

SCHOOL OF ENVIRONMENTAL & EARTH SCIENCES

North Maharashtra University, Jalgaon

M. Sc. (Environmental Sciences) Syllabus

SEMESTER - I

- EES 101: Environmental Science: An Interdisciplinary Approach.
- EES 102: Ecology and Environment.
- EES 103: Environmental Chemistry.
- EES 104: Practical Course on Environmental Chemistry.
- EES 105: Practical Course on Ecosystem.

SEMESTER - II

- EES 201: Air and Noise Pollution.
- EES 202: Water Pollution.
- EES 203: Terrestrial Pollution.
- EES 204: Practical Course on Air and Noise Pollution.
- EES 205: Practical Course on water and Terrestrial Pollution.

SEMESTER – III

- EES 301: Remote Sensing and Computer Application.
- EES 302: Environmental Monitoring for EIA.
- EES 303: Pollution Control and Waste Management.
- EES 304: Practical Course on Environmental Monitoring.
- EES 305: Practical Course on Pollution Control and Waste Management.

SEMESTER – IV

- EES 401: Industrial Safety, Hygiene and Toxicology.
- EES 402: Environmental Policies and Legislation..
- EES 403: Nature Conservation and Environmental Management.
- EES 404: Practical Course on Industrial Visits.
- EES 405: Practical Course on Research Dissertation.

EES-101: Environmental Sciences: An Interdisciplinary Approach

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. **(07)**

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. **(08)**

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. **(08)**

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. **(10)**

Effects of agriculture on environment: Effects of fertilizers on agriculture, pest control and agro-chemicals, integrated pest management, undesirable effects of irrigation. **(08)**

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-a-vis sustainability, minimization of pollution, cost benefit analysis (CBA), policy instruments. **(07)**

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, Nileema Rajvaidya APH Publishing House, Delhi (1989)
5. T.D. Bishwas & S. K. Mukharji, A.J.B. of Soil Sciences, Tata Mc-graw hill pub. Co. Ltd. New Delhi. (II Edition 1997)

EES-102: ENVIRONMENT AND ECOLOGY

Introduction to ecology: Scope, basic concepts in ecology, levels of ecology, environmental heterogeneity, dynamism and evaluation of environment, reducing and oxidizing atmosphere, autecology and synecology and applied ecology, environmental complexes, interaction of ecological factors.

(07)

Abiotic factors: Light, temperature, precipitation (rainfall), humidity. Atmosphere – gases and wind, atmospheric gases, wind factor and fire factor-

(i) Topographic factor (Physiographic) – height and direction of mountain steepness of slopes and exposure of slopes.

(ii) Edaphic factor – Importance, formation of soil, factors affecting on soil formation, soil composition, soil profile, soil erosion and soil conservation.

(iii) Ecological Adaptations – Ecological groups of plants and ecological adaptations (i) Hydrophytes (ii) Mesophytes (iii) Xerophytes (iv) Halophytes.

Ecological adaptations in animals.

(12)

Biotic factors:

(i) Population ecology – Population characteristics, population growth curves, law of population growth, biotic potential, natality, mortality, age structure.

(ii) Ecosystem-Introduction, kinds of ecosystem, structure and function of ecosystem, ecological energetics, energy flow in ecosystem, energy flow models, food chain and food webs, pyramids of energy, biomass and numbers.

Major ecosystems – pond, grassland, forest, desert, cropland etc. productivity of different ecosystems- primary productivity in terrestrial ecosystems, secondary productivity.

Biogeochemical cycles in ecosystems-carbon, nitrogen, sulfur and phosphorous.

(iii) Community ecology – Evaluation, origin, structure, composition and development of community, species diversities in communities, ecotones and the concept of edge effect, ecological niche.

(16)

Systems ecology and ecosystem modeling: Development of environmental modeling, scope, types, state of art.

(06)

Biodiversity: Concept of biodiversity, types of biodiversity, major biomes distribution.

(02)

Ecological succession: Mechanism of succession, course of succession, types and trends of succession, climax concept in succession, succession and chemical cycling.

(05)

Recommended Books:

1. K.C. Agrawal, Environmental Biology, Agro-Botanical publishers, Bikaner. (1993)
2. E.P.Odum, Fundamentals of Ecology Revised edition (1995)
3. P.S.Verma, V.K.Agrawal, Environmental Ecology S. Chand & Co., New Delhi.(1998)
4. P.D.Sharma, Ecology & Environment, Rastogi Publications, Meerat.(VII Edi.2000)
5. Eldon D. Enger and Bradley F. Smith, Environmental Sciences, WBC publishers, Boston.(1995)
6. Daniel Botkin and Edward Keller, Environmental Sciences, John wiley & Sons, New York.(1997)
7. R.K. Dixit, Environment, Forest Ecology and Man, Rastogi publication, New Delhi. (1997)
8. S. E. Jorgeson et al, Handbook of Environmental and Ecological Modeling, Levis Publications, New York. (1995)

EES-103: ENVIRONMENTAL CHEMISTRY

Fundamentals of environmental chemistry: Concept and scope of environmental chemistry, stoichiometry, Gibb's energy, redox potential, chemical potential, chemical equilibria, acid-base reaction, solubility products, solubility of gases in water, definition of environmental terms. **(10)**

Atmospheric chemistry: Atmosphere- composition, structure, heat balance, chemical composition of air (classification of elements, chemical speciation, particles, ions and radicals in atmosphere), chemical processes for formation of inorganic and organic particulate matter, thermo chemical and photochemical reactions in the atmosphere, oxygen and ozone chemistry. **(06)**

Soil chemistry: Lithosphere- formation of the earth, zonal structure of the earth and its composition, composition of the earth as a whole, differentiation of elements. Soil and agricultural, nature and composition of soil, acid-base and ion-exchange reaction in soil, macronutrients in soil, NPK in soil, micronutrients in soil. **(08)**

Chemistry of water and aquatic system: Hydrosphere- characteristic, characteristic and structure of the ocean, snow and ice, fresh water system. Properties of water and their significance, characteristic of water bodies, alkalinity, acidity, calcium and other metals in water, sedimentation, coagulation, organic pollutants in sewage, soaps, oil and detergents, pesticides in water, their classification, radio-nuclide in water. **(10)**

Analytical environmental data : Basic concept and definition, true results, error, types of error, accuracy, precision and standard deviation **(02)**

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 **(12)**

Recommended Books:

1. A. K. De Environmental Chemistry,. Wiley Eastern Ltd, New Delhi (2001).
2. G. S. Sodhi, Fundamental 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 examination of water, sewage and industrial effluent, Pragati prakashan, Meerut, (1996).
5. Standard Methods for the examination of Water and Wastewater, 19th Edn, American Public Health Association (1995).

EES 104: Practical Course 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. Study on physical characteristics of soil.
5. Determination of organic matter by Walkley and Black method from soil.
6. Estimation of dissolved oxygen by Winkler's method.
7. To study principles, component & working operation of flame photometer.
8. To study principles, component & working operation of colorimeter / Spectrophotometer
9. To compare chemical characteristics of soil by rapid tests.
10. Determination of temporary & permanent hardness of water.
11. Demonstration of HPLC for pesticides analysis.
12. Analysis of total dissolved & suspended solids from water.
13. Demonstration of potentiometric Galvano stat for heavy metal analysis.

EES 105: Practical Course on Eco-system

1. Microscopy-
 - a) Use of compound microscopy
 - b) Calibration of microscopy

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. To study the biotic components of a pond ecosystem

5. To compare the biomass and net primary productivity of ungrazed & grazed grassland.

6. To determine the minimum size of the quadrat by 'Species Area Curve' method.

7. To determine the minimum number of quadrats to be laid down in the field under study.

8. Estimation of total viable counts in water and soil samples.

9. Preparation and sterilization of microbial media.

10. Estimation phosphatic fertilizers by colorimetric analysis.

11. Estimation of sucrose from sugar industry effluent.

12. Estimation of protein from leather industry effluent.

13. Practical on ecological modeling.

EES - 201: Air and Noise Pollution

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.

(06)

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- α -pyrene (BAP) formations, atmospheric sinks.

(12)

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.

(07)

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.

(06)

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.

(09)

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.

(10)

Recommended Books:

1. Magill, Holden and Ackley, 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)

EES - 202: Water Pollution

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. (08)

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. (08)

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. (10)

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. (07)

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. (10)

Bio-indicators: Specific pollutants in aquatic system and their speciation, behavior, toxicity and detoxification of pollutants. (Heavy metals, pesticides, fertilizers and radioactive materials) (05)

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)

EES - 203: Terrestrial Pollution

Composition of solid wastes: 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. **(08)**

Sources of solid waste: 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. **(08)**

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 **(08)**

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. **(08)**

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. **(08)**

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. **(08)**

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)

EES - 204: Practical Course 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. Determination of NO_x from ambient air.
5. Determination of SO_x from ambient air.
6. Determination of RPM & TSPM from ambient air.
7. Construction of windrose and study of wind profiles.
8. Measurement of noise levels.
9. Evaluation of impact of refuse on soil quality
10. Analysis of genetic effects of radiation on microbial systems.
11. Determination of CO₂ & O₂ by Orsat apparatus.
12. Analysis of physical parameters of solid waste.
13. Analysis of chemical characteristics of solid waste.
14. Determination of pollution load through leachate of solid waste dump.

EES- 205: Practical Course on Water Pollution

1. Estimation of chlorides in water sample by Mohr's method.
2. Estimation of residual chlorine in water sample by iodometric method.
3. Estimation of sulphate in water sample by turbidimetric method.
4. Estimation of sulphite in water sample by titrimetric Method.
5. Estimation of ferric and ferrous iron present in water.
6. Estimation of chromium in water.
7. Estimation of nitrate in water.
8. Determination of Chemical Oxygen Demand (COD) in waste water.
9. Determination of Biological Oxygen Demand.(BOD) of a waste water.
10. Determination of Most Probable Number (MPN) in water.
11. Determination of total acidity and CO₂ in water.
12. Determination of total bacterial and fungal count from garbage piles in housing colonies.
13. Determination of oil/grease in water.
14. Determination of Inorganic Phosphorus in water.

EES 301: Remote Sensing and Computer Applications

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. **(04)**

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 **(10)**

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 **(09)**

Application of remote sensing in environmental studies: Land use / land cover; Wastelands; Forest, Forest fires; Water resources, Disasters; Wildlife habitat, Vegetation **(05)**

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. **(10)**

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 softwares, Use of GIS in environmental management **(10)**

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).
7. Geographic Information System: R. Ram Mohan Rao and A. Sharieff, Rawat Publication, New Delhi, (2002).

EES 302: Environmental Monitoring for EIA

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.

(05)

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.

(08)

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.

(14)

Public participation in EIA: Decision making, Public participation in environmental decision making, Objectives and techniques for public participation, Advantages and disadvantages of public participation.

(04)

Preparation and writing of EIA: For water resources, Dams and irrigation projects; Mining and Infrastructural projects etc.

(06)

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.

(11)

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).

EES 303: Pollution Control and Waste Management

Primary wastewater treatment: Introduction to wastewater treatment, Volume and strength reduction of wastewater, Flow diagram of wastewater treatment, Preliminary treatments - flow measurement, screen and shredder, grit chamber, skimming tank., Primary treatments-sedimentation, primary clarifier, final clarifier.

(06)

Secondary wastewater treatment: Trickling filter, activated sludge process, biological tower, combined filtration and aeration process, tapered, step and extended aerations. Low cost treatments- sand filter, contact bed, rotating biological contactor, septic tank, stabilisation pond and lagoons.

(06)

Tertiary wastewater treatment: Chemical precipitation, Membrane filtration, Reverse osmosis, Ion exchange, Electro-dialysis and Effluent disinfections, Design aspects of effluent treatment plant (ETP), Concept, operation and maintenance of common effluent treatment plant (CETP), Wastewater treatment for major industries such as fertilizer, sugar, petroleum refining, pesticides, pulp and paper, textile and power generation.

(14)

Sludge treatment: Organic and inorganic sludges, Primary and secondary sludges, Compressible and noncompressible sludges, Thickening, Conditioning, Dewatering, Filtration, Digestion and Drying of sludges, Sludge disposal strategies.

(06)

Solid waste management: Land filling, Incineration, Pyrolysis, Composting, Biogas generation and recycling; Hazardous waste management; generation, classification, collection, storage, transportation and disposal.

(08)

Air and noise pollution control: Control of particulate matters; Gravity settling chamber, Cyclone separator, Bag filter and Electrostatic precipitator; Control of gaseous pollutants- scrubbing, adsorption, combustion and dispersal. Noise pollution control; at source, during transmission and at receptor

(08)

Recommended Books:

1. Waste Water Engineering: Metcalf & Eddy, Tata Mc-Graw Hill Publishers, III Edition (1995)
2. Water Supply and Sanitary Engineering: S. C. Rangwala, Charotar publishing house, Anand (1992)
3. Water and Wastewater Technology: Mark J Hammer & Mark J Hammer Jr., Prentice Hall of India, IV Edition (2002)
4. Environmental Pollution Control Engineering: C.S.Rao, New Age International (P) Ltd. (1991)
5. Sewage Disposal and Air pollution engineering: S. K. Garg, Khanna publishers, New Delhi (1998)
6. Air Pollution and Control: Mowli and Subbaya, Divyajyoti Prakashan, Jodhpur (1989)
7. Air Pollution: V.P. Kudesia, Pragati Prakashan, New Delhi (1997)
8. Noise Pollution and Management: G. Gaur, Sarup and Sons, New Delhi (1997)

EES-304: Practical Course on Environmental Monitoring

1. Basic program for standard deviation.
2. Basic program for BOD/COD/Hardness
3. Use of excel program for data manipulation, functions and formulae, chart and graphs.
4. Use of MS-Word for creating document, tables and graphs.
5. Interpretation of aerial photographs.
6. Use of GIS software for environment studies
7. Determination of height of the object in aerial photographs
8. Interpretation of satellite images
9. Study of energy plants.
10. Impact of air pollution on photo density flux of plant leaves.
11. To study the impact of flood on ecology.
12. To estimate the effect of exhaust gases on chlorophyll content in different plants.
13. Determination energy content of biomass.

EES-305: Practical Course on Pollution Control and Waste Management

1. To determine the ambient air quality in industrial belt.
2. Study on noise and dust pollution in flourmills.
3. To evaluate the impact of traffic density on mix environment.
4. To study the effluent characteristics of pulp and paper industry.
5. To study pollution potential of dairy effluent.
6. Analysis of textile mill effluent.
7. Estimation of MLSS, MLVSS from the sewage.
8. Determination of chlorine demand for drinking water.
9. To study environmental status of thermal power plant.
10. To draw the flow chart for industrial effluent treatment.
11. Design of settling tank.
12. Design of aeration tank.
13. To compare the impact of chemical pesticides vis-à-vis bio-pesticides on micro flora.
14. To examine the effect of chemical v/s bio-fertilisers on root ramification and plant growth.

EES 401: Industrial Safety, Hygiene and Toxicology

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. **(10)**

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. **(04)**

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. **(10)**

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, anaesthetics, 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. **(10)**

Elementary industrial toxicology: Introduction, Definitions, Major toxic substances, Environmental agents causing public concern, Factors affecting toxicity, LD₅₀: definition and uses, Dose response curve, Extrapolation of animal studies results to human, Probit factor, Carcinogenesis: initiation, promotion and progression, Chemicals and industrial processes associated with human cancer, Occupational exposure limits, Threshold limit

values (TLV) and criteria used in arriving at TLV, Morphological, functional and biochemical changes. **(08)**

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) **(06)**

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).

EES 402: Environmental Policies and Legislation

Environmental policy: Population, industrialization and urbanization policies of GOI, International and Government of India's policies in the protection of environment; Environment action plan (EAP); Making of environmental laws; implementing the laws. National Forest Policy, 1989, National Water Policy, 2002.

(07)

Policy statement for abatement of pollution: Introduction, problems, objectives and future directions; Critical polluted areas and their standards; Constitutional provision regarding Environmental Protection (article 48 and 58 A)

(07)

Leading case studies: The Environmental concern in India, Silent valley; Sardar Sarovar; Tehri Dam and Chipko Movement

(04)

Global environmental awareness and action plan: Stockholm Conference (UNCHE); Montreal Protocol; UN conference on environment and development, Rio (UNCED) Summit; Population conference, Cairo and climatic change conference, Kyoto; International union for conservation of nature and natural resources (IUCN); UN environmental programmers (UNEP); World-wide fund for nature (WWF).

(10)

Environmental laws in India: The Factories Act, 1948 and Amendment thereof, The Water (prevention and control of pollution) Act, 1974; The Forest (conservation) Act, 1980; The Air (prevention and control of pollution) Act, 1981; The Environment (protection) Act, 1986, Public Liability Insurance Act, 1991, The Wildlife (protection) Act, 1972.

(12)

Environmental rules in India: Hazardous Waste (management and handling) Rules, 1989; Rules framed under industrial waste; Biomedical waste management rules; Noise and Environmental Pollution under Motor Vehicles Rules, 1989; Noise Pollution (regulation and control) Rules, 2000; Coastal Zone Regulation, 1991.

(08)

Recommended Books:

1. Environmental Governance -The Global Challenge: Lamont, C., Affiliated East-West Press Pvt. Ltd, New Delhi (1998).
2. A Text book in Environmental Sciences: Subramanian, Narosa Publishing House, New Delhi (2000).
3. Environment and Pollution Law Manual: Mohanty S. K., Universal Law Publishing Co-Pvt. Ltd., New Delhi (2000).
4. Labour and Industrial Law: Sing, A, K. and Agrawal R. K., Pioneer Printers, Agra (2000).
5. Environmental Policies: Sinha P. C., Anmol Publications Pvt. Ltd, New Delhi (1998).
6. Environmental Geography: Savindra Singh, Prayag Pustak Bhawan, Allahabad (2002).
7. Climate Change in Asia and Brazil: James G. Speth and Mohaned EL-Ashry, TERI, New Delhi (1994).
8. Environmental Guidelines and Standards in India: Goel P. K and Sharma K. P, Techno Science Publications, Jaipur (1996).
9. Commentaries on water and air pollution law: Lal, Universal Publication, New Delhi (1992).
10. Earth Summit, Vol. I & II: Bhaskar Rao, Universal Publication, New Delhi (1996).

EES-403: Nature, Conservation and Environmental Management

Biodiversity 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),

(15)

Conservation of resources: 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.

(12)

Environment Biotechnology: Vermiculture technology- Role of earthworm, process of vermicomposting, applications; Biofertilizer technology- Definition, classification importance, prospects; Fermentation Technology- Bioreactor, pretreatment and purification, fermentation design considerations, materials of the bioreactor,

(08)

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

(05)

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

(04)

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

(04)

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).

EES –404: Practical Course on Industrial Visits

Industrial visits: Sugar, Distillery, Dairy, Foundry, Textile, Pulp and Paper, Pharmaceutical, Chemical, Food Processing Agrochemical, Fertilizer, etc. Writing of report on the local industrial visits and long tour report

Case study on EIA: Any one case study from the followings: Mining, Hydel , Irrigation and Thermal Power Plant

EES - 405: Practical Course on Research Dissertation

Dissertation topic on environmental protection and nature conservation. The students are expected to study the local environmental problems related to the following aspects during their dissertation.

- 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.