, skimming, equalization, sedimentation

3.3 : Secondary treatment: Activated sludge process, Aerated lagoons, oxidation pond, trickling filter

3.4 : Tertiary treatment: Carbon adsorption, Chlorination, reverse osmosis, water softening

3.5 : Sludge treatment process: Sludge thickening, sludge digestion, sludge conditioning

3.6 : Sludge disposal methods: Sludge drying bed, composting, incineration, ocean disposal

Unit – IV: Design and functioning of treatment plants

4.1 Water Treatment Plant (WTP): Concept, Working, advantages and disadvantages.

4.2 Sewage Treatment Plant (STP): Concept, Working, advantages and disadvantages.

4.3 Effluent Treatment Plant (ETP): Concept, Working, advantages and disadvantages.

4.4. Common Effluent Treatment Plant (CETP): Concept, Working, advantages and disadvantages.

4.5 Public own Treatment Plant: Concept, Working, advantages and disadvantages.

4.6 Design of Water Traetment plant

Unit – V: Radiation Pollution

5.1 : Introduction, Definition, Classification and sources of radiation pollution
5.2 : Health Effects of Radiation Pollution, Acute vs. chronic exposure, biological effects on human health: cancer, genetic mutations,
5.3 : Environmental impact: effects on ecosystems and biodiversity
5.4 : Monitoring and Measurement Techniques: Sampling and analysis methods for environmental monitoring, Remote sensing techniques and satellite imagery
5.5 Mitigation and Remediation Strategies: Containment and cleanup of contaminated areas, Risk communication and public engagement
5.6 : Case studies on nuclear disaster: Chernobyl and Fukushima.

Unit – VI: Environmental Sanitation

6.1 : Introduction to Environmental Sanitation: Definition and scope of environmental sanitation, Relationship between sanitation, public health, and sustainable development.
6.2 : Sanitation-Related Diseases and Health Impacts: Waterborne diseases: cholera, typhoid, hepatitis A, Vector-borne diseases: malaria, dengue, Zika virus, Impact of poor sanitation on maternal and child health, nutrition, and well-being.
6.3 : Sanitation Policy and Governance: National sanitation policies and strategies, international initiatives, Role of government agencies, NGOs, and private sector in sanitation service delivery.
6.4 : Sustainable Urban Sanitation: Introduction, Definition, scope and importance.
6.5 : Challenges and opportunities in rural sanitation.
6.6 : Innovative waste management technologies: anaerobic digestion, waste-to-energy.

Proposed Pedagogies:

1. Teaching Methodologies:
   Lectures: Theoretical concepts and case studies
   Laboratory Sessions: Hands-on experiments and simulations
   Seminars: Guest lectures and student presentations
   Field Visits: Industry tours and site visits to environmental facilities
2. Learning Methodologies:
   Experiential and Reflective Learning, Self-Directed Learning:
3. Evaluation Methodologies: Assignments: Literature reviews, case studies, problem-solving exercises
   Laboratory Reports: Analysis of experimental data and results interpretation
   Examinations: Midterm and final exams covering theoretical concepts and applications
   Project Work: Research projects or design assignments on environmental engineering topics

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26. Tchobanoglous, G., Burton, F. L., & Stensel, H. D. (2014). *Wastewater engineering: Treatment and resource recovery* (5th ed.). McGraw-Hill Education.
27. Vallero, D. A. (2008). *Fundamentals of air pollution* (4th ed.). Academic Press.

Model Questions:

Long answer question

Q.1 Explain in detail principle, operation and design of electrostatic precipitator.
Q.2 Explain in detail mechanism and application of solar detoxification process.
Q.3 Explain in detail sludge disposal methods.
Q. 4Explain common effluent treatment plant in detail.
Q.5 Describe classification and sources of radiation pollution.
Q.6 Explain sanitation related waterborne diseases in detail.

Short answer question

Q.1 Describe the principle of cyclone separator
Q.2 Describe the types of baghouse filter.
Q.3 Explain the applications of wet scrubber
Q.4 Explain activated carbon adsorption for VOC Control
Q.5 Describe advanced oxidation process.
Q.6 Describe Selective catalytic reduction for NOX control
Q.7 Explain screening process for waste water treatment.
Q.8 Describe chlorination process for waste water treatment.
Q.9 Describe in short sludge digestion process.
Q.10 Describe primary treatment of sewage.
Q.11 Explain concept of wastewater treatment plant
Q.12 Explain tertiary treatment of Effluent treatment plant.
Q.13 Explain biological effects of radiation on human health.
Q.14Describe effects of radiation pollution on biodiversity.
Q 15 Explain sampling methods for environmental monitoring.
Q.16 Explain scope of environmental sanitation.
Q.17Describe vector borne diseases.
Q.18 Explain National sanitation policies.

Rubric for Internal Assessment for Theory Paper

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI Internal Theory Assessment M.Sc. II (Environmental Science) SEMESTER – IV (NEP)			
Paper: DSC I-4	Course Code: EVS-120	DSC-I.4 Environmental Engineering and Technology	Max Marks: 40
S.N.	Assessment Criteria		Marks
1	Attendance		05
2	Class assignments		05
3	Unit Test (MCQ)		20
4	Participation in activity/Field visit		05
5	Overall Performance		05

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
6.5	IV	EVS-121	DSC-II.4Environmental Statistics and Modelling	4	60 (10 per Unit)	2 Hrs.	40 (Int)+ 60 (Ext)

Course Objectives:

1. Need for studying environmental statistics
2. To introduce basic concepts useful for environmental data analysis
3. To aware of a wide range of applications of statistics in environmental management & decision making
4. To develop technical skills to use statistical tools and software in environmental data analysis

Course Outcomes:

Course Outcomes After learning this course students will be able to -

CO1: Learn the basic concepts of Environmental statistics.

CO2: Introduced to various common tools that are used for data classification and analysis.

CO3: Understand the importance of hypothesis testing and also learn prediction models.

CO4: Applications of statistics in Environmental Science will be introduced through various examples.

CO5: Understand the basic concepts & apply tests of significance.

CO6: Acquire knowledge of environmental system analysis and modeling .

Detailed Curriculum:

Unit I: Data analysis:

- 1.1. Concept of Population, Sample, variable, parameters, random variable and parameters of interest
- 1.2. Sampling, Types of random and non-random sampling
- 1.3. Concepts of statistical inference, sample selection
- 1.4. Concept of data, its types; Discrete and continuous data, frequency and non-frequency data
- 1.5. Frequency distributions
- 1.6. Data presentation methods; Diagrammatic methods Graphical methods

Unit – II: Measure of Central Tendency

- 2.1 Mean: Types and significance
- 2.2 Median
- 2.3 Mode
- 2.4 Geometric mean.
- 2.5 Harmonic mean
- 2.6 Partition values

Unit – III: Measure of Dispersion

- 3.1 Range , Variance and standard deviation
- 3.2 Coefficient of variation, Skewness and Kurtosis
- 3.3 Probability - Concept of Probability and distribution models; terms and definitions
- 3.4 Normal distribution and its properties
- 3.5 Binomial Distribution, Poisson Distribution
- 3.6 Calculations of probabilities for different events

Unit – IV: Correlation & Regression

- 4.1 Concept of Correlation and Regression,
- 4.2 Linear and non- linear regression models
- 4.3 Estimating coefficients of correlation and regression
- 4.4 Calculation of fitted values and residuals
- 4.5 Concepts of Hypothesis testing, p-value ,
- 4.6 Concept of Parametric and non-parametric test

Unit – V: Test of Inference

- 5.1 Introduction to small sample and large sample test
- 5.2 Chi-square test for goodness of fit and for independence of attributes.
- 5.3 students t-test for single mean and difference of means
- 5.4 F-test for equality of variances
- 5.5 One way & two-way ANOVA
- 5.6 Concept & applications of PCA Introduction, Basic Definitions and concepts

Unit – VI Environmental System analysis and modeling

- 6.1 Approaches To Development Of Models,
- 6.2 Linear, Simple And Multiple Regression Models,

6.3 Validation and Forecasting Models,
6.4 Population Growth and Interaction Model
6.5 Lotka Volterra Model, Leslie's Matrix Model, Point Sources Stream Pollution Model,
6.6 Box Model, Gauss ion plume model.

Proposed Pedagogies:

Case-Based Learning: Engage students with real-world EIA and audit case studies

- Field-Based Learning: Provide hands-on learning experiences through site visits and fieldwork.
- Simulation and Role-Playing: Simulate EIA and audit processes where students take on various stakeholder roles.

Project-Based Learning: Students undertake comprehensive projects that involve EIA or audits.

Guest Lectures and Workshops: Involve professionals from the field to provide insights and practical knowledge.

Evaluation Methodologies: Assignments: Literature reviews, case studies, problem-solving exercises
Laboratory Reports: Analysis of experimental data and results interpretation
Examinations: Midterm and final exams covering theoretical concepts and applications
Project Work: Research projects or design assignments on environmental engineering topics

Bibliography:

1. Daniel, W. W., & Chad Lee Cross. (2019). *Biostatistics : a foundation for analysis in the health sciences*. Wiley.
2. Ott, W. R. (2018). Environmental Statistics and Data Analysis. Routledge
3. Rajaraman. V. (1973). *Computer Programming in Fortran IV*.
4. Snedecor, G. W., & Cochran, W. G. (1989). *Statistical Methods*.
5. Sundar, S., & Richard, J. (2012). *An introduction to biostatistics and research methods*. Phi Learning.
6. Walpole, R. E., Myers, R. H., Myers, S. L., & Keying Ye. (2012). Probability & statistics for engineers & scientists. Prentice Hall.
7. Zar, J. H. (2010). Biostatistical Analysis. Pearson.

Model Questions: 10/5/3

Long answer question: 10 Marks

Q.1 Why environmental impact assessment is essential? Describe the procedure in detail and goals of EIA process.
Q.2 Describe various types of impact analysis methods. Highlight their specific features in brief.
Q.3 What are the basic steps for prediction and assessment of impact of air quality?
Q.4 Describe the various parameters essential to measure EIA of water pollution?
Q.5 Describe different methods of Environmental impact assessment.
Q.6 Define the objectives of public participation and how would you identify various publics for an EIA?

Short answer question: 5 Marks

Q.1 Write the basic contents of an impact statement.
Q.2 How 'Air pollution dispersal potential is measured?
Q.3 How would you identify 'known cultural resources' and 'potential cultural resources?
Q.4 Discuss techniques of public participation.
Q.5 What is the purpose of public participation?
Q.6 Discuss advantages and dis advantages of public participation
Q.7 How microscale impact calculations can be carried out conservative /non conservative pollutants?
Q.8 What are various water quality standards?
Q.9 Write components of EIA for dams.
Q.10 Write a note on 'checklists.

Short answer question: 3 Marks

Q.1 Define the objectives of public participation
Q.2 Give advantages of public participation disadvantages
Q.3 What are importance of EIA?
Q.4 Describe the procedure of EIA in brief.
Q.5 Discuss in brief different parameters essential to measure water pollution

Rubric for Internal Assessment for Theory Paper

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI Internal Theory Assessment M.Sc. II (Environmental Science) SEMESTER – III (NEP)			
Paper: DSE II-4	Course Code: EVS-121	Environmental Statistics and Modelling (ESM)	Max Marks: 40
S.N.	Assessment Criteria		Marks
1.	Attendance		05
2.	Class assignments		05
3.	Unit Test (MCQ)		20
4.	Participation in activity/Field visit		05
5.	Overall Performance		05

Sant Gadge Baba Amravati University, Amravati

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
6.5	IV	EVS-122	DSC-III.4 - Environmental policies and legislation	4	60 (10 per Unit)	2 Hrs.	40 (Int)+ 60 (Ext)

Course Objectives:

1. To understand the basic concepts, principles and environmental policies.
2. To create awareness among the students about the legislative measures for protection of environment and spirit of Indian Constitution for protection of environment.
3. Provides the opportunities to the students to understand the activist role played by Indian Judiciary in protection of environment.
4. Evolution of different principles polluter pay principle, precautionary principle, inter-generational equity and sustainable development
5. To understand the rearrange prevention and control rules, regulations and governmental policies.

Course Outcomes:

After the completion of this course, student is able to-

CO 1: Know the overall environmental legal regime of the country as well as its international obligations.

CO 2: Understand the principles of basic knowledge and skills to understand Environmental Law issues.

CO 3: Acquaint the students with basic principles as to the skill of drafting of various types of Applications

CO 4: Critically assess Petitions, Notices, and complaints,

CO 5: Develop effective problem-solving skills

CO 6: Develop basic skill for Filing IPR

Detailed Curriculum:

Unit I: Environmental policy and Historical Perspectives

1.1 Historical origin of Environment Law,

1.2 International and Government of India's policies in the protection of environment;

1.3 Environment action plan (EAP); Making of environmental laws; implementing the laws.

1.4 National Forest Policy, 1989, National Water Policy, 2002.

Unit – II: Environment Protection under the Constitution of India:

2.1 Fundamental Rights, Directive Principles of State Policies, Fundamental Duties, Distribution of Legislative Powers

2.2 Remedies - write Jurisdiction of High Court and Supreme Court

2.3 Public Interest Litigation and Environment Protection - Role of Indian Judiciary

2.4 Criminal Liability and Environment Protection - Offences affecting public health and safety under Indian Penal Code, 1860 and Section 133 of Cr. P.C.

Unit – III: Principles of International Environmental Law and policies -

3.1 Stockholm Conference, 1972, Rio Summit or Earth Summit-I, 1992, its Impact in India

3.2 UNEP, Convention on Climate Change, Earth Summit - II, 1997, its Impact on India

3.3 World Summit on Sustainable Development, 2002, UNFCCC, 2015 - Position in India

3.4 International agreements: Montreal protocol, Kyoto protocol and climate negotiations; Convention on Biological Diversity (CBD).

Unit – IV: Resource Management I - Legislative and Judicial Perspective:

4.1 The Water Act, 1974, The Air Act, 1981,

4.2 Environment (Protection) Act 1986 - Definitions, Measures taken for protection and conservation of natural resources, Authorities, offences and penalties and important judicial decisions under these legislations

4.3 Protection of Forests: The Forest Act,1927 - Definitions, Types of Forests, Acts prohibited in these forests, transit of forest produce, powers of forest officers, offences and penalties, important judicial decisions

4.4 The Forest (Conservation) Act, 1980 - De-reservation of forest land for non-forest purpose, Advisory Committee, Penalties. The Wildlife Protection Act, 1972

Unit – V Resource Management II - Legislative and Judicial Perspective:

5.1 The Biological Diversity Act, 2002

5.2 The Public Liability Insurance Act, 1991

5.3 The Noise Pollution (regulation and Control) Rules, 2000, Guidelines for Eco-Sensitive Zones around Protected Areas

5.4 Hazardous Wastes (Management and Handling) Rules d) Municipal Solid Wastes (Management and Handling) Rules.

Unit – VI: Environment and Development case studies:

6.1 Environmental issues involved in the development projects like
Silent Valley Project, Narmada Valley Project and Koondankulam Nuclear Power Plant

6.2 Human Rights Perspective - Displacement and Rehabilitation

6.3 Environment and Protection of Cultural Rights

6.4 Environment Impact Assessment (EIA) - Meaning, Evolution and history, Process, Constraints, EIA Notification of 1994 and 2006, E-waste management

Proposed Pedagogies:

1. Teaching Methodologies: narrative method, talk and chalk method
2. Lectures: Theoretical concepts and case studies
3. Attend legal Sessions and public hearings related to Environment, EIA, etc.
4. Seminars: Guest lectures and student presentations
5. Field Visits: Industry tours and site visits to environmental facilities, visit to legal agencies.

Learning Methodologies

Experiential and Reflective Learning, Self-Directed Learning:

a. Evaluation Methodologies: Assignments: Literature reviews, case studies, problem-solving exercises
b. Laboratory Reports: Analysis of experimental data and results interpretation
c. Examinations: Midterm and final exams covering theoretical concepts and applications
d. Project Work: Research projects or design assignments on environmental laws, public hearings, topics

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2. Christopher D. Stone, Should Tree Have Standing and Other Essays on Law, Morals and Environment, (1996), Oceana.
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4. State of Indian Environment 1999-2000.
5. Department of Science and Technology, Government of India, Report of the Committee for Recommending Legislative Measures
6. and Administrative Machinery for Ensuring Environmental Protection, (1980
7. Ishwara Bhat, *Natural Resources Law: Concepts and Approaches*, Eastern Book.
8. Jaswal,P.S. *Environmental Law*, Allahabad Law Agency.6. Kailash Thakur, Environmental Protection Law and Policy in India, (1997), Deep & Deep Publications, New Delhi.
6. Leelakrishnan. P. (eds), Law and Environment, (2021), lexisNexis.

1. Leelakrishnan. P., The Environmental Law in India, (1999), Buttersworth-India.
2. Leelakrishnan, P. *Environmental Law in India*, LexisNexis, New Delhi.
3. Leelakrishnan, *Environmental Law Case Book*, LexisNexis, New Delhi
4. Philippe Sands, *Principles of International Environmental Law*, Cambridge University Press, New York.1.
5. Ritwick Dutta and Sanjeet Purohit, *Commentary on the National Green Tribunal Act, 2010*, Universal Law Publications.
6. Richard L. Riversz, (eds), Environmental Law, The Economy and Sustainable Development, (2000), Cambridge.
7. Shastri,S,C. *Environmental Law*, Eastern Book Company, Lucknow, 2005.
8. Sahasranaman, P.B. *Handbook of Environmental Law*, Oxford University Press.
9. Sing R.B. and Suresh Mishra, Environmental lw in India, (1996), Concept Publishing Co., New Delhi.
10. Shyam Divan and Armin Rosencranz, *Environmental Law and Policy in India*, Oxford
11. Tiwari, H.N. *Environmental Law*, Allahabad Law Agency .
12. Tiwari Committee Report. Indian Journal of Public Administration, Special Number on Environment and Administration, July-
13. September 1998, Vol. XXXV, No.3, pp. 353-801.
14. University Press, New Delhi.
15. World Commission on Environment and Development, Our Common Feature (1987), Oxford.

Model Questions:

Long answer question

Q.1 Explain origin of Environment Law, International and Indian Jurisprudence
Q.2 Describe the Fundamental Rights and Fundamental duties.
Q.3 Explain in detail Montreal protocol.
Q.4 What are The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006
Q.5 Discuss in Hazardous Wastes (Management and Handling) Rules
Q.6 Explain EIA Notification of 1994 and 2006

Short answer question

Q.1 Describe Protection of Environment in Ancient India and during British period.
Q.2 Describe Common aspects of environmental law
Q.3 Explain in detail CRZ (Coastal zone management) Notification.
Q.4 Explain Nature of Environmental Law - Public law or private law.
Q.5 Discuses Rio Summit or Earth Summit-I, 1992, its Impact in India
Q.6 Describe Public Liability Insurance Act, 1991
Q.7 Explain Municipal Solid Wastes (Management and Handling) Rules
Q.8 Discuses Convention on Biological Diversity (CBD).
Q.9 Describe Narmada Valley Project.
Q.10 Explain Guidelines for Eco-Sensitive Zones around Protected Areas
Q.11 Explain concept EIA Notification of 1994 and 2006.
Q.12 Explain basic principles of Environment and Protection of Cultural Rights.
Q.13 Brief note The Noise Pollution (regulation and Control) Rules, 2000
Q.14 Describe essential of personal protective equipment's.
Q.15 Summarize The features of National Forest Policies of 1952 and 1988
Q.16 Explain the National Green Tribunal Act, 2010.
Q.17 Describe in brief Responsibility of States in Protection of Environment.
Q.18 Explain the Polluter Pays Principle.

Rubric for Internal Assessment for Theory Paper

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI Internal Theory Assessment M.Sc. II (Environmental Science) SEMESTER – III (NEP)			
Paper: DSE III-4	Course Code: EVS-122	DSC- III.4 Environmental Policies and Legislation	Max Marks: 40
S.N.	Assessment Criteria		Marks
1	Attendance		05
2	Class assignments		05
3	Unit Test (MCQ)		20
4	Participation in activity/Field visit		05
5	Overall Performance		05

Sant Gadge Baba Amravati University, Amravati

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
.5	IV	EVS-123	DSE IV.4 Environmental Management System and Life Cycle Assessment (EMS & LCA)	4	60 (10 per Unit)	2 Hrs	40 (Int)+ 60 (Ext)

Course Objectives:

1. Understand environmental management system (EMS) definitions, concepts, and guidelines and requirements of the ISO 14001 standard
2. Understand the stages of EMS implementation, learn best practice techniques, apply environmental management principles to achieve continual improvement in an organization
3. To provide a basic understanding of various tools and techniques such life cycle assessment, environmental audits, evaluation of environmental performance for environmental decision-making.
4. Understand concept need and objectives of Life Cycle Assessment.
5. To know new concept of Environmental Management.

Course Outcomes:

By the end of this course, the student will be able to-

CO1: Acquainted with the environmental management system and its benefits

CO2: Identify and review audit-related documentation, prepare checklists and audit process

CO3: Apply tools such life cycle assessment, environmental audits, evaluation of environmental performance for environmental decision-making .

CO4: Evaluate the effectiveness of systematic EMS monitoring processes.

CO 5: Perform Environmental Audit.

CO 6: Understand and apply new concept of Environmental Audit.

CO 7: Understand concept of Life Cycle Assessment thus permits to quantify environmental impacts and make better environmental decisions.

CO 8: Quantify environmental impacts at the different stages of producing the product or service, stakeholders may understand what changes to make at the distinct stages to improve environmental outcomes overall.

Detailed Curriculum:

Unit – I: Introduction to Environment Management System

1.1 : Introduction, concept of environmental management

1.2 : Overview of the state of the global environment,

1.3 : The earth's natural systems,

1.4 : Sustainability and sustainable development–Case study

1.5 Introduction to the evaluation tools.

1.6 Concept of environmental Management System (EMS),

Unit – II: Elements of EMS -I

2.1 : organizational barriers,

2.2 : management responsibility,

2.3 : elements and extent of application

2.4 : EMS structure

2.5 : ISO 14000-Background

2.6 : The ISO 14000 series

Unit – III EMS Structure

3.1 Business and standards,

3.2 Voluntary standards and GATT/WTO,

3.3 ISO 14000 and world practice,

3.4 ISO 14000 in US, ISO Europe

3.5 International chamber of commerce principles

3.6 ISO in developing world

Unit – IV: EMS and Auditing

4.1 ISO 14001 & elements of EMS environmental policy

4.2 Implementation and operation checking & correction action and management review–Case study

4.3 Auditing,

4.4 Scope and objectives

4.5 Standards for auditing.

4.6 Implementing the audit.

4.7 Registrations and procedures,

4.8 Benefits, environmental auditing as a management tool-Case study

Unit – V: Life Cycle Assessment (LCA)

5.1 Introduction to Life Cycle Assessment and Components of LCA,

5.2 Principles of LCA, Measuring environmental impact (life-cycle stages of product, boundaries, functional unit.
5.3. Impact categories in Life Cycle Impact Assessment (LCIA); (climate change, ozone depletion, eutrophication, acidification, human toxicity (cancer and non-cancer related), respiratory inorganics, ionizing radiation, ecotoxicity, photochemical ozone formation, land use, and resource depletion).
5.4 Issues at each life-cycle stage Benefits of LCA,
5.5 Stages in LCA
5.6 trategic framework for LCA and LCA-a tool for sustainability-Case study

Unit- VI New Concept of EM
6.1 Newer concepts of corporate environmental management product design for the environment (ISO 14062),
6.2 Product stewardship,
6.3 Principles of clean production,
6.4 Packaging, sustainable procurement,
6.5 The social responsibility function of corporations, ecolabelling,
6.6 Ecological and carbon footprints (ISO 14064-65)–Case study

Proposed Pedagogies:
Teaching Methodologies:

- Interactive Lecture
- Group Discussion

Learning Methodologies:

- Lecture-based learning
- Case-based Learning
- Technology-based learning
- Experiential Learning by field visit.

Evaluation Methodologies:

- Case studies.
- Home Alignments.
- Unit Test
- Class Seminars

Group Discussions

Bibliography:
Reference/Text Books/Research Articles-

1. Christopher S. and Mark Y. (2007) Environmental Management Systems, (third edition), Earthscan Publications, First South Asian Edition.
2. David L.G. and Stanley B.D. (2001) ISO 14000Environmental Management, Prentice Hall.
3. Earthscan J.B. (edited) (2005) Environmental Management in Organizations, the IEMA Handbook (Sections 1.1, 1.2, 1.3, 3.2, 3.4, 4.3, 4.4, 5.3).
4. Gilbert M.M. (2004) Introduction to Environmental Engineering and Science, Second Edition, Pearson Education.
5. Harrison R.M. (edited) (2001) Pollution: Sources, Effects and Control, (selected chapters), Royal Society of Chemistry.
6. LaGrega M.D., Buckingham P.L. and Evans J.C. (1994) Hazardous Waste Management, McGraw-Hill International Edition, New York.
7. Madu C.N. (2007) Environmental Planning and Management, Imperial College Press, (Chapters 2, 3, 4, 6, 7, 8, 10).
8. Murtuza Ali Environmental Management: New Concepts KOROS PRESS .
9. Welford R. (edited) (1996) Corporate Environmental Management: Systems & Strategies, Vol. 1&2, (Volume 1, Part 1; Part 2, chapters 3, 7, 8; Part 3, chapter 14).

Suggested readings

1. Cases in Environmental Management and Business Strategy Richard Welford.
2. Environmental Management Strategies: The 21st Century Perspective, Gabriele Crognale (Prentice Hall Ptr Environmental Management Series, Vol 5).
3. International Institute for Sustainable Development. 1992, Business Strategy for Sustainable Development: Leadership and Accountability for the '90s. IISD, Winnipeg, Canada, p. 116.
4. Kenneth M.M. (1999) Basic Concepts in Environmental Management, Boca Raton, FL, Lewis.
5. United Nations Industrial Development Organization Report on an Expert Group Meeting on the Potential Effects of ISO 9000 and ISO 14000 Series and Environmental Labelingon the Trade of Developing Countries (1995) Vienna, 23-25.
6. US EPA (1997) The Environmental Audit Program Design Guidelines for Federal Agencies, EPA 300-B-96-011, Washington, D.C.
7. Virginia H.D. and Mary R.E. (eds.) (1999) Tools to Aid Environmental Decision Making, New York, Springer.

Case studies Websites Journals

1. Journal of Cleaner Production
2. Journal of Environmental Economics and Management

- E Contents, E-Books (Free Available or Purchase Links),
- Digital Resources like Weblinks,
- Educational Software, Databases, etc.

Web Links -

1. https://ebooks.inflibnet.ac.in/esp12/chapter/environmental-management-system-iso-14000/
2. http://www.untagsmd.ac.id/files/Perpustakaan_Digital_1/ENVIRONMENTAL%20MANAGEMENT%20ISO%2014000%20environmental%20management%20standards%20engineering%20and%20financial%20a.pdf
3. https://journals.lww.com/joem/fulltext/1997/04000/iso_14000_and_training.33.aspx
4. https://www.egyankosh.ac.in/bitstream/123456789/87995/1/Unit-8.pdf

LCA-

5. https://venturewell.org/tools_for_design/measuring-sustainability/life-cycle-assessment-content/life-cycle-assessment-examples/
6. https://sphera.com/glossary/what-is-a-life-cycle-assessment-lca/
7. https://www.apec.org/docs/default-source/Publications/2004/2/Life-Cycle-Assessment-Best-Practices-of-International-Organization-for-Standardization-ISO-14040-Ser/04_cti_scsc_lca_rev.pdf
8. https://books.google.co.in/books?id=hCsmCgAAQBAJ&pg=PR9&lpg=PR9&dq=LCA+Exercises&source=bl&ots=DIYiQQichH&sig=ACfU3U2DKu6VDC2v3GbU1yhBLO8ZgDRafQ&hl=en&sa=X&ved=2ahUKEwjlvMi8-ZuGAxXo7TgGHXrTClE4FBDoAXoECAQQAw
9. https://pressbooks.bccampus.ca/chbe220/chapter/life-cycle-assessment/

Model Questions:

Long Type for 10 Marks:

1. Discuss Environmental Management and Environmental Management System .
2. Discuss sustainability with its types and sustainable development with suitable development.
3. Discuss structure and components of EMS.
4. Discuss key standards and advantages of ISO 14000.
5. Discuss concept, principles and benefits of Life Cycle Assessment.
6. Discuss significance and advantages of new concept of Environment Management.

Long Type for 05 Marks.

1. Explain concept of EMS.
2. Explain structure of EMS.
3. Describe voluntary standards of ISO 14000.
4. Explain objectives and scope of Environmental Audit.
5. Explain concept and advantages of Life Cycle Assessment.
6. Describe new concept of Environment Management.

Short Type for 3/4Marks:

1. What is ISO, ISO 14000, and ISO 14001?
2. How are these standards developed?
3. What must a community do to have an EMS that meets the ISO 14001 standard?
4. Is an Environmental Management System (EMS) under ISO 14001 relevant to Communities?
5. What is the purpose of an environmental management system?
6. What are the stages of EMS?
7. What are 4 benefits of environmental management system?
8. What are the key elements of EMS?
9. How many types of environmental management are there?
10. Which are the natural systems working on earth?
11. Define sustainability and sustainable development.
12. Which are the organizational barriers for EMS?
13. What is meant by ISO 14000?
14. What is the purpose of ISO 14000?
15. Explain purpose of Life Cycle Assessment?
16. Which are the Tools of Life Cycle Assessment?
17. Which are advantages of Life Cycle Assessment?
18. Explain New Concept of Environmental Management.

Rubric for Internal Assessment for Theory Paper

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI Internal Assessment M.Sc. I (Environmental Science) SEMESTER – I (NEP)			
Paper DSE-IV-4	Course Code: EVS-123	Title: Environmental Management System and Life Cycle Assessment (EMS & LCA)	Max Marks: 40
S.N.	Assessment Criteria		Marks
1.	Attendance		05
2.	Class assignments		05
3.	Unit Test (MCQ)		20
4.	Participation in activity/Field visit		05
5.	Overall Performance		05

Lab./ Experiments / Practical based on: (any five experiments on each category)

1. DSC-I.4 Environmental Engineering and Technology
2. DSC-II.4 – Environmental Statistics and Modelling
3. DSC- III.4 Environmental Policies and Legislation.
4. DSE-IV-4 Environmental Management System and Life Cycle Assessment.

A. Lab./ Experiments / Practical based on DSC-I.4 Environmental Engineering and Technology. Major Exercise

1: Determination of settleable particulate matter from ambient air by paper Method
2: Determination of NOX from ambient air by air sampler.
3: Determination of SOX from ambient air by air sampler
4: Determination of BOD from waste water sample
5: Determination of COD from waste water sample
6: Determination of inorganic phosphorus from waste water sample. 7:
7:Estimation of Nitrate from waste water sample.
8: Determination of hexavalent Chromium from waste water sample. 9:
9:Estimation of Iron from waste water sample.
10: Estimation of MLSS and MLVSS from waste water sample.

MINOR EXERCISES:

1. Impact of air pollution on Photo density flux of plant leaves.
2. Determination of pH from waste water sample.
3. Determination of oil and grease from waste water sample.
4. Estimation of conductivity from waste water sample.
5. Determination of turbidity from waste water sample.
6. Determination of chlorides from waste water sample.
7. Estimation of total solids and total dissolved solids from waste water sample.
8. Estimation of H2S from waste water sample.
9. Estimation of Alkalinity from waste water sample.

B. *Lab./ Experiments / Practical based on DSC-II.4 – Environmental Statistics and Modelling.*

1. Classification of data and preparation of frequency distribution tables
2. Problem based on diagrammatic representation of data
3. Graphical data representation by Histogram and frequency polygon
4. Calculating measures Of Central tendency mean, median, and mode for the given data
5. Calculating variance.
6. Calculating Standard deviation and Coefficient of variation for given data.
7. Problems based on probability distribution models
8. Use of statistical tables, analyzing level of significance, p-value
9. Computing correlation coefficient and testing its significance.
10. Computing simple linear regression.
11. Plotting scatter diagram and Regression line
12. Comparison between means of two independent samples - Paired t-test.
13. Method of analysis of variance: one way and two- way classification.
14. Introduction to software used in Environmental data analysis.

B. Exercise based on: Environmental Policies and Legislation.

1. Based on the given project details, classify them as Category A and Category B1 and B2 projects.
    a. Prepare the scope of any recent developmental project of Category A which received Environmental Clearance.
    b. To prepare a questionnaire and compilation of primary data to study the scope of the project based on public participation.
    c. Based on the impacts identified in Activity 4, formulate mitigating measures for the project.
    d. To conduct a public hearing for any project and prepare a draft for the process.
2. Prepare a brief EIA report of a River Valley Project.
3. Visit a thermal power plant in and around your city and write its sustainability report.
4. Examine and evaluate EIA reports available on different sectors and topics worldwide and give

appropriate recommendations, if any.

5. Field survey of a waste treatment facility in your city, assess their sustainability and give recommendations if required.
6. Develop sustainability reporting of your institute
7. Examine and report the sustainability of your residential society or residential area around your College
8. Prepare a working plan (in the form of a flowchart/ graphical abstract) for the environmental audit of any organization/ institution focusing on pre-audit, on-site and post-audit objectives and activities.
9. Prepare a brief profile of any selected organization/ institution (Area, land use, green cover, organizational setup, demography etc.) and discuss its environmental policy and the environmental management systems
10. Prepare an interpretive electricity consumption report of the organization/ institution over a five-year period (both actual or arbitrary data can be used).
11. Prepare an interpretive water consumption report of the organization/ institution over a five year period (both actual or arbitrary data can be used). Also, identify the sources of wastewater discharge and its management, if any.
12. Survey the campus and prepare a list of the plant/ animal (or both) diversity, highlighting its importance and threats faced.
13. Prepare a comprehensive assessment report of Solid Waste Management at the organization/ institution highlighting compliance to Solid Waste Management Rules, 2016.
14. Composition of e-waste and segregation- from the material provided
15. Prepare water audit report of the college/house/locality/colony.
16. Assess air quality index (AQI) of any location using real-time air quality parameters.
17. Determine magnitude of solid waste generated in a home/college on a monthly basis.
18. Depict temperature/precipitation trend of a given study area using online data
19. Formulate questionnaire/online surveys for assessment of the impact of climate change on people
20. Assess Nationally Determined Contributions (NDCs) of developed and developing countries
21. Development and simulation of Model UNFCCC for inoculating negotiation skills at climate change summits
22. Development and simulation of Moot Court for Mock Trials in Negotiation Green Tribunal
23. Identify carbon footprint of your college/home/locality (refer wwf@envis.nic.in).
24. Sampling of plant and animal biodiversity of the College campus.
25. Assessment of carbon foot-print of different countries using online databases and mathematical tools.
26. Characterization and categorization of threatened species and habitat for biodiversity conservation in peri- urban forest ecosystem.
27. To make a single species inventory with enumeration with locational habitats.

C. Exercise based on: E Environmental Management System and Life Cycle Assessment.

1. Preparation of Audit Checklist.
2. Study of Overall Environmental Impact of producing Industrial product.
3. Evaluation of all stages of a product's life and study environmental Impact on each stage.
   (Energy, Resource Depletion, Carbon Footprint, Summer smog, Acidification, Eutrophication, Water Footprint, Toxins, Ozone Depletion, Waste)
4. Goal Scope Inventory, Impact Analysis and Interpretation
5. Study the possible need of EMS for educational institution and find some benefits.
6. 2. Study the key difference between ISO 14001 and EMAS and in what way does that affect the implementation process.
7. 3. Study environmental aspects and impacts for a education institute. What is the important difference between aspect and impact.
8. 4. How is environmental legal compliance obtained with EMAS and ISO 14001 respectively? What are important differences.
9. . Prepare an environmental management plan for a Industrial project in area.

Rubric for Internal Assessment for Practical

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI Internal Practical Assessment M.Sc. II (Environmental Science) SEMESTER –IV (NEP)			
Paper: DSCI.4, DSCII.4, DSCIII.4 and DSE-IV	Course Code: EVS-124	1. DSC-I.4 Environmental Engineering and Technology. 2. DSC-II.4-Environmental Statistics and Modelling. 3. DSCIII.4 Environmental Policies and Legislation. 4. DSE-IV- Environmental Management System and Life Cycle Assessment. LAB-7	Max Marks: 50

S.N.	Assessment Criteria	Marks
1	Attendance	10
2	Field Visit-Survey Report/ Assignment	10
3	Active participation in activities	10
4	Submission of practical record	10
5	Internal examiner viva-voce	10

Rubric for External Assessment for Practical

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI External Practical Assessment M.Sc. II (Environmental Science), SEMESTER – IV (NEP)		
Course Code: EVS-124	Lab-7 1. DSC-I.4 Environmental Engineering and Technology. 2. DSC-II.4-Environmental Statistics and Modelling. 3. DSCIII.4 Environmental Policies and Legislation. 4. DSE-IV- Environmental Management System and Life Cycle Assessment. LAB-7	Max Marks: 50 Time: Six.Hrs.

Question No.	Experiment/ Activity	Marks
1	Experiment based on-DSC I.4	11
2	Experiment based on-DSE II.4	11
3	Experiment based on-DSCIII.4	11
4	Experiment based on-DSEIV.4	11
5	Viva-voce	06

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Code of Course	Title of Course	Credit
EVS -125	Research Project Phase -II	6

Research Project Phase II: EVS-125

The Research Project must be submitted in the hard bound copy to the Department / College/ Institute. For internal evaluation, the student shall have to give presentation on the project in a given semester. Further for external examination, project is evaluated by the concerned teacher/supervisor /guide in the University/ Department/College as an internal Examiner along with an External Examiner appointed by university.

Modalities:

1. Individual or group projects can be taken up.
2. Involved in literature survey in chosen field.
3. Use Science and Engineering principles to solve identified issues.
4. Adopt relevant well defined / innovative methodologies to fulfil specified objectives.
5. Submission of scientific report in specified format.

Examination: EVS- Research project –(Lab-8) Max. Marks -150

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI Research Project Assessment M.Sc. II (Environmental Science) SEMESTER –IV (NEP)		
Course Code: EVS-125		Max Marks: 150
S.N.	Assessment Criteria	Marks
1	Internal Assessment	75
2	Submission of Research Project	25
3	Viva-voce (Internal & External Examinewr)	50
Total		150

Note: Internal assessment will be continuous and based on performance of the student thought the session along with satisfactory submission of the term work.