

M.Sc. Sem-I to IV

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SANT GADGE BABA AMRAVATI UNIVERSITY

विज्ञान विद्याशाखा
(FACULTY OF SCIENCE)

अभ्यासक्रमिका
विज्ञान पारंगत परिक्षा (पर्यावरणशास्त्र)
सत्र - १ ते ४

PROSPECTUS
OF
MASTER OF SCIENCE EXAMINATION
IN
ENVIRONMENTAL SCIENCE
Semester -I, Winter 2008,
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SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI
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 carrying capacity, environmental attitudes of individuals, society, corporate bodies and global institutions.
- Unit II** : **Earth as a system:** Environmental unity, earth and life, earth as a eco-system, changes and equilibrium in systems, 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, Environmental geo-science-fundamental concepts (i) short term geological hazards-floods, landslides, earthquakes, volcanoes (ii) Long term hazards- erosion, desertification, urbanization. Concept of major trace elements and REE 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. Food and resources supply and environment, ecological perspective on agriculture, forestry, sources of food, soil and agriculture. Effects of fertilizers on agriculture, 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, procurement methods and disposal. Importance of environmental economics, use of desirable resources vis-à-vis sustainability, minimization of pollution, 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, Nileel11a Rajvaidya APH Publishing House, Delhi (1989)
5. T.D. Bishwas & S. K. Mukharji, A.J.B. of Soil Sciences, Tata McGraw hill pub. Co. Ltd. New Delhi. (II Edition 1997)

PAPER II: CONCEPTS OF ECOLOGY AND BIODIVERSITY

- Unit I** : **Ecological Principals & Concepts :-** Levels of ecology (Gene to organism – Individual to Biome & Biosphere), Environmental heterogeneity and dynamics and evolution of environment early atmosphere Reducing and oxidizing atmosphere, Auto ecology, Synecology & Applied 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 realized minimum carrying capacity size and distribution of population. (Random, Aggregative and uniform populations)
- Unit III** : **Ecological Succession and community Ecology :-** Mechanism of succession; course of succession, trends of succession, climax concept in succession, models of succession. Characteristics of community, composition and structure, 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, hotspots of biodiversity, loss of biodiversity, convention on biological diversity strategies for conservation of biodiversity Exsitu and Insitu conservation, National parks & Sanctuaries, Extinct and endangered species, steps to preserve biodiversity, conservation of gene bank gene pool, species conservation.
- Unit V** : **Biodiversity Action Plan :-** Biodiversity legislation, International cooperation, Sustainable utilization, Research and developmental activities, education & training research, National Policy and action plan, 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

PRACTICAL I: LABORATORY EXERCISE BASED ON PAPER I AND II

A. Experiments based on field Ecology :

1. To study the biotic components of a Pond ecosystem.
2. To compare the biomass and net primary productivity of ungrazed and grazed grass land.
3. To determine the minimum size of quadrat by “Species Area Curve” method.
4. To determine the minimum no. of quadrats to be laid down in the field under study.

5. To study Ecological modelling.
6. To determine importance value index (IVI) of vegetation.

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.)

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.

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

Q.1	Any one Experiment based on field ecology	-	20 Marks
Q.2	Any one Experiment based on Ecological adaptation	-	10 Marks
Q.3	Summary Report based on Ecological Energetics or Disasters	-	05 Marks
Q.4	Viva Voce	-	05 Marks
Total Marks		-	40 Marks

PAPER III: ENVIRONMENTAL CHEMISTRY

Unit I :- Fundamentals of Environmental Chemistry: - Stoichiometry, 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 :- Global Warming: - Chemistry of green house gases, emission of Co₂, consequences of green house gases, control & remedial measures, global warming a serious threat. Earth radiation balance & heat islands. Chemistry of ozone layer formation of ozone, depletion of ozone layer, mechanism of ozone depletion, its effect & protection measures. Formation of acid-rain & its effects. Chemistry of 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 waste water, 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. Destruction of hazardous substances – Acid halides – and anhydrides, alkali metals, cyanides and cynogen bromides, chromium, aflatoxins, halogenated compounds
- 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 of techniques):** Neutron activation analysis, isotope dilution analysis, colorimetry, spectrophotometry, atomic absorption spectrophotometry, flame photometry, gas chromatography, high performance liquid chromatography, ion exchange chromatography and polarography

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 Arnold press 1980.
8. Fundamentals of Environmental Chemistry:- Stanley E. Manahan.
9. Demalogy:- Wetzel
10. Photo chemistry & spectroscopy:- 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, biotic and abiotic components and their functions, nutrient pool, energy flow through ecosystems : Ecological energeties, food chains, food web, Trophic levels, ecological pyramids. Concepts of biomass, Biomass utilization, Productivity, types of productivity Methods of measurement of biomass and productivity, Ecological efficiencies.
- Unit II : Geo-environment :-** Introduction, Environmental dilemmas, fundamental concept of environmental geology. The concept of earth system, cycles in earth system- The energy cycle (energy inputs, solar radiations, geothermal energy, tidal-energy). Earth's thermal environment and seasons. Indian monsoon, El-nino; The rock cycles (heat transfer in the earth, plate tectonics and earth's external structure,) droughts, tropical cyclones & western disturbances.
- Unit III : Geological hazards :-** Assessing geologic hazards & risks, types of hazards, earth quakes, volcanic eruptions, floods, subsidence, landslides, hazards of ocean & weather. Environmental impacts of mining, mining for ground water, sea water intrusion, surface blasting etc.
- Unit IV : Conventional energy resources:-** Sources of energy, Energy requirement, - wood, Coal hydro and thermal power energy,
- Unit V : Non-conventional energy resources :-** Biogas energy, Ocean & tidal energy, Nuclear energy, solar energy, wind energy, geothermal energy, energy from wastes Eco technology 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 :- Kellv.Natural hazards :- Alexander.

PRACTICAL II: LABORATORY EXERCISE BASED ON PAPER III AND IV

A Experiments based on Environmental Chemistry :

1. Calibration 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 leather 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 Potentio-galvano Stat for heavy metal analysis.

Distribution of Practical Marks (6 Hrs)

Q.1	Any one Experiment based on Environmental Chemistry	-	20 Marks
Q.2	Minor Experiment based on Environmental-Chemistry (Any One)	-	10 Marks
Q.3	Experiments on Instrumental Techniques	-	05 Marks
Q.4	Viva-Voce	-	05 Marks
Total Marks			40 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. Addition and multiplication laws of probability and examples.

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 least squares- fitting of straight line. 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 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 Ftest for equality of variances. Concept of ANOVA-examples on one way and two way classifications.

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 volterra 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, MS PowerPoint, MS-Excel) for data input & output Development of different environmental models by simple computer programming. Internet access to generate the environmental data.

Recommended Books:

1. Biostatistics; A Foundation for Analyses in Health Sciences :- Wayne W. Daniels : Wiley International.
2. Statistical Methods :- Snedecor and Cockran (Second Ed.) (Prentice-hall) India, S.P. Gupta.
3. Computer Programming in Fortran IV:- Rajaraman V. Prentice – Hall, 1982.
4. An Introduction to Biostatistics :- Sunder Rao, PHI.

5. Biostatistical Analysis :- Zar, Jerrold H. (1998) Prentice Hall, N.J.
6. Statistics 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).
Statistical Methods for engineers and Scientist:- Bethea, R.M. Duran, B.N. and Bonlion. T.L. (1975).
15. Fundamentals of Applied Statistical :- S.C. Gupta and V.K. Kappor.
16. Elements of Statistics :- Donald R. Byrkit.
17. Multiveniance Analysis :- Hunt and Shelly.
18. Computerized Environmental Modeling :- J. Hardstay, D.M. Taylor & S.E. Metcalf (John Villa & Sensl 1993) Publication.
19. Computerized Aided Environmental Management:- S.A. Abbasic & F.I. Khan (Discovery Publication house Delhi. 2000)
21. An Introduction to Biometry:- Anilm. Mungi Kasaraiwathi Printing Press A'bad.

PAPER VI: ENVIRONMENTAL MICROBIOLOGY

- Unit I** : **Microorganisms and the Environment** :- Microorganisms and the structure of ecosystems. The physiological state of microorganisms in Ecosystems. Microbiology of extreme environments. 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 & Sulpher, 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. Control of microorganisms by physical and chemical agents.
- 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** :- 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) Microbiology of the atmosphere:- Gregory, 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 Addison Wesley Long Man Inc.
- 7) The Microbil World :- Stainer et.al, P.H. I, 1990.
- 8) Medical 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 Principles of Bacteriology:- Salle, A.J. (1986).
- 13) Microbiology 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).

PRACTICAL III: LABORATORY EXERCISE BASED ON PAPER V AND VI

A. Experiments on Environmental Microbiology :

1. Microscopy -
 - a) Use of compound microscope
 - b) Caliberation 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.

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.

Distribution of Practical Marks (6 Hrs)

Q.1	Major Experiment on Environmental Microbiology	-	20 Marks
Q.2	Minor Experiment on Environmental Microbiology	-	10 Marks
Q.3	Experiments on Biostatistics	-	05 Marks
Q.4	Viva-voce	-	05 Marks
Total Marks		-	40 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, global background concentrations, macro and micro methodological influences, transport and diffusion of pollutants, emission and ambient standards, local regional and global criteria for effects of air pollution, vehicular pollution and urban air quality. Air pollutants: Sulfur oxides (SO_x); nitrogen oxides (NO_x), 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 and RSP for toxic trace metals like Pb, Cd, Hg, Ni and Cr. Importance of inorganic ionic composition like SO₄, Cl, NH₄, Na, K, Ca, Mg and organic acids in aerosols and precipitations, 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.
- Unit IV :** **Air pollution meteorology:** Wind speed, direction and their vertical profiles, turbulence (mechanical and thermal), atmospheric stability characteristics and classes, Plume behavior, effects of micrometeorology on point source emission, wind-valley effects, land/sea breeze-effects, heat island effect, mixing height-boundary layer definition, temperature inversions, factors affecting on dispersion of air pollutants, micrometeorological instruments.
- Unit V :** **Noise pollution:** Properties of sound waves, sound pressure and sound level measures, sound level meters, definition of noise, industrial community noise factors, effects of noise on human beings, hearing mechanism, audiometric tests, damage - risk criteria, effects on human performance, noise rating systems, 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, Techno Science 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, nature of sources-stationary, intermittent, continuous and mobile, 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, exit velocity, 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, ice sheets and fluctuations of sea levels, 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, bio-magnification 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 and detoxification of pollutants. (Heavy metals, pesticides, fertilizers and radioactive materials).

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 NO_x from ambient air.
- (6) Determination of SO_x 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	Major Experiment on Water / Air Pollution - (Any One)	20 Marks
Q.2	Any two minor Experiments on Water / Air Noise Pollution	15 Marks
Q.3	Viva Voce	05 Marks
Total Marks		40 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, bulky wastes, special wastes or hazardous wastes, manures, paper products, rubber, leather, metals, oils, paints, chemicals, explosives and radioactive wastes, industrial waste, agro-waste, sewage treatment residues. Urban and rural, agricultural and industrial, demolition, extractive industry, 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 system parameters, 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, perish ability and disease, vectors
- 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, cost of pollution.
- 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, energy and resource recovery from solid waste management, 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)

PAPER X : REMOTE SENSING, GIS AND COMPUTER APPLICATIONS

- Unit I :** **Introduction to remote sensing:** Definition, Historical perspective, Electromagnetic radiations(EMR), EMR spectrum, EMR quantities, Radiation laws, Black body and real body radiation, Hemispheric reflectance, Transmittance, Absorbance, Application of remote sensing in environmental studies. 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, necessity, importance and scope 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, PAN and WiFS scanners in IRS series
- Unit III :** **Aerial photography:** Definition, Photogrammetry, Flight lines of vertical aerial photography, Types of aerial photography, Types of films, Measurements of heights and slopes from aerial photographs, Aerial photo interpretation. Differences between aerial photography and remote sensing.
- Unit IV :** **Computer and statistical applications:** History, characteristics and classification of computers, Application of computers; Basic language, Main parts of PC, Familiarity with microsoft windows software, Basic elements and tools of statistical analysis, probability, Sampling measurement and distribution of attributer, 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, hierachical and network data structures, Overview of GIS software, Use of GIS in environmental management

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 Publishing Co., New Delhi (1994).
4. Remote Sensing for Large Wildfires: E. Chuvieco, Springer, New York (1999).
5. Introduction to Geographic Information System: Chang, Kang-tang, Tata McGraw Hill, New Delhi (2002).
6. Geographic Information System: R. Ram Mohan Rao and A. Sharieff, Rawat Publication, New Delhi, (2002).

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, functions 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

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 Experiment based on - 20 Marks
terrestrial pollution

Q.2 Any one Experiment based on Computer and Statistical Applications	-	10 Marks
Q.3 Any one Experiment based on Geographical Information systems (GIS)	-	5 Marks
Q4. Viva-voce	-	05 Marks
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Total Marks	-	40 Marks
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PAPER XI : ENVIRONMENTAL IMPACT ASSESSMENT AND AUDIT

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

Unit II : Impact assessment methodologies: Definition and concept of impact; Types of impacts (Negative & Positive: Primary & Secondary; Reversible and Irreversible; Tangible and Intangible); 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 socio-economic, 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.

Unit V : Environmental auditing: Notification and guidelines for Environmental audit; Scope, applicability and objective of environmental audit; procedure of environmental auditing; Water, raw material and energy balance; Hazardous waste audit, Safety audit; Applicability of statutory environmental audit statement.

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 & Thotman, 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).

PAPER XII : POLLUTION CONTROL TECHNOLOGY

Unit I : Air Pollution Control Methods :- Need for control methods. Particulate emission control gravitational settling chambers, cyclone separators, 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 & design 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, control measures of beta radioactivity. 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, separation of organic and inorganic i.e. removal of metals like iron, solid waste loading, collection transport and storage. Solid waste disposal methods solid waste reuse : Recycling and incineration pyrolysis, 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. Press 1984.
- 4) Pollution Control in Process Industries:- S.P. Mahajan, Tata Mc.Graw Hill Publications. New Delhi.
- 5) Meteorology of Air Pollution:- R.S. Scores 1990. Ellis Harwood 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 Engineering :- 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 1990 Khanna. Publication.
- 21) Water Supply and Sanitary Engineering:- G.S. Bridie & J.S. Brides Dhanpat 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) or Pollution Control Techniques	-	20 Marks
Q.2 Any two minor Experiments on Environmental Impact Assessment (EIA) or Pollution Control Techniques	-	16 Marks
Q.3 Viva Voce	-	04 Marks
Total Marks	-	40 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, & mutagenicity.

Unit II :- Bio-assay techniques; study design protocols to evaluation of toxicants. Tests for assessing carcinogenicity and mutagenicity 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; Aflatoxins, ergots, pyrethroids. Heavy metal pollution caused by lead, arsenic, mercury, cadmium and chromium, their effect on human health. Factors affecting metabolism of xenobiotics.

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. Dumping up of garbage from houses, hotels, and hospitals and their effects on soil substratum and public 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, radio active wastes, sources characteristic & disposal methods safe to environmental for industries, viz insecticides, caustic soda, chlorine plants etc.

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, degradation of recalcitrant xenobiotics. Transportation of hazardous wastes; Import and export of hazardous wastes for recycling and uses.

Recommended Books:

- 1) Principal of Environmental Toxicology:- Ian C. Shaw & John Chadwick; Taylor and Frances
- 2) Environmental Toxicology And Chemistry. :- Donald G. Crosty 1998
- 3) Environmental Toxicology : - David A. Wright & Pamela Welbourn Cambridge University Press 2002.
- 4) Text book of modern toxicology:- Ernest Hodgson & Patricia E. Levi Appleton & Cengage Stamford etc U.S.A 1995.
- 5) Basic Toxicology:- Frack C. Lu, Hemisphere publishing Corporation, 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 standards and codes, 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, Appraisal of plant safety and measurement of safety performance, Total loss control concept, Introduction to productivity, Quality, Reliability, and Safety (PQRS) theory.

- 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 Off-site emergency preparedness.
- Unit III** : **Specific hazards:** Identification of hazard, Categorization methods for elimination of hazard, Mechanical hazards; 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, WBGT index measurement, 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, Types of airborne contaminants, Introduction to air sampling and evaluation methods, Occupational exposure limits, Engineering control measures, Principles of ventilation.
- Unit V** : **Occupational health:** Concept of health and occupational health, Spectrum of 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. Industrial Safety and pollution control handbook: National Safety Council and Associate publishers Pvt. Ltd, Hyderabad(1993).
2. Handbook of Environmental Health and Safety: Herman Koren and Michel Bisesi, Jaico Publishing House, Delhi (1999).

3. Environmental Toxicology and Chemistry: Donald G. Crosby , Oxford University Press, USA (1998).
4. Handbook of Environmental Risk Assessment and Management: Peter Calow, Blackwell Science Ltd. USA (1998).
5. Principals of Environmental Toxicology: Ian C. Shaw and John Chadwick, Taylor and Francis, USA (1998).
6. The Factories Act-1948, Government Printing Press, Civil lines, Delhi(1994).
7. Risk Assessment and Environmental Management: D. Kofi Asvite-Dualy, John Willey & Sons, West Sussex, England (1998).
8. 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:** Definition, Hot spot of biodiversity, Strategies for biodiversity conservation, National park, Sanctuaries, Gene Pool, Causes and Impacts of depletion in biodiversity; Endangered and threatened plant and animal species, Conventional on biodiversity (CBD). Importance and need of conservation, Mineral resources, Forest resources, Water resources; Environmental impact of resource exploitation, Wasteland reclamation, Wetland conservation; Watershed management- approach and prioritization of watershed, principle of influencing operation, Rain water harvesting.
- Unit II** : **Environment Biotechnology:** Vermiculture technology- Role of earthworm, process of vermicomposting, applications; Bio-fertilizer technology- Definition, classification importance, prospects; Fermentation Technology- Bioreactor, pretreatment and purification, fermentation design considerations, 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 (Nuclear reactor, Status of Nuclear power, Cost benefit analysis) 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 : Environmental Education: Concept, Definition, History, Objectives, Teacher training program, Environmental aspects need to be highlighted in EE, EE at various levels, Role of NGO's in EE

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).

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, status of environmental education in new education policy – role of various organization Govt. and non-Govt. shairing concerns in Env. Education.

Unit II : Environmental Policy :- Government policies in the protection and development of environment – environmental considerations in economic planning and development in India. Public policy strategies in pollution control. Environmental policy resolution. NCEP and district environmental committee. Emerging environmental concerns in India. A case study of silent valley, Sardar Sarover, Tehri dams etc.

Unit III : 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 IV : 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 Industrial Wastes and law, see 12 of Factories Act (1988) and rules framed there under. Noise Pollution and law, sec. 119 and 120 of the Motor Vehicle Act (1989) rules framed there under. Hazardous waste management and handling. Rules 1989 as amended up to 2003.

Unit V : Env. Governance:- Between two centuries-designing the future, earth summit assessing the summit's supers – sustainable development An agenda for centurey-21. Causes of environmental destruction framing the problem, environmental driving forces. Global warming –the charging climate in science and politics green house science, tracing the human cause, converting science into policy. Political economy – Trade and environment the role of the corporation- designing Green market – the political ecosystem- Prospects for super national Governance. Ethical frame work for global action . The risk of progress. The policies? for sustainable future.

Recommended Books:

- 1) Hand book of Env. Laws, Acts, Rules, Guidelines, Compuliances and Standards VoL. 1 & 2 :- R.K. Trivedy Enviromedia Edition:1st 1996
- 2) Pollution control Acts, Rules, and notifications issued there under: - Central Pollution Control. Board Aprill. 1995.
- 3) Environmental Protection and the Law's:- 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. Caldwell 1990.
- 6) Lal's Commentaries on water, Air Pollution laws along with the environmental (Protection) Act, and rules, 1986, 3rd Ed. 1992:- Law Publisher India.
- 7) University Environment and pollution law manual:- S.K. Mohanty 1998.
- 8) Environmental Governance (the Global Challenge):- Lamont C. Hempel Affiliated East-West Press Pvt. Ltd. New Delhi.
- 9) Declaration of :- The Stockholm conference, Rio, Rio +5 and Rio +10.
- 10) Constitution of India [Referred articles from Part III, Part IV and Part IVA].
- 11) Praes Distn. Environmental laws in India :- (Deep. Deep, Lated edn.)
- 12) Environmental problems, protection and control Vol I and II Ed.:- Arun Kumar 1999.
- 13) Universal Environment pollution law Manual.:- S.K. Mohanty 1998.

PRACTICAL VII: LABORATORY EXERCISE BASED ON PAPER XIII TO XVI

A. Experiments on Environmental Toxicology :

- (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.

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 Scarcity Area)
- (2) Study of afforestation programme of social forestry.

Distribution of Practical Marks :

- Q.1) One Experiment on Environmental Toxicology.- 15 Marks
 Q.2) Experiments on Industrial Hygiene and Safety.- 10 Marks

- Q.3) Experiments of Natural Resource Management - 10 Marks
 Q.4) Viva-voce - 05 Marks

Total Marks - 40 Marks

PRACTICAL VIII: PROJECT

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
- e. Reclamation of problematic soil.
- f. Bioremediation.
- g. Health effects of pollution.
- h. Environmental and socio-economic impacts of various human activities.

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