M.Sc. Environmental Science **Prospectus No. 20131212**

संत गाडगे बाबा अमरावती विद्यापीठ

SANT GADGE BABA AMRAVATI UNIVERSITY

विज्ञान विद्याशाखा
(FACULTY OF SCIENCE)

अभ्यासक्रमिका
विज्ञान पारंगत सत्र-१ ते २ परिक्षा २०१२-१३
विज्ञान पारंगत सत्र ३ व ४ परिक्षा २०१३-१४
(पर्यावरणशास्त्र)

PROSPECTUS

OF
MASTER OF SCIENCE IN
ENVIRONMENTAL SCIENCE
Semester -I & III , Winter 2012
Semester-II & IV, Summer-2013

2012

(Visit us at www.sgbau.ac.in)

Price Rs.12/-

PUBLISHED BY
Dineshkumar Joshi
Registrar
Sant Gadge Baba
Amravati University
Amravati-444602

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M.Sc. (Environmental Sciences) Prospectus No.20131212

SYLLABUS PRESCRIBED FOR M.Sc. PART-I

ENVIRONMENTAL SCIENCE

SEMESTER-I

PAPER I: ENVIRONMENTAL SCIENCE-AN INTERDISCIPLINARY APPROACH

Unit I **:** Basic issues in environmental sciences: Definition, principles and scope of environmental science, human population growth, urbanization, sustainability and carryingcapacity, environmental attitudes of individuals, society,

Unit II : Earth as a system: Environmental unity, earth and life, earth as a eco-system, mass and energy transfer across various interfaces, material balance, first and second law of thermodynamics, heat transfer process.

Unit III : Environmental geo-science and geo-chemistry: Basic environmental problems, geo-science factors in environmental planning, Concept of plate tectonics, major plates and boundries. Major trace elements and classification of trace elements, mobility of trace elements, biogeochemical factors in environmental health.

Unit IV : Urban environment, waste management and sustaining living resources: City as a system, influence of city life on city planning and environment, concept of waste disposal, . Effects of fertilizers on, pest control and agro-chemicals, integrated pest management, undesirable effects of irrigation.

Unit V : Minerals, environment and environmental economics: Importance of minerals in environment, agriculture, industry and life, resources and reserves, Importance of environmental economics, cost benefit analysis (CBA), policy instruments.

Recommended Books:

1. Environmental Sciences, Daniel Botkin and Edward Keller, John Wiley and Sons, New York (1997)
2. Environmental Science, Eldon D. Enger and Bradley F. Smith, WCB Publishers, Boston (1995).
3. Forests in India, Dr. A. K. Jain Vorha Publication, Allahabad (1989).

4. Advances of Environmental Science and Technology, Nileel1la Rajvaidya APH Publishing House, Delhi (1989)
5. T.D. Bishwas & S. K. Mukharji, AJ.B. of Soil Sciences, Tata Mcgraw hill pub. Co. Ltd. New Delhi. (II Edition 1997)

PAPER II: CONCEPTS OF ECOLOGY AND BIODIVERSITY

Unit I : **Introduction:** Definition, principles and scope of ecology, history of ecology, subdivisions of ecology, relation to other sciences, relevance to civilization, levels of organization types of ecology – syn ecology, aut ecology

Unit II : Population ecology :- Basic concepts of population ecology,population dynamics characteristic features: Natality Mortality, fecundity, density, age distribution, biotic potential, prey-predator relationship, Environmental resistance in relation to absolute maximum and realizedminimum carrying capacity size and distribution of population. (Random, Aqqreqate and uniform populations)

Unit III : Ecological Succession and community Ecology :- Mechanism of succession; course of succession, trends ofsuccession, climax concept in succession, models of succession. Characteristics of community, composition andstructure, origin and development, ecotone, edge effect, ecological niche, interspecific and intra specific competition.

Unit IV : Biodiversity and its conservation :- Species, genetic and ecosystem diversity, levels of biodiversity, Importance and biodiversity indices, values of biodiversity, hotspots of biodiversity, loss of biodiversity, convention on biological diversity ,strategies for conservation of biodiversity.

Unit V : Biodiversity Action Plan :- Exsitu and Insitu conservation, Biodiversity legislation, Sustainable utilization. National Policy and measurement estimation of the biological biodiversity, diversity act 2002, Biological diversity rules, 2004.

Recommended Books:

1. Fundamentals of Ecology: - E.P. Odum, Revised Edition 1995-96 Edition 2003.
2. The Biological diversity Act 2002 and Biological diversity rules 2004: - National Biodiversity Authority INDIA. 475, 9th South cross street, Kalpalocwar Nagar, Neelangarai Chennai – 600041.

3. Biodiversity and Environment: - S.K. Agarwal, S. Tiwari and P.s. Dubey, 1996.
4. Concept of Ecology: - E.J. Koromondy, 1996, Concept of modern Biology Series, Prentice Hall
5. Biodiversity Measurement and Estimation: - D.L. Hawks worth Director international Mycological Institute Surrey, UK, Published:- Chapman & Hall, Condou New York, Tokyo, Madras.
6. Ecology and Environment: - P.D. Sharma, 1994.
7. Biodiversity Conservation: - Global agreements and nationat concems. RAMSAR sites CBD, Ouarantine, Regulation, National terety pdicy Biodiversity Act wild life Act.
8. Environmental Science: - Daniel Botkin and Edward Kelter, John Wiley and Sons, New York.
9. Environmental Science: - Eldon d. Enger and Bradley F. Smith, WCB Publishers; Boston.
10. Ecology 2000: - Sir Edmand Hillary.
11. Manual for field Ecology: - R. Mishra.
12. Modern Concepts of Ecology: - H.D. Kumar.
13. Fundamentals of Ecology:- Dash M.C. Tata McGraw Hill. Pub. Co- Ltd. New Delhi.
14. Ecology and Environment: - P.W. Sharma Rastogi Publications, Meerut.
15. Principals of Environmental Biology: - P.K.G. Nair, Himalaya Pub. House, Delhi.
16. Environmental Science: - Enger, Smith, Smith W.M.C, Brown. Company Publication
17. Principles of Ecology – P.S. Verma, V.K. Agarwal, S. Chand and Co. Delhi.
18. Principles of Environmental Science – Wart K.E.F. (1973) Mc Graw Hill Book Company.
19. Ecology – M.P. Arora
20. Concept of Ecology – E.J. Koromondy, 1996, concept of modern biology series, prentice Hall.
21. Principles of Environmental Biology – P.K.G. Nair, Himalaya pub. House, Delhi
22. Basic concepts of soil science – A.K. Kolay, Willey estern ltd., New Delhi.
23. Environmental Science – Enger, Smith, Smith, W.M.C. Brown company publishing

24. Practical Method in Ecology – R.K. Trivedi, P.K. Goel and Trisal., Enviro Publication, Karad.
25. Fundamental of Ecology – Dash M.C. Tata McGraw Hill Pub. Co. Ltd. New Delhi.
26. Concepts of Ecology (Fourth Edition)- Edward J. Kormondy, Prentice Hall of India Pvt. Ltd. New Delhi.
27. Biodiversity and environment – S. K. Agarwal
28. The Biological Diversity Act. 2002 and Biological Diversity rules 2004 – National Biodiversity Authority India. 475, 9th South cross street, Kalpalocwar Nagar, Neelangarai, Chennai – 600041.
29. Biodiversity measurement and estimation – D. L. Hawks
30. Biodiversity conservation – Global agreements and national concerns. RAMSAR sites CBD, Quarantine, Regulation, National Forestry policy, Biodiversity Act, Wild life protection Act,

PRACTICAL I : LABORATORY EXERCISE BASED ON PAPER I AND II :

A. Experiments based on field Ecology :

1 To determine the minimum size of quadrat by "Species Area Curve" method.
2. To determine the minimum no. of quadrats to be laid down in the field under study.
3. To determine frequency density and abudance of a species of a given stand.
4. To determine importance value index (IVI) of vegetation.
5. To study the biotic components of a Pond ecosystem.
6. To compare the biomass and net primary productivity of ungrazed and grazed grass land.
7. To study Ecological modeling.

B. **Experiments based on Ecological Adaptations:**

1. Visit to an aquatic ecosystem and methods for water collection (sampling, handling and preservation)
2. Plankton identification and quantification of water and soil.
3. Ecological adapatations in flora and fauna. (Hydrophytes, Mesophytes and Xerophytes, Sandy, muddy and rocky fauna, fossorial, curboreal, Aerial and Desert adaptations (five each.).

4. To study the ecological adaptation in plants to aquatic habitat (Hydrophytes)
5. To study the ecological adaptation in plants to mesophytes.
6. To study the ecological adaptation in plants to desert conditions (Xerophytes)
7. Determination of rate of transpiration in mesophytic plants.
8. To study the ecological adaptation in animals to aquatic habitat

C. **Experiments on Ecological energetics and Disaster :**

1. To study the impact of flood on ecology.
2. Visit to landslide area and survey.
3. Visit to local forest or a sanctuary.
4. Study of energy plants.
5. Visit to aquatic and terrestrial ecosystem.

D. **To study the property of rocks and minerals.**

E- **Experiments on Biodiversity.**

1. Determination of Shannon Weiner Species diversity index to terrestrial animal communities.
2. Determination of Margalef diversity index to terrestrial animal communities.
3. Determination of Kothe's Species Deficit index to aquatic organisms.

Distribution of Practical Marks (Time - 6 Hrs.) :-

Q.1	Two major experiments based on field ecology and adaptations	20 Marks
Q.2.	Two minor experiments based on field ecology and adaptations	20 Marks
Q.3	Summary Report based on Ecological Energetic or Disasters .	10 Marks
Q.4	Experiment based on rocks and minerals.	10 Marks
Q.5.	Experiment based on biodiversity.	20 Marks
Q. 6.	Practical record	10 Marks
Q.7	Tour/ visit report	05 Marks
Q.8	Viva Voce -	05 Marks
	Total Marks -	**100 Marks**

PAPER III: ENVIRONMENTAL CHEMISTRY

Unit I : Fundamentals of Environmental Chemistry: -Stochiometry, Gibb's energy, chemical potential, chemical equilibria, acid base reactions, solubility Product, solubility of gases in water, the carbonate system unsaturated and saturated hydrocarbons.

Unit II : Chemistry of atmospheric pollutent - Chemistry of green house gases,emission of Co2, Earth radiation balance. Chemistry of Ozone layer formation and depletion mechanism. Formation of acid-rain & its effects. Chemistryof photochemical smog, O3, Nox, HC, CFCS & PAN. Thermo chemical and photo chemical reaction in the atmosphere.

Unit III : Chemistry of Industrial Pollutants: - Classification of Industrial Pollutants, Chemical characteristics of wastewater, heavy metals, soaps & detergents, polymers &plastics, asbestos & food additives, fertilizers, insecticides,fungicides, herbicides chemistry of pollutants from pulp &paper mill, sugar & starch industries, textile, cement &pharmaceutical industries.

Unit IV : Analytical Environmental Data: Basic concept and definition, true result, error, types of error, accuracy, precision and standard deviation.

Unit V : Instrumental techniques in environmental analysis(principle, Instrumentation merits and demerits oft echniques colorimetry, spectrophotometry, atomic absorption spectrophotometry, flame photometry, gas chromatography,high performance liquid chromatography, ion exchange chromatography , high volume air sampler and polargraphy.

Recommended Books:

1. A. K. De Environmental Chemistry, Wiley Eastern Ltd, New Delhi (2001).
2. G.S. Sodhi, Gundamental concepts of Environmental Chemistry, Narosa Publishing House, New Delhi (2002).
3. F.W. Field and P.J. Haines, Environmental Analytical Chemistry, Blackwell Science Ltd. USA (2000).
4. Physicochemical examinatin of water, sewage and industrial effluent, Pragati prakashan, Meetrut, (1996).
5. Standard Methods for the examination of Water and Wastewater, 19th Edn, American Public Health Association (1995).

6. Environmental Chemistry: - A.K. De, Wiley eastern Ltd, 1987.
7. Environmental Chemistry:- R.C. Rasswell, Edward Armold press 1980.
8. Fundamentals of Environmental Chemistry:- Stanley E. Manahan.
9. Demalogy:- Wetzel
10. Photo chemistry & spectroscology:- J.P. Simmons Wiley 1971.
11. Fundamentals of Photo chemistry:- K.K. Rohatgi-Mukherjee.
12. Environmental Chemistry:- B.K. Sharma.
13. Elements of Environmental Chemistry.:- H.V. Jadhav, Himalya Publication House
14. Environmental Chemistry:- B.K. Sharma and H.kaur, Krishan Prakashan Meia (p) Ltd.
15. Environmental Pollution analysis:- S.M. Khopkar, New Age, International.
16. Environmental Chemical Analysis:- Lain L. Marr, Mallelm S. Cresser, international text book company, USA.

PAPER IV: GEODYNAMICS AND ENERGY RESOURCES

Unit I : Ecosystem dynamics and biomass productivity: - Definition,kinds of ecosystems, fundamental concepts, structure and functions of ecosystem , energy flow through ecosystems : Ecological energeties,food chains and food web, ecological pyramids. Concepts of biomass, Productivity,Methods of measurement of biomass and primary productivity, Ecological efficiencies.

Unit II : Geo-environment :- Introduction, fundamental concept of environmental geology. The concept of earth system, cycles in earth system Earth's thermal environment and seasons.Indian monsoon, El-nino; The rock cycles, droughts,

Unit III : Geological hazards :- Assessing geologic hazards & risks,types of hazards - earth quakes, volcanic eruptions, floods,subsidence, landslides, soil erosion and desertification. Hazardous of ocean and weather- sea water intrusion, tsunami, tropical cyclones. Environmental impacts of mining, mining for ground water,

Unit IV : Conventional energy resources and mechanism of utilization:- Sources of energy, Energy requirement, - wood, Coal. Oil and natural gas, nuclear energy.

Unit V : Non-conventional energy resources :- Biogas energy,Ocean & tidal energy, Nuclear energy, solar energy,

windenergy, geothermal energy, energy from wastes Ecotechnology sustainable development. Photovoltaics, solar ponds. Energy from biomass, biogas, anaerobic digestion;energy use pattern in different parts of the world.

Recommended Books:

1. Environmental Geology :- K.S. Valdiya Indian. Context Tata Mcgraw Hill Pub. Co, New Delhi, 1987.
2. Environmental Geology :- Barbara, Wim, Brain, J.S. Stephen, C.P. John Wiley & Sens. Inc.
3. Environmental Geology :- Cundgran, Lawrence Prentice Hall.
4. Geology in Env. Planning :- Howard, A.D., and Remson, McGraw. Hill, New York 1978.
5. Env. Geology :- Kellev.Natural hazards :- Alexander.

PRACTICAL II : LABORATORY EXERCISE BASED ON PAPER III AND IV :

A. Experiments based on Environmental Chemistry :

1. Caliberation of pH meter and determination of pH of the sample
2. Study on Molarity, normality and buffers.
3. Estimation of conductivity from the samples.
4. Determination of temporary and permanent hardness of water.
5. Estimation of Phosphate from fertilizers by colorimetric analysis.
6. Estimation of sucrose from sugar industry effluent.
7. Estimation of Protein from industry effluent.
8. Analysis of total dissolved and suspended solids from water.
9. Estimation of dissolved oxygen by Winkler's method.
10. Determination of energy contents of biomass.

B. Experiments based on Instrumental Techniques :

1. To study Principles, components and working operation of flame photometer.
2. To study principle, components and working operation of colorimeter / spectrophotometer.
3. Demonstration of HPLC for Pesticides analysis.
4. Demonstration of Atomic absorption spectrophotometer.

Distribution of Practical Marks (6 Hrs)

Q.1	Major experiment based on Environmental Chemistry -	20 Marks
Q.2	Minor Experiment based on Environmental Chemistry (any two)-	20 Marks
Q.3	Experiments on Instrumental Techniques -	20 Marks
Q.4	Experiments on Biostatastics -	20 Marks
Q.4	Viva-voce	10 marks
Q.5	Practical Record	10 marks
	Total Marks	**100 Marks**

SEMESTER II

PAPER V : BIOINFORMATICS IN ENVIRONMENTAL ANALYSIS

Unit I : **Biostatistics** :- Introduction to statistics population, sample primary and secondary data- collection of primary data graphical and diagrammatic representation of data. Measures of central tendency mean, median and mode.

Measures of dispersion range, standard deviation, raw and central moments, skewness and kurtosis (definitions only).Concept of probability classical and relative frequency definitions of probability.

Unit II : Concept of random variable, probability mass function,probability density function, and probability distribution function (definitions only). Binomial, Poisson and normal distribution (definitions and statements of properties)examples

Principle of test squares-. persons coefficient of correlation and statement of its properties and examples. Concept of simple linear regression-examples.

Unit III : Test of Significance :- concept of simple random sampling; random sampling and stratified random sampling; concept of testing of hypothesis; critical region-two types of errors; level of significance; large sample; tests for single mean and difference of means; single proportion and difference of proportion. Chi-square test for goodness of fit and for independence of attributes, students t-test for single mean

and difference of means and F-test for equality of variances. Concept of ANOVA-examples on one way and two way classification

Unit IV : Environmental System analysis and modeling :- Approaches to development of models, linear, simple and multiple regression models, validation and forecasting models, population growth and interaction model Lotka voltrra model, Leslie's matrix model, point sources stream pollution model, box model, Gauss ion plume model.

Unit V : Computer Programming: - Computer organization,computer generation and classifications, structure, function, capabilities and limitations of computers, computer packages, DOS, MS-Office (MS Word, MSPowerPoint, MS-Excel) for data input & output Developmentof different environmental models by simple computerprogramming. Internet access to generate the environmental data.

Recommended Books:

1. Biostatistics; A Foundation for Analyses in Health Sciences :- Wayne W. Daniels : Wiely International.
2. Statistical Methods :- Snedecor and Cockran (Seeond Ed.) (Prentice-hall) India, S.P. Gupta.
3. Computer Programming in Fortan IV:- Rajaraman V. Prentic1982
4. An Introudction to Biostatistics :- Sunder Rao, PH1.
5. Biostatistical Analysis :- Zar, Jerrold H. (1998) Prentice Hall, N.J.
6. Staistics for Engineering and Scientists :- Walpole, R and Myers (1995) 5th Edn. Mac Millan, N.Y.
7. Environmental Statistics and Data Analysis :- Wayne, R. ott (1995) CRC Press.
8. The statistical sleuth :- Ramsay & Schafer (1997) Dunbury Press.
9. Fundamentals of Computers :- V. Rajaraman.
10. Computer techniques in Env. Sci:- Ouellette.
11. DOS 6.0 Secret :- Ainsbary.
12. DOS 6.0 :- Kamin.
13. Elements of Practical Statistics ;- S.K. Kolhapur.
14. Applied Regression. Analysis :- Droper A. and Smith G. (1981).
15. Statistical Methods for engineers and Scientist:- Bethea, R.M. Duran, B.N. and Bonlion. T.L. (1975).
16. Fundamentals of Applied Statistical :- S.C. Gupta and V.K. Kappor.
17. Elements of Statistics :- Donald R. Byrkit.

18. Multiveniance Analysis :- Hunt and Shelly.
19. Computerized Environmental Modeling :- J. Hardstay, D.M. Tailor & S.E. Metcalf (John Villa & Sensl 1993) Publication.
20. Computerized Aided Environmental Management:- S.A. Abbasic & F.I. Khan (Discovery Publication house Delhi. 2000)
21 An Introduction to Biometry:- Anil. MungiKar Printing Press A'bad.

PAPER VI: ENVIRONMENTAL MICROBIOLOGY

Unit I : Microorganisms and the Environment :- Microorganisms and the structure of ecosystems. The physiological stateof microorganisms in Ecosystems.. Surfaces & Biofilms , Microbial mats. Pure culture concept. Techniques used for environment of culture concept. Method of pure culture, preparation, maintenance and preservation of microbial culture, types of culture, sterilization and disinfections. The influence of environmental factors on growth.

Unit II : Microbiology of Air , Water & Soil :- Distribution of microbes in air, Allergic disorders by air microflora fungal and pollen allergens. Collection and enumeration of aeroallergens. The microbial community in Marine and Fresh water environments. Aquatic nutrient cycles - Carbon, Nitrogen, Phosphorus & Sulphur, Bacteriological analysis of water. Sewage and waste water microbiology

Biodegradation of Industrial wastes Microbiology of soil – soil, habitats, microbial biogeochemical cycling. Nutritional types of organisms. Nitrogen fixation.

Unit III : Microbiology of food :- Microorganisms and food spoilage. Microbial examinations of food. Food processing and methods of preservation . Preservation alternatives. Microbial examination of milk & dairy products. Important fermented food. Disease and foods. Microorganisms as sources of food.

Unit IV : Industrial Applications of microorganisms.:- Role of microorganisms in the production process of products medicines (Pharmaceuticals) organic acids, amino acids, Enzymes, fuels, Alcoholic beverages, Enhanced recovery of metals, petroleum products.

Unit V : Infection and Disease :-Disease definition , water borne , soil borne , air borne diseases. Transmission of disease,

types of diseases, Establishment of disease, resistance to disease. Immune disorders bacterial diseases of man, viral disease of man. Control of microorganisms by physical and chemical agents.

Recommended Books:

1) Microbiology By:- Pelezar.
2) Introduction Microbiology:- Stainer.
3) Introduction to Microbiology :- Modi
4) Mcirobiology of the atmosphere:- Gregary, P.H. Wiley & Company.
5) Microbiology:- LM Prescott John P. Harley, Bonald. A.Klein 4th Ed. WCB/Mc Graw –Hill.
6) Microbiology Fundamental and Application :- Ronald M. Atlas and Richard Bartha 4th Ed. Aim Print of Addision Wesley Long Man Ine.
7) The Microbil World :- Stainer et.al, P.H. I, 1990.
8) Medial Microbiology :- Anant Narayan.
9) General Microbiology :- Robert F. Boyd. /Times, Mirror/Mosby College publishing st. lawisis, Toronto/ Santa Clara. 1984.
10) General Microbiology :- Stainer, R,Y, Adelberg, E.A. and Ingrahm,J.I. 1977, Macmillan Press .
11) Microbiology :- P.D. Sharma (1993). Rastogi and Company, Meenut,India.
12) Fundamental Principals of Bacteriology:- Salle, A.J. (1986).
13) Microbilogy of Extreme Environment:- Clave Edwards.
14) Microbiology for Environmental Scientists & Engineers:- Gindyh, A.F. and Gandy. E. (1982) McGraw Hill, N.Y.
15) Microbiology An Environmental Perspective:- Paul Edmonds(1978) Max Milan Publishing.
16) Basic Microbiology:- Brock, T.D., K.M. Book and D.M. Ward (1996) (III edition).
14) General microbiology – Power and Dagniwala
15) Microbiology – P.D. Sharma
16) Fundamental principle of bacteriology – P.C. Salle
17) Microbiology – Pelczar, M.S. Chand.
18) Introduction to Microbiolgoy – Kappor and Touro
19) Microbiology – Maheswari and Dubey
20) Encyclopedia of environmental microbiology – P. Hotter
21) Industrial microbiology – K.C. Daa
22) Medical microbiology – Anant Narayana

PRACTICAL III: LABORATORY EXERCISE BASED ON PAPER V AND VI

A. **Experiments on Environmental Microbiology :**

1. Microscopy - a) Use of compound microscope b) Calibration of microscope
2. Staining Techniques - a) Monochrome staining b) Negative Staining c) Gram Staining d) Special Staining Methods
3. Slide culture techniques for examination of fungi / actinomycetes.
4. Estimation of total viable counts in water and soil samples.
5. Preparation and sterilization of microbial media.
6. Determination of total bacterial and fungal count from garbage piles in housing colonies.
7. Determination of most probable number (MPN) in water samples.
8. Staining of bacterial suspension by simple staining method (monochrome)
9. Staining of bacterial suspension by Hooker's modification or by Gram's staining.
10. Study of microorganisms by Standard Plate Count (SPC) methode.
11. Isolation of bacteria from water, soil, decaying matter.
12. Isolation of fungi from soil/ water/ decaying matter.
13. Identification and classification of bacteria.
14. Study of allergenic and non allergenic pollen grains.
15. Study of laboratory instruments used for microbiological study.
16. Study of preparation of sterilization of culture media.
17. Determination of MPN from drinking water resource for potability.
18. Determination of hydrogen sulfide (H2S) from sewage sample.

B. **Experiments based on Biostatistics :**

1. To find out mean, mode and median of given data.
2. To find out probability of occurrence and relative frequency of dominant species.
3. To study the random variables in community.

4. Applications of chi-square and t-test for the given data.
5. To study the concept of ANNOVA.
6. Calculation of standard deviation from data.
7. Calculation of variance from data.
8. Calculation of standard error (SE) from data.
9. Problems on correlation coefficient.
10. Problems on probability.
11. Problems on t- test.
12. Problems on ANOVA.
13. Problems on chi-square test.
14. Problems on Regression equation.

C- Experiments on Computer

1. MS-Word
2. MS-Power Point.
3. MS – Excel
4. Use of internet.

Distribution of Practical Marks (6 Hrs)

Q.1 Major Experiment on Environmental Microbiology	20 Marks
Q.2 Twon minor Experiment on Environmental Microbiology	30 Marks
Q.3 TwoExperiments on Biostatistics -	20 Marks
Q.4 Two Experiments on Computer.	20 Marks
Q. 5. Viva-voce -	05 Marks
Q.6. Practical record.	05 Marks
Total Marks -	**100 Marks**

PAPER VII : AIR AND NOISE POLLUTION

Unit I : Air pollution: Definition, natural and man made sources of air pollution, stationary and mobile sources, primary and secondary pollutants, transport and diffusion of pollutants, emission and ambient standards, , vehicular pollution and urban air quality. Air pollutants: Sulfur oxides (SOx); nitrogen oxides (NOx), carbon monoxide, total suspended particulate matter, respirable particulates, photo-chemical oxidants, specific pollutants (Hydrogen sulphide,

particulate fluoride, formaldehyde and volatile organic compounds), chemical composition of SPM photochemical smog, peroxy acyl nitrates (PAN), benzo-a-pyrene (BAP) formations, atmospheric sinks.

Unit II : Global air pollution problems: Green house effect (green house gases: CO2, CH4, N2O, CFC's, water vapor concentration, alternatives for CFC's, fire extinguishers), global warming and climate change, ozone layer depletion (ozone depleting processes, ozone hole, environmental effects and strategies for ozone layer protection), acid rain.

Unit III : Effects of air pollution and air monitoring instruments: Human health, plants, animals and microbes, archeological monuments and aesthetics, Orsat apparatus, high volume air sampler and source monitors Status of Air pollution in India..

Unit IV : Air pollution meteorology: Wind speed, direction and their vertical profiles, turbulence (mechanical and thermal), atmospheric stability characteristics and classes, Plume behavior, , wind-valley effects, land/sea breeze-effects, heat island effect, mixing height-boundary layer definition, temperature inversions, factors affecting on dispersion of air pollutants,

Unit V : Noise pollution: Properties of sound waves, sound level meters, definition of noise, industrial community noise factors, effects of noise on human beings, hearing mechanism, audiometric tests, , effects on human performance, , noise standards and guidelines, permissible noise levels for occupational exposures, noise pollution control and abatement measures.

Recommended Books:

1. Magill, Holden and Ackdey, Air Pollution Hand Book, Mc-Graw Hill, New Delhi (1998)
2. R. K. Trivedi & P. K. Goel, An Introduction to Air Pollution, TechnoScience Publications, Jaipur (1995)
3. C.S.Rao, Environmental Pollution Control Engineering, New Age International Publication New Delhi (2001)
4. A. Sharma & A. Roychaudhari, The Deadly Story of Vehicular Pollution in India, CSE New Delhi (1996)
5. Wahi S.K., Agnihotri A. K., and Sharma J.S.,Environmental Management, Willey Eastern Ltd., New Delhi. (1992)

6. G. N. Pandey, and G.C. Carney, Master Gillbert M., Introduction to Environmental Engineering and Science, Prentice Hall, New Delhi (2000).
7. E. Robart Alley and Associates, Air Pollution Control Hand-book,Mc-Graw Hill, New Delhi (1998)

PAPER VIII : WATER POLLUTION

Unit I : Characteristics of water and wastewater: Physical, chemical, and biological characteristics of water and wastewater, physiochemical and bacteriological sampling and analysis of water quality, quality standards, (BIS, WHO, CPCB and US Environmental Protection Agency), water quality indices: definition, types, applications and significance, water quality for industrial and bathing purpose, prevention and control of water pollution, sewage treatment plant.

Unit II : Sources of water pollution: Sources of water pollution from urban, industrial, agricultural and natural waters, interaction in aquatic system, , sources of marine pollution, criteria for disposal of pollutants in marine ecosystem, coastal management.

Unit III : Pollution potential of industrial effluents (Process, sources and characteristics): Effluent characteristics- (temperature, concentration and volume). Nuclear/thermal power stations, agriculture, sugar, food processing, chemical, tanneries, pulp and paper, oil and petroleum, textile and electroplating industries.

Unit IV : Water resources and environment: Phytoplankton, zooplankton and macrophytes in aquatic ecosystem, global water balance, origin and composition of sea water, types of water: surface, ground water, brackish and marine water, human use of surface and ground water, exploration of ground water, ground water table, aquifers, design, construction and maintenance of wells and infiltration galleries.

Unit V : Consequences of water pollution: Biological uptake of pollutants and their effects on land, vegetation, animals and human health, bio-deterioration, bioaccumulation, biomagnifications and eutrophication, infectious microbial agents in water system and their consequences on human health. Bio-indicators: Specific pollutants in aquatic system and their speciation, behavior, toxicity .

Recommended Books:

1. Gerard Kiely, Environmental Engineering Vol. I, II,& III Liptak, Tata McGraw Hill, New Delhi.(1998)
2. A.K. De, Environmental Chemistry. 2nd edn., 1990, Wiley Eastern Ltd., New Delhi.
3. Nancy J. Sell, Industrial Pollution Control, John Willey and Sons, Inc., New York (1992)
4. S.S. Dara A Text Book of Environmental Chemistry and Pollution Control, S. Chand, and Co. Ltd., New Delhi. (1995)
5. P. K. Goal and K. P. Sharma, Environmental Guidelines and Standards in India, Techno science Pub. Jaipur, India (1996)
6. G. R. Pathade, and G. K. Goal, Environmental Pollution and Management of Waste Water by Microbial Techniques, A. B.D. Pub. Jaipur India (2001)
7. S. N. Jogdand, Environmental Biotechnology (Industrial Pollution Management) Himalaya Pub. House Delhi. (1995)

PRACTICAL IV : LABORATORY EXERCISE BASED ON PAPER VII AND VIII

A. Experiments based on Air and Noise Pollution :

(1) Study of Micrometeorological equipments.

(2) To study principle, components and working operation of Respirable dust sampler.

(3) To study principle, components and working operation of stack monitoring kit.

(4) Measurement of Noise levels.

(5) Determination of NOx from ambient air.

(6) Determination of SOx from ambient air.

(7) Determination of RPM and TSPM from ambient air.

B. Experiments based on Water Pollution :

(1) Determination of CO2 & O2 by Orsat apparatus.

(2) Determination of oil / grease in water.

(3) Determination of Inorganic Phosphorus in water.

(4) Estimation of chlorides in water sample by Mohr's method.

(5) Estimation of Residual chlorine in water sample by iodometric method.

(6) Estimation of sulphate in water sample by turbidimetric method.

(7) Estimation of ferric and ferrous ions present in water.

(8) Estimation of Nitrate in water.

(9) Determination of chemical oxygen demand (COD) in waste water.

(10) Determination of Biological Oxygen demand (BOD) of waste water.

(11) Determination of total acidity CO2 in Water.

Distribution of Practical Marks (6 Hrs)

Q.1	Any one Major Experiment on Water Pollution	20 Marks
Q.2	Any one Major Experiment on Air Pollution	20 Marks
Q.3	Any one minor Experiments on Water pollution	15 Marks
Q.4	Any one minor Experiments on air pollution	15 Marks
Q.5	Any one minor Experiments on noise pollution	15 Marks
Q.6	Practical Record.	05 Marks
Q.7	Viva Voce	10 Marks
	Total Marks -	**100 Marks**

SEMESTER III

PAPER IX : TERRESTRIAL POLLUTION

Unit I : Composition and Sources of solid waste: Ashes, residues, slag, grit, debris, dirt, masonry, garbage, rubbish, trash, dead animals, abandoned vehicles, industrial waste, agro-waste, sewage treatment residues. Urban and rural, agricultural and industrial, demolition, , textile, paper and allied products, chemical and agro-chemical, petroleum refining, rubber and plastic products, leather, primary metals, steel plant, ordnance factories, hospitals.

Unit II : Collection, transportation and characterization of solid wastes: Waste storage devices, , collection equipments, alley, curb, backyard, block and curbside collections, transportation equipments, transfer station, long distance transports, processing of solid wastes for disposal, general properties, physical, chemical and biological properties of solid wastes, Bulkiness, combustibility, solubility.

Unit III : Effects of solid wastes: Effects of mining and transportation activities, odour nuisance and occupational hazards, health hazards, social and aesthetic impacts of terrestrial pollution, interaction of terrestrial pollution with air and water pollution, agricultural land and their effects on environment,

Unit IV : Pollution from production methods: Environmental effects of nuclear, thermal and hydel power production methods pollution from oil, coal, wood and agro-residues burning, food and chemical manufacturing industries, agro industries, fertilizers and pesticides, petroleum production, acid plants.

Unit V : Management of solid wastes: Physical methods such as open dumping, sanitary landfill, ocean dumping, incineration, chemical methods such as pyrolysis, biological methods such as composting and vermi-composting, management of hazardous wastes, modern trends in solid waste management, recycling of waste materials, waste minimization technology.

Recommended Books:

1. A. D. Bhide and B.B. Sundersen, Solid Waste Management in Developed Countries, INSDOC, New Delhi (1983)
2. Sinha R. K., Sinha A. K., Saxena V. S., A Book on Waste Management, INA, Shri publishers, Jaipur (2000)
3. Robert A. Corbitt, Standard Handbook of Environmental Engineering, Mc-Graw Hill, (1989)
4. E. D. Enger, B.F. Smith, Environmental Science - a study of interrelationships. 5th Edn. W.C.B. Publ., London. (1995)
5. D. Botkin and E. Keller, Environmental Science - Earth as a Living Planet. John Wiley and Sons, Inc., New York, (1997)
6. Pollution control in process industry – S. P. Mahajan
6. Global air pollution – Brijman
7. Environmental pollution and management – L. Mohan
8. Environmental analysis – P. R. Trivedy and Gurdeep Ray
9. Soil pollution and soil organism – P.C. Mishra

PAPER X : REMOTE SENSING, GIS AND COMPUTER APPLICATIONS

Unit I : Introduction to remote sensing: Definition, Historical perspective, Electromagnetic radiations(EMR), EMR spectrum, Radiation laws, Black body and real body radiation, Hemispheric reflectance, Transmittance, Absorbance,. Application of remote sensing in environmental studies: Land use / land cover; Wastelands; Forest, Forest fires; Water resources, Disasters; Wildlife habitat, Vegetation .

Unit II : Interaction of electro magnetic radiation (EMR) and remote sensing: With earth surface: reflection, transmission, spectral signatures. With the atmosphere: scattering, absorption, refraction, Types of remote sensing, Characteristics of remote sensing, Platforms and orbits: ground based, air borne, space borne Orbits: geostationary satellites and polar-orbiting satellites Sensors: MSS and TM scanners in landsat series, HRV scanners in spot series, LISS,

Unit III : Aerial photography: Definition, Photogrammetry, Flight lines of vertical aerial photography, Types of aerial photography, Types of films, , Aerial photo interpretation.

Applications of Remote Sensing:, , Geologic and Soil Mapping, Agricultural applications, Forestry applications, , Water Resource applications, Urban and Regional Planning application, Wetland Mapping, ,.

Unit IV : Computer and statistical applications: History, characteristics and classification of computers, Application of computers;, Main parts of PC, , Basic elements and tools of statistical analysis, probability, Chi-square test, Arithmetic, geometric and harmonic means; Linear equations, Tests of hypothesis and significance.

Unit V : Geographical information system (GIS): GIS: definition, capabilities and advantages, History of GIS, Objectives of GIS, Elements of GIS, Data model: Raster and vector data model, Data structures: relational, hierarchical and network data structures, Use of GIS in environmental management Components of GIS, GIS Workflow, GIS Categories, Levels/ Scales of Measurements

Recommended Books:

1. Principles of Remote Sensing: A.N. Patel and S. Singh, Scientific Publishers (India), Jodhpur (1999).
2. Remote Sensing of the Environment: J. R. Jensen, Pearson Education Inc, Delhi(2003).
3. Remote Sensing for Environment and Forest Management: A. Mehrotra and R.K. Suri, Indus
4. Publishing Co., New Delhi (1994).
5. Remote Sensing for Large Wildfires: E. Chuvieco, Springer, New York (1999).
6. Introduction to Geographic Information System: Chang, Kangtang, Tata McGraw Hill, New Delhi (2002).
7. Geographic Information System: R. Ram Mohan Rao and A. Sharieff, Rawat Publication, New Delhi, (2002).
8. Textbook of Remote sensing and GIS (Third edition, 2006) by M. Anji Reddy BS Publication, Hyderabad
9. Fundamentals of remote sensing (Second edition, 2005) by George Joseph Universities press (India) Private Ltd., Hyderabad.
10. Remote sensing and image interpretation (Fifth edition, 2007) by Thomas M. Lilesand, Ralph W. Kiefer, Jonathan W. Chapman Wiley India publication, New Delhi .
11. Remote sensing of the environment (2000) John R. Jensen, Dorling Kindersley India Pvt. Ltd,
12. Current sciences special issue remote sensing for national developmentVolume 61 numbers 3 and 4 August 1991

PRACTICAL V : LABORATORY EXERCISE BASED ON PAPER IX AND X :

A. **Experiments based on Computer and Statistical Applications** :

(1) Basic Program for standard deviations.

(2) Basic Program for BOD/ COD/Hardness

(3) Use of Excel program for data manipulations, functionas and formulae, chart & graphs.

(4) Use of MS-Word for creating document, tables, and graphs.

B. **Experiments based on G.I.S. :**

(1) Interpretation of aerial photographs.

(2) Use of GIS software for Environmental Studies.

(3) Determination of height of the object in aerial photographs.

(4) Interpretation of Satellite Images

(5) Analysis of aerial photographs by using stereoscope (3 P)

(6) Indexing of Topo sheet.

(7) To study the conventional signs and symbols from Toposheet.

(8) Interpretation of Topo sheet.

(9) To study of conventional signs and symbols from weather map.

10) Interpretation of weather map.

C. Experiments based on Terrestrial-pollution:

(1) To Estimate the effect of Exhaust gases on chlorophyll content in different plants.

(2) Analysis of Physical Parameters of Solid Waste.

(3) Analysis of Chemical characteristics of Solid Waste

(4) To compare chemical characteristics of soil by rapid tests.

(5) Study on physical characteristics of soil.

(6) Determination of organic matter by walkley and Black method from soil.

Distribution of Practical Marks (Duration - 6 Hrs)

Q.1	Any one major Experiment based on terrestrial pollution	20 Marks.
Q.2.	Any one minor Experiment based on terrestrial pollution	10 Marks.
Q.3	Any one Experiment based on Computer and Statistical Applications	15 Marks
Q.4	Any one major Experiment based on Geographical Information systems (GIS)	20 marks
Q.5	Any one minor Experiment based on Geographical Information systems (GIS)	15 marks
Q.6.	Viva-voce	10 Marks
Q.7.	Practical record	10 Marks
	Total Marks -	**100 Marks**

PAPER XI : ENVIRONMENTAL IMPACT ASSESSMENT AND AUDIT

Unit I : Environmental impact assessment (EIA): Definition of EIA and EIS, , Concepts, scope and objectives of EIA; National Environmental Policy Act (NEPA, 1969); EIA guidelines-1994 (Notification of Government of India).

Unit II : Impact assessment methodologies: Definition and concept of impact; Types of impacts (Negative & Positive: Primary & Secondary; Reversible and Irreversible;); Impact identification; Methods for impact identification: Matrices, networks and checklists, Advantage & disadvantages of EIA methodologies.

Unit III : Components of EIA: Environmental Setting; Baseline data; Prediction and evaluation of impacts; Environmental management plan and monitoring, Baseline information, Prediction, evaluation and mitigation of impacts on socioeconomic, air water, soil and noise environment. Public participation in EIA: Decision making, Public participation in environmental decision making, Objectives and techniques for public participation, Advantages and disadvantages of public participation.

Unit IV : Preparation and writing of EIA: For water resources, Dams and irrigation projects; Mining and Infrastructural projects etc., eco – labeling eco-marks, ecotourism, eco-feminism, Eco-regulation, eco-accountability, green management, green products, green claims, eco wars.

Unit V : Environmental auditing: Notification and guidelines for Environmental audit; Scope, applicability and objective of environmental audit; procedure of environmental auditing; Designing and implementation of audit tools – pre audit activities – on site activities – post audit activities – Environmental statement – benefits of environmental audit – EA scenario in India – submission of Environmental Audit report in MoEF format.

Recommended Books:

1. Environment Impact Assessment: Larry W. Canter, Mc-Graw Hill Inc., New York (1996).
2. Introduction of Environmental Impact Assessment: John Glassion, Rikay Therival and A. Chadwick, UGC Press Ltd., London (1994).
3. Methods of Environmental Impact Assessment: Peter Morris, Ricky Therivel, UGC Press Limited, London (1994).

4. Environmental Impact Assessment & Management: Daya Publishing House, New Delhi (1998).
5. Using Environmental Management system to improve profits: B. Pearson, BFP Little and M. J. Brierley, Graham & Thotrman, Kluwer Academic Publisher Group, London(1992).
6. A monograph on Environmental Audit: The Institute of cost and works Accounts of India, New Delhi (1994)
7. Handbook of Environmental Impact Assessment (Vol. I): Judith Petts, Blackwell Science, USA (1999).
8. Handbook of Environmental Impact Assessment (Vol. II): Judith Petts, Blackwell Science, USA (1999).
9. Environmental Impact Assessment: A. Eillpin.
10. Environmental Impact Assessment and Management: H. Kumar (1998).
11. Environmental Impact Assessment of Tehri Dam: V. Govardhan.
12. Practical guide to Environmental Impact Assessment: Belly Bowers and Marriott (1977).
13. Environmental Impact Assessment: A. K. Shrivastava APH Publication 2003.
14. Law of Intellectual Property: Dr. S. R. Mysani Asia Law House (2nd Edition) Law Book Sellers, Publishers and Distributors Hyderabad.
15. Environmental Impact Assessment, L. W. Canter, McGraw Hill publication, New Delhi.
16. Proceedings Indo-US workshop on environment impact analysis and assessment (1980) NEERI, Nagpur.
17. Environment & Social impact assessment, Vlcany, F., Bronsetin DA (1995), John Wiley & Sons, New York.
18. EIA – A Biography. B. D. Clark, B. D. Bissel, P. Watheam.
19. Second world congress on engineering and environment 1985, Institution of engineers.

PAPER XII : POLLUTION CONTROL TECHNOLOGY

Unit I : Air Pollution Control Methods :- Need for control methods.Particulate emission control gravitational settling chambers,cyclone separaters, fabric filters, Electrostatic precipitators,wet scrubbers. Control of gaseous pollutants – So2, Nox,Co, Co2 PAN & Hydrocarbons modifications of operating conditions. Modification of design conditions. Automobile pollution control - control at source, fuel tank, carburetor, crankcase Exhaust emissions, Indian scenario.

Unit II : Sewage and Industrial Waste Water Treatment :- The need for waste water treatment: Treatment of waste water – Primary treatment (Sewage)-screens, grit chambers and oil separation & primary sedimentation. Primary treatment (industrial waste water) – segregation, equalization, neutralization, sedimentation, flotation & Oil separation . Secondary treatment principal of biological treatment – waste stabilization ponds – Aerated lagoon, - Activated sludge process- trickling filters. Sludge treatment and disposal, preliminary operations- sludge thicker-sludge digesters, sludge conditioning- dewatering methods – sludge drying beds, vacuum filtration – filter process, centrifugation – sludge disposal methods.

Unit III : Advanced waste water treatment :- Removal of suspended solid, dissolved solids, nitrogen removal-phosphorous removal - Adsorption-refractory organics and their treatment – Reuse and recycle of waste water. Operation, monitoring & designig of Effluent treatment plants, including preliminary, primary, secondary and tertiary treatment for the industries Viz-Sugar, Pulp & Paper, Dairy, Textile, Distillery, fertilizer & petrochemical industries. Concept of common effluent treatment plant (CETP) and Public owned treatment plant (POTP).

Unit IV : Radiation and Noise Pollution Control Measures:- Types of radiations, sources of radiations, biological effects of radiations, Nuclear energy scenario,. The nuclear dilemma. Introduction to noise pollution. The decibel scale – physiological,psychological effects of noise – Noise measurement Noise control criteria, Equipments for noise measurement – Noise control in industries.

Unit V : Solid Waste Management: - Need of Solid Waste management, types of solid waste, biodegradable, refractory, and inorganic, industrial solid waste, pulp and paper, sugar, thermal power station, food processing, textile, urban and agricultural. Solid waste treatment compaction, dewatering, briquette, size reduction,. Solid waste disposal methods solid waste reuse : Recycling and incineration pyrolisis, biogas generation, solid waste as a source of raw material i.e. light weight bricks from fly ash, composting etc. Management of urban solid waste.

Recommended Books:

1) Air Pollution :- H.C.V. Rao, 1990.
2) Air Pollution & Control:- P. Pratapmouli G.N. Vekatasubbayya, Divya Jyothi. Prakashan, Jodhapur 1989.
3) Fundamentals of Air Pollution:- 2nd Ed. Arthur C.stern Acad. Press1984.
4) Pollution Control in Process Industries:- S.P. Mahajan, Tata Mc.Graw Hill Publications. New Delhi.
5) Meterology of Air Pollution:- R.S. Scores 1990. Ellis Hardood publication.
6) Air Pollution :- M.N. Rao, Mc Graw Hill 1993.
7) Waste Water Engineering, treatment, Disposal and reuses:- Metcalf and Eddy.
8) Water Supply & Sanitary Engineering :- R.C. Rangwala.
9) Introduction to Waste Water treatment process. :- Ramalho R.S.
10) Environmental Engineering :- Arcadvo. P. Sincero& Gregorial A.Sincero Prentice Hall of India Pvt. Ltd.
11) Ecotechnology for pollution control and environmental management:- R.K. Trivedy and Arvind Kumar Enviro. Media.
12) Water and Waste Water Technology:- Mark J. Hammer Joh Witeyt Sons.
13) Waste Water Engineening :- J.R. White.
14) Environmental Pollution and Engineering:- C.S. Rao.
15) Environmental Engineering:- M. Narayanrao.
16) Solid Waste Management in developing Country:- A.D. Bhide.
17) Integrated Solid Waste Management :- George Techbanogl Theisen and Vigsl
18) Industrial Waste Water Treatment :- M.N. Rao & A.K.Dutta. Oxford 4 IBH Publ. House 1987.
19) A Treatise or Rural, Muncipal and Industrial water Management:- KVSG Murali Krishna.
20) Sewage Disposal and Air Pollution Engineering:- S.K. Garg 1990Khanna. Publication.
21) Water Supply and Sanitary Engineering:- G.S. Bridie & J.S. BridesDhanpat Rai & Sons. 1993 6th Ed.
22) Water treatment specification:- Frank rose Mc growl Hill 1985.

PRACTICAL VI : LABORATORY EXERCISE BASED ON PAPER XI AND XII :

A. Experiments based on Environmental Impact Assessment (E.I.A.)

(1) To evaluate the impact of traffic density on mix environment.

(2) To study pollution potential of diary effluent.

(3) To draw the flow chart for industrial effluent treatment.

(4) To compare the impact of chemical pesticides vis-a-vis bio-pesticides on micro flora.

(5) To examine the effect of chemical v/s bio fertilisers on root ramification and plant growth.

(6) Impact of air pollution on photo density flax of plant leaves.

(7) Evaluation of impact of refuse on soil quality.

B. Experiments on Pollution Control Techniques and Analysis :

(1) To study the effluent characteristics of pulp and paper industry.

(2) Analysis of textile mill effluent

(3) Estimation of MLSS, MLVSS from the sewage.

(4) Determination of chlorine demand for drinking water.

(5) Determination of pollution load through leachate of solid waste dump.

Distribution of Practical Marks (Duration - 6 Hrs)

Q.1- Any one major Experiment on Environmental Impact Assessment (EIA)	25 marks
Q. 2 -Any one minor Experiment on Environmental Impact Assessment (EIA)	20 marks
Q.3 - Any one major Experiment on Pollution Control Techniques	20 Marks
Q.4 - Any one minor Experiments on PCT.	15 Marks
Q.5- Q.6-Viva Voce	10 Marks
Q.7- Practical Record	10 Marks
Total Marks -	**100 Marks**

SEMESTER IV

PAPER XIII : ENVIRONMENTAL TOXICOLOGY AND HAZARDOUS WASTE MANAGEMENT

Unit-I : Scope and concepts of ecotoxicology and toxicology, paracelsus's view of poison; clinical, environmental, economic toxicology; xenobiotic concentration and dose, calibration of Dose response curve, lethal, Lc50 and threshold concentration, acute, sub acute and chronic toxicity; bioconcentration and biomagnifications, Toxicity Vs chemotherapy. Neurotoxicity, carcinogenicity, & mutagenecity.

Unit II : Bio-assay techniques; study protocols to evaluation of toxicants. Tests for assessing carcinogenicity and muta toxicity of compounds. TLC techniques for determination of toxicants in water & vegetable samples.

Unit III : Classification of toxicants: natural and synthetic toxins; chemicals classification and mode of action of pesticides. Recent trends in the use of pesticides. Plant toxins; Affla-toxins, ergots, pyrethriods. Heavy metal pollution caused by lead, arsenic, mercury , cadmium and chromium, their effect on human health.

Unit IV : Hazardous waste management: Nature and scope of hazardous wastes, classification of hazardous substances and wastes, Hazardous wastes and air and water pollution control, physical forms and segregation of wastes, hazardous substances and health.. Separation of waste at sources of generation for recovery plastic, paper, and metal etc. Need of hazardous waste management; type of wastes, biodegradable, refractory and inorganic, industrial wastes. Industrial sludge, radioactive wastes.

Unit V : Waste treatment and disposal :- treatment and disposal of hazardous wastes, reduction, recycling and methods of wastes treatment, neutralization, oxidation reduction, precipitation, solidification, stabilization, incineration Pyrolysis, wet-oxidation etc. landfill treatment for hazardous waste disposal & leachate management, land farming, bioremediation.

Recommended Books:

1. Principles of Environmental toxicology:-Ian C.Shaw and John Chadwick, Taylor and Francies

2. Environmental Toxicology and Chemistry:-Donald G. Crosfy 1998

3. Text book of modern Toxicology:- David A. Wright and Pamela Welbourn Cambridge University Press 2002.Ernest Hodgsen and patricia E.levi Appleton and Lange Stamford etc U.S.A.1995.
5. Basic Toxicology:- Frank C. Lu, Homisphere publishing Corporation, New York, Washington 1993.
6. Essentials of Toxicology:- Loomis TA, Leae Fabiger.
7. Toxicology:-Hayes.
8. Principles of toxicology:-Cassarett and Doulls.
9. Environmental Engineering:- M.Narayanrao.
10. Solid Waste Management in developing countries:-A.D.Bhide
11. Integrated Solid Waste Management:-George Tehbanoglous Theisen and Vigil.
12. Guide lines for setting up operating facility:-Hazardous waste management CPCB Manual, 1998.
13. Environmental Pollution and Toxicology:-S.P.Ray, Chaudhari, D.S. Gupta.
14. Environmental Engineering designing approach:-Arcadia P. Sincero Gregoria A.Sincero Prentice hall of India Pvt. Limited.
15. Encyclopedia of Environmental control technology (9 Vols. Set):- Paul N.Cheremisinoff Technip Book International.
16. Principal of Environmental Toxicology:-Ian C.Shaw & John Chadwick; Taylor and Frances
17. Environmental Toxicology And Chemistry. :- Donald G. Crosty 1998
18. Environmental Toxicology : - David A. Wright & Pamela Welbourn Cambridge University Press 2002.
19. Text book of modern toxi.:- Ernest Hodgsen & Patricia E. levi Appleton & Cange stamfend etc U.S.A 1995.
20. Basic Toxicology:- Frack C. Lu, Homisphere publishing Cerporation, New York, Washington 1993.

PAPER XIV : INDUSTRIAL HYGIENE AND SAFETY

Unit I : Industrial safety: History and development of safety movement, Need for safety, Safety legislation: Acts and rules, Safety policy: safety organization and responsibilities and authorities of different levels, Accident sequence theory, Causes of accidents, Accident prevention and control techniques, Plant safety inspections, Job safety Analysis and investigation of accidents, Role of safety committee and its formation, Safety awareness programme: motivation, education and training.

Unit II : Risk assessment and management: Checklist procedure, Preliminary hazard analysis, What if analysis, Failure mode effect analysis, Hazard and operability (HAZOP) studies, Hazard analysis techniques: Fault tree analysis, Event tree analysis, General outline of DOW index, Risk estimation and management, Major hazard control, On-site and Offsite emergency preparedness.

Unit III : Specific hazards: Identification of hazard, machine guarding, safety with hand tools/ portable power tools, Pressure vessel hazards and their control, Safety in material handling: hazards and safe Practices, safety with storage of materials, Electrical hazards: classification, safe work practices, Chemical hazards: laboratory safety, bulk handling of chemicals, Fire and explosion hazards, Fire detection, Prevention ,control, and extinguishments, Industrial layout, Industrial waste management.

Unit IV : Industrial hygiene: Environmental stresses: physical, chemical, biological and ergonomic stresses, Principles of industrial hygiene, Overview of control measures. Permissible limits. Stress, Exposures to heat, Heat balance, Effects of heat stress, Control Measures. Chemical agents, IS/UN classification, Flammables, Explosives, Water sensitive chemicals, Oxidants, Gases under pressure, Chemicals causing health hazards: irritants, asphyxiates, anesthetics, systemic poisons and carcinogens, Chronic and acute exposure, Routes of entry, , Occupational exposure limits, Engineering control measures, Principles of ventilation.

Unit V : Occupational health: Concept of health and occupational health, , Occupational and work related diseases, Levels of prevention, History of occupational health, Characteristics of occupational diseases, Essentials of occupational health service, personal protective equipments (respiratory and non-respiratory)

Recommended Books:

1. Frank Lees Book on loss prevention in process industry, vol. 1 & 2.
2. Industrial safety / safety management – K.G. Mistry
3. Safety Management – Grimandi and siemens.
4. Safety supervision – Peterson
5. Eleventh edition of NSC, USA
6. IS 14489 On Safety Audit
7. Factories Act 1948

8. Environmental Protection & Law – H. V. Jadhav & V. M. Bhosale
9. Law Science & Environment – R. P. Ananad
10. Instrumental Methods of chemical analysis – Willard Merrit Dcan.
11. Analytical Spectroscopy – Chhatwal
12. Analytical Instrumentation – NEERI Publication
13. Analytical Chemistry – Kennedy
14. Instrumental Method –Sharma
15. A text Book of Quantitivative Inorganic Analysis – A. L. Vogel
16. International Environmental Policy emergence and Dimension by L. K. Caldwel 1990.
17. Industrial Safety and pollution control handbook: National Safety Council and Associate publishers Pvt. Ltd, Hyderabad(1993).
18. Handbook of Environmental Health and Safety: Herman Koren and Michel Bisesi, Jaico Publishing House, Delhi (1999).
19. Environmental Toxicology and Chemistry: Donald G. Crosby Oxford University Press, USA (1998).
20. Handbook of Environmental Risk Assessment and Management: Peter Calow, Blackwell Science Ltd. USA (1998).
21. Principals of Environmental Toxicology: Ian C. Shaw and John Chadwick,Taylor and Francis, USA (1998).
22. The Factories Act-1948, Government Printing Press, Civil lines, Delhi (1994).
23. Risk Assessment and Environmental Management: D. Kofi Asvite-Dualy, John Willey & Sons, West Sussex, England (1998).
24. Introduction to Environmental Engineering & Science:Gilbert M. M., Pearson Education, Singapore (2004).

PAPER XV : NATURE, CONSERVATION AND ENVIRONMENTAL MANAGEMENT

Unit I : Biodiversity and resource conservation:, Strategies for biodiversity conservation, Causes and Impacts of depletion in biodiversity; Endangered and threatened plant and animal species, Importance and need of conservation, Mineral resources, Forest resources, Water resources; Environmental impact of resource exploitation, Wasteland reclamation, Wetland conservation; Watershed management, Rain water harvesting.

Unit II : Environment Biotechnology: Vermiculture technology- Role of earthworm, process of vermin composting, applications; Bio-fertilizer technology- Definition, classification importance, prospects; Fermentation Technology- Bioreactor, pretreatment and purification, materials of the bioreactor,

Unit III : Non-conventional energy sources and their programs in India: Biogas, Wind Mill (wind farm, Advantages and limitation, wind energy), Solar energy (SPV,ST), Geothermal energy, Nuclear energy, Hydro power (small hydal project), Tidal power

Unit IV : ISO 14000: Definition, Standards (14001), TC-207, EMAR and EMAS, TAG. ISO 9000, ISO 14001, Relation between ISO 14001 and ISO 9000, Certification, Accreditation and Registration, Preparation for ISO 14000

Unit V : **Sustainable Development:** Concepts of sustainable development; definition of sustainable development, Principles of sustainable development; barriers to sustainable development – health aspect of sustainable development; practices of sustainable development in India;

Industrial and urban environmental problems in India:

Industrial development – impact on resources depletion and pollution (case studies), environmental problems of urbanization.

Recommended Books:

1. Biodiversity: K. C. Agrawal, Agro Botanical Publishers, New Delhi, India (1996),
2. Environmental Biology: S.N.Prasad, Campus Books International, New Delhi (2000),
3. Fundamentals of Biotechnology: S.S.Purohit and S.K.Mathur, Agro Botanical Publishers, New Delhi, India. (1990).
4. Environmental Biology: K. C. Agrawal, Agro Botanical Publisher, New Delhi, India. (1993).
5. Compendium of Environmental Statistics: Central Statistical Organization, Dept. of State. Ministry of Planning and Programme Implementation, Govt. of India. (1997).
6. Environment Pollution and Development: Prof. Chandra Pal, Mittal Publications, New Delhi (1999).
7. Environmental Guidelines and Standards in India: P. K. Goel and K. P. Sharma, Techno science Publications, Jaipur, (1996).
8. Global Environmental Chemistry: D. C. Parashar, C. Sharma and A

P. Mitra, Narosa Publishing House (1998).
9. Environmental Challenges and the Universities: AIN (1994).
10. Environment and Development: I. S. Grover and A. K. Thukval, Scientific Publishers, Jodhpur (1998).
11. CEE towards a green future – CEE Ahamedabad 1999.
12. Waste minimization – Prasal Modak
13. Towards an agro-ecosystem policy for India – A Damodharan
14. Environmental economics for sustainable development – Kumar
15. Ecology and economics: an approach to sustainable development –Sengupta
16. Environment, Development and sustainability – Bhaskar Nath
17. Water technology management challenges and choices – A.K.

PAPER XVI : ENVIRONMENTAL POLICIES AND LEGISLATION

Unit I : **Environmental education programme :-** Definition and background of environmental education, need and objectives of environmental education, Role of environmental education in the formal education, – role of various organization Govt. and non-Govt. shairing concerns in Env. Education.

Unit II : **Environmental Education :**

Traditional methods of environmental education . Methods of education for sustainable development , . Current problems in environmental education:Environmental education at various levels.Teachers training programe. Recent methods of environmental education.

Unit III : **Global environmental Controversies:**

Environmental movements and peoples responses; social, political and economic issues in the controversies over natural resources, silent valley, Narmada Project, Almatti dam project, Sardar Sarovar project, Tehri dam, Koyna dam, , , impact of Mahtura refineries on Taj Mahal.

Unit IV : **Environmental Awareness and Conservation strategies**:- Stockholm conference, Earth summit, Agenda-21 (Rio,1992) Johansburg 2002),World commission on environment and development (WCED). World water council (WWC), World health organizations (WHO) ISI, EPHA, United Nations Environmental Programme (UNEP), International Union for conservation of Nature and Natural Resources (IVCN) World wide fund for Nature (WWF)

Unit V : **Environmental Laws**:- Wild life protection Act, 1972, amended 1991. Forest (Conservation) Act, 1980, Indian forest Act (Revised) 1982, Air (Prevention and Control of Pollution) Act,1981 as amended by Act, 1987 and rule 1982. Motor Vehicle Act, 1988. The Water (Prevention and Control of Pollution) Act, 1974 as amended up to 1988 and rules 1975. The Environ (Protection)Act, 1986 and rules 1991. Public Liability Insurance Act, 1991 Hazardous waste management and handling. Rules 1989 as amended up to 2003.

Recommended Books:

1. Hand Book of Env. Laws, Acts, Rules, Guidelines, Compliance and Standard Vol. 1 & 2: R. K. Trivedy Environmental Edition: 1st 1996.
2. Pollution control Acts, Rules and notifications issued there under: Central Pollution Control Board April. 1995.
3. Environmental Protection and the Laws: C. N. Mehta, 1991.
4. Legal aspects of Environmental Pollution and its Management: Ed. S. M. Ali, 1992.
5. International Environmental Policy Emergence and Dimensions: by L. K. Caldwel 1990.
6. Lal's Commentevis on water, Air pollution laws along with the environmental (Protection) Act and rules 1986, 3rd Rd. 1992: Law Publisher India.
7. Universal Environment and Pollution law manual: S. K. Mohanty 1998.
8. Pares Distn. Environmental Laws in India: (Deep, Lated Edn).
9. Environmental Problems, protection and control Vol I & Vol II Ed: Arun Kumar.
10. Hand book of Env. Laws, Acts, Rules, Guidelines, Compuliances and Standards VoL. 1 & 2 :- R.K. Trivedy Enviromedia Edition:1st 1996
11. Pollution control Acts, Rules, and notifications issued there under: - Central Pollution Control. Board Aprill. 1995.
12. Environmental Protection and the Law's:- C.N. Mehta, 1991.
13. Legal aspects of Environmental Pollution and its Management:- Ed.S.M. Ali, 1992.
14. International Environmental Policy Emergence and Dimensions:- by L.K. Caldwel 1990.
15. Lel's Commentenes on water, Air Pollution laws along with the environmental (Protection) Act, and rules, 1986, 3rd Ed. 1992:- Law Publisher India.

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PRACTICAL VII: LABORATORY EXERCISE BASED ON PAPER XIII TO XVI :

A. Experiments on Environmental Toxicology :/ environmental education

(1) Effects of radiation on Microbial genetic system.
(2) Designing of protocols to evaluate pollutants toxicity.
(3) To study absorption and accumulation of heavy metals by aquatic flora.
(4) Study of Bio-accumulation of pesticides in aquatic fauna.
(5) To collect the data of natural resources from local area.
(6) To collect the data of practices for waste management from your local area.
(7) To collect the data of environmental education awareness among the local people.
(8) Case study of daily waste collection practices in house hold.

B. Experiments on Industrial Hygiene and Safety :

(1) To determine the ambient air quality in Industrial belt.
(2) Study of noise and dust pollution in flour mills.
(3) Design of settling tank.
(4) Design of Aeration tank.
(5) To study Environmental Status of Thermal Power Plant.
(6) Construction of wind rose and study of wind profiles.

C. Experiments on Natural Resource Management :

(1) Identification and observation of Hot spot (Water Scarity Area)

(2) Study of a forestation programme of social forestry.
(3) To study the water shade management practices from local area.
(4) To study the water harvesting practices from local area and prepare flow chart.

Distribution of Practical Marks :

Q.1)	One major experiment on Environmental Toxicology/ Environmental education	20 Marks
Q.2)	One minor Experiment on Environmental Toxicology/ Environmental education	15 Marks
Q.3)	Experiments on Industrial Hygiene and Safety	20 Marks
Q.4)	Experiment of Natural Resource Management	25 Marks
Q.5)	Viva-voce	10 Marks
Q.6)	Practical record	10 marks
	Total Marks-	**100 Marks**

PRACTICAL VIII: PROJECT Total marks – 100.

Project topic on Environmental protection and nature conservation :

The students are expected to study the local environmental problems related to the following aspects during their Project work.

a. Urban Environmental Problems.
b. Quality of water resources.
c. Watershed management
d. Biodiversity study and its conservation
e. Quality of soil parameters.
f. Ecotourism
g. Wildlife management.
f. Bioremediation.
g. Health effects of pollution.
h. Environmental and socio-economic impacts of various human activities.
i. Environmental health, hygiene and sanitation.
j. Environmental microbiology.

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