FACULTY OF SCIENCE

SYLLABI

FOR

M.Sc. ENVIRONMENT SCIENCE
(SEMESTER SYSTEM)

2018-19

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M.Sc. (Environment Science)
Outlines of Syllabus, Reading Material and Tests
Session: 2018-2019

<table>
<thead>
<tr>
<th>Semester -1</th>
<th>Paper-I</th>
<th>Subject</th>
<th>Marks</th>
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<td>ENV-6101</td>
<td>Geo-Environment and Meteorological Science</td>
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<td>Paper-II</td>
<td>ENV-6102</td>
<td>Educational Principles</td>
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<td>Paper-III</td>
<td>ENV-6103</td>
<td>Environmental Chemistry &amp; Toxicology</td>
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<td>Paper-IV</td>
<td>ENV-6104</td>
<td>Solid Waste Management and Techniques</td>
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<td>Biodiversity and Conservation</td>
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<td>Paper-II</td>
<td>ENV-6202</td>
<td>Environmental Analyses : Techniques and Instrumentation</td>
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<td>ENV-6203</td>
<td>Environmental Pollution</td>
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<td>Paper-IV</td>
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<td>Environmental Technology</td>
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<td>Paper-II</td>
<td>ENV-6302</td>
<td>Regional and Global Environmental Issues</td>
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<td>Statistical Applications and Research Methodology</td>
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<td>Paper-II</td>
<td>ENV-6402</td>
<td>Environmental Biotechnology</td>
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<td>Paper-III</td>
<td>ENV-6403</td>
<td>Remote Sensing and GIS in Environmental Studies</td>
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<td>Paper-IV</td>
<td>ENV-6404</td>
<td>Training of at least 4 weeks, project report, presentation</td>
<td>125 (50+50+25)</td>
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Each semester shall comprise of 4 Papers, each of 125 marks and a total of 500 marks per semester.
Except for the Paper IV in Semester IV, each paper shall consist of 100 marks for theory (including 20 of the continuous internal assessment based on tests) and 25 for the Practical.

There shall be no internal assessment for the Paper IV in Semester IV.

For Paper IV in Semester IV, every student shall be required to do a project training of at least one-month and submit a project report based upon their training / research undertaken during the course of study. There shall be a presentation based upon the project submitted by the student.
Instructions for Final Theory Paper Setters:
The question paper shall comprise of a total of nine questions containing two questions from each unit and one compulsory question from whole of the syllabus. Candidates will attempt five questions, including one from each section and the compulsory question. Each question will carry equal marks. The duration of theory paper will be 3 hours.

Instructions / Rules for Continuous Internal Assessment:
There shall be two tests each of 20 marks based upon the definitions / short answer questions / multiple choice questions, to be conducted during the course of each paper. The marks obtained by the student in two tests shall be rationalized out of 20 and counted as Internal Assessment.

To qualify for the degree, a student has to score a total of 50 percent marks in each semester with a minimum of 40 percent in each paper, including marks of internal assessment.
Paper I: Geo-Environment and Meteorological Science

Objective: To acquaint the students with the fundamental concepts of geo-science in relation to environmental aspects.

UNIT-I
Environmental Geo-science: Fundamental concepts, Primary differentiation and formation of core, mantle, crust, atmosphere and hydrosphere; magma generation and formation of rocks; plate tectonics – sea floor spreading, mountain building, rock deformation and evolution of continents. Mineral Resources and Environment: Resources and reserves. Abundance of elements and mineral resources; classifications; plate tectonics and mineral resources; resources, population and development. Oceans as new areas for exploration of mineral resources. Environmental impact of exploration, processing and smelting of minerals. (12 lectures)

UNIT-II
Atmosphere: Different layers, their characteristics and temperature relationships; Atmospheric stability, inversions and mixing heights, windroses. Meteorology: Weather and Climate, Atmospheric general circulation, Air mass and weather fronts, Weather elements, Precipitation and types of storms, Indian monsoon, El Nino effect, and western disturbances Weather forecasting, Methods of weather forecasting on short- and long range, World Meteorological Organization. (12 lectures)

UNIT-III

UNIT-IV

Practical
1. Studying the internal structure of earth
2. Studying the hand specimens of rock samples
3. Diagrammatic representation of different layers of atmosphere, their characteristics and temperature relationships;
5. Reading of topo maps and Geological maps.
6. Interpretation of Remotely sensed data.
7. Map work related to meteorology.
8. Assignments/project as assigned by the teacher.

Suggested Readings
Paper II: Ecological Principles

Objective: To acquaint the students with the concept of ecology so that they get well versed with different ecosystems and try to relate them in their day to day life.

UNIT-I
Ecology: A brief history; Concept, and major branches.
Ecosystem: Energy flow and mineral cycling;
Population Ecology: Characteristics of population; Dynamics and Interactions; Regulation; Life history strategies; Population genetics; Metapopulations - demes and dispersal, interdemic extinction, age-structured population

UNIT-II
Terrestrial ecosystems: Major terrestrial biomes - Forest, Desert, and Grassland (a brief account); Relationship between Precipitation and temperature in determining the vegetation; Forest Types of India (a concise account).
Aquatic Ecosystems: Fresh water and marine, their types, characteristics and components; Wetlands and their significance.

UNIT-III
Community Ecology: Concept, Characteristics and dynamics; Interactions (positive and negative); Development of community (Plant Succession); Parasitism; Prey-Predator relationship; Metacommunities; Fugitive species; Theory of Island biogeography

UNIT-IV
Biological Invasion: Concept; Pathways of Invasion; Process of Invasion; Mechanism of Invasions; Impact of Invasive Species - Ecological, Environmental, Economical; Some examples of major invasive plants and animals in India.
Speciation: Concept and types.
Extinction: A brief history and reasons.
Practical
1. To determine the minimum number and size of quadrat for studying vegetation in a grassland.
2. To calculate density, frequency, abundance and dominance of plant species in grassland using quadrat method.
3. To calculate the Importance Value Index (IVI) of species.
4. To find out association between two species using Chi-square method.
5. To calculate similarity index between two adjoining communities.
6. To study and enlist various biotic and abiotic components of pond and forest ecosystem.
7. To study ecology of some major exotic invasive weeds.

Suggested Readings

Paper III: Environmental Chemistry and Toxicology

Objective: To acquaint the students with the dynamics and principle of environmental chemistry and their toxicological effects on environment.

UNIT- I
Fundamental of Environmental Chemistry: Henry' Law, Photochemistry, Electrochemistry, Elements and organics in nature, Petroleum and its products, Chemistry of Earth: Mineral and Organic components of soil; Reactions in soil solution; Ion exchange (Physiosorption); Ligand exchange (Chemisorption); Complexations, Chelation; Precipitation / dissolution (12 lectures)

UNIT-II
Chemical composition of Air: Classification of elements, chemical speciation. Particles, ions, and radicals in the atmosphere. Chemical processes for formation of inorganic and organic particulate matter. Sources of trace gases in the atmosphere; Thermo-chemical and photochemical reactions in the atmosphere. Tropospheric oxidation chemistry; Oxygen and ozone chemistry. Chemistry of air pollutants. Role of hydrocarbons; Sulphur chemistry; Halogen Chemistry in the atmosphere Green Chemistry: Concept and a Brief account (12 lectures)
UNIT-III

Water Chemistry: Chemistry of water, dissolution / precipitation reactions; complexation reactions; concept of DO, BOD, COD; concept of salinity; composition of seawater and physico-chemical speciation in oceans; Suspended particles; concept of sedimentation, coagulation, filtration.

Environmental Toxicology: Emergence as a science; concepts and definitions; Factors affecting toxicity;

Evaluation of Toxicity: Evaluation of LC₅₀, LD₅₀.

(12 lectures)

UNIT-IV

Toxic Chemical in the Environment: Metals and other inorganic contaminants; Organic contaminants; Fate of organic contaminants; Pesticides; Biochemical aspects of Arsenic, cadmium, lead, mercury, carbon monoxide, ozone and PAN Pesticides; Insecticides, MIC, Photochemistry of Brominated Flame Retardants (BFR)

(12 lectures)

Practical

1) Semi-micro qualitative analysis (using H2S or other methods) of mixtures - not more than four ionic species (two anions and two cations, excluding insoluble salts) out of the following:
   Cations: NH₄⁺, Pb²⁺, Bi³⁺, Cu²⁺, Cd²⁺, Fe³⁺, Al³⁺, Co²⁺, Ni²⁺, Mn²⁺, Zn²⁺, Ba²⁺, Sr²⁺, Ca²⁺, K⁺
   Anions: CO₃²⁻, S²⁻, SO₂⁻, S₂O₃²⁻, NO₃⁻, CH₃COO⁻, Cl⁻, Br⁻, I⁻, NO₃⁻, SO₄²-, PO₄³-, BO₃³-, C₂O₄²-, F⁻
2) Estimation of total hardness of a given sample of water by complexometric titration.
3) Determination of COD.
4) Determination of DO.
5) Determination of BOD.
6) Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps
   (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH-meter.
   a) Preparation of buffer solutions
   b) Measurement of the pH of buffer solutions and comparison of the values with theoretical values.
7) Salicylic acid by green approach (using ceric ammonium nitrate).
8) Report on Minamata disease
9) Report on Itai-Itai disease

Suggested Readings
Paper IV: Solid Waste Management and Techniques

Objective: To acquaint the students with the common municipal solid wastes, their characteristic and the chaos caused by these wastes in the environment and to study the latest technologies to dispose of such wastes.

UNIT- I
Waste generation, Need and requirements for management and planning Solid waste- types, generation trends, quality and quantity aspects
Types of solid waste – Municipal waste, urban -., rural - and industrial wastes,
Integrated Solid waste Management;
Solid waste characterization: ultimate and proximate analysis;
Waste reduction at source, volume reduction
Collection techniques. Transport of solid waste and its optimization, transfer stations

UNIT- II
Hierarchy in waste management
Materials recovery/recycling; - Recycling of Aluminum, glass, plastic and, paper
Treatment and disposal techniques - Burning, Open dumping,
Landfill: landfilling methods and operation
Landfill liners: clay, Geo-membrane, HDPE, Geonet, Geotextile
Protection at disposal sites Landfill closure methods and operations

UNIT- III
Composting, Vermi-composting, Incineration
Energy from Waste: Pyrolysis, Gasification, Refuse derived fuels, Biogas
Merits and demerits of waste disposal methods
Role of GIS in Waste Management

UNIT- IV
Municipal Waste (Management and Handling) Rules 2000
Impacts of landfill on environment
Landfill emissions: Leachate and Landfill gas
Leachate collection & analysis
Landfill gas management

Practical
1. A visit to Composting/Vermicomposting Unit/RDF plant/Sanitary landfill
2. Ultimate analysis of Solid waste
3. Recycling of paper
4. To prepare a list of materials from municipal waste stream that can be reused /recycled
5. Practice exercises on computer related to handling of data
6. To determine moisture content of sample
7. To determine the pH of the given sample.

Suggested Readings
Paper I: Biodiversity and Conservation

Objective: To acquaint the students with the basic and applied aspects of protecting biodiversity and conservation of natural resources, while providing for human needs

UNIT-I

Conservation Biology—What?

Concept of Biodiversity / Biological diversity: Where is the World’s Biological Diversity Found; levels of diversity; alpha, beta and gamma diversity, and their measurement;

Valuing Biodiversity: Ecological Economics and Direct Use Values; Indirect Use Value; Ethical Values

Biodiversity Hotspots – concept and a brief account; Biodiversity hotspots of India: a short account

(12 lectures)

UNIT-II

Threats to Biological Diversity: Extinction; Vulnerability to Extinction; Habitat Destruction, Fragmentation, Degradation, and Global Climate Change; Overexploitation, Invasive Species, and Disease

Endangered and threatened species: IUCN Categories of Extinction; Endangered and threatened animals and plants (of India);

Biodiversity conservation: Ex situ and In situ conservation Strategies

Concept of Protected Areas: National Parks, Wildlife Sanctuaries, Biosphere Reserves; Managing Protected Areas; Conservation Outside Protected Areas; Restoration Ecology (A brief account)

(12 lectures)

UNIT-III

Conservation: Concept, objectives and aims; Renewable and non-renewable resources; Policies and strategies of Conservation

Conservation of Mineral Resources: Demographic quotient, depletion curves.

Conservation of Forests: Plantation programmes in India; Joint Forest Management, Forest Conservation Act

Conservation of Soil: Reasons of soil degradation, Role of soil micro-organisms; Reclamation of Alkaline and Saline soil

(12 lectures)

UNIT-IV

Conservation of Agriculture: Conservation of arable land, Conservation of crop genome, Environmental hazards of pesticides - their impact on life and life support system; Role of botanicals and natural plant products in crop protection; Integrated approach of pest and weed management


Conservation of Deserts: Strategies for conservation of wastelands and desert.

Wildlife Conservation: Preservation of Breeding Stock; Artificial stocking; Wildlife Protection Act

(12 lectures)

Practical

1. To calculate index of diversity, richness, evenness and dominance of species.
2. Assignment on biodiversity (to be assigned by the instructor)
3. To undertake a field visit to understand the concept and consequences of soil degradation
4. To study different types of plantation systems.
5. To prepare a list of wild and cultivated varieties of cereal crops commonly used in adjoining areas of Chandigarh.
6. To prepare a list of plants which are the sources of botanicals?
7. To make a list of various botanical pesticides available in the market

Suggested Readings


Paper II: Environmental Analysis: Techniques and Instrumentation

Objective: To upgrade the students with knowledge on instrumental techniques of chemical analysis, practical work with the realistic samples from the environment so that they could become familiar with the instrumentation this is inevitable for contemporary investigations of environmental pollution.

UNIT-I
Concept of accuracy, precision and error, Sample preservations, handling of samples and chemical in lab, Sample handling of Volatile and non-volatile organic compounds, pH metry, Solvent partitioning, Titrimetry, (12 lectures)

UNIT-II
Instrumentation and analytical methods involved in the following techniques and their applications in environment: Colorimetry, Spectrophotometry, Fluorescence Spectroscopy, Visible, Atomic and Infrared spectrometry, Flame photometry, Atomic Absorption Spectroscopy. (12 lectures)

UNIT-III
Chromatography, Gas Chromatography, HPLC, Supercritical Fluid chromatography, Reverse phase liquid chromatography, Electrophoresis: Capillary, X-ray diffraction, X-ray fluorescence, Bomb colorimetry, Mass Spectroscopy. (12 lectures)

UNIT-IV
Handling of radioactive and hazardous samples, Determination of radionuclide in the environmental samples: Utilization of different techniques for analysis of Polycyclic Aromatic Hydrocarbons (PAHs), Pesticide residues, Polychlorinated Biphenyls in the Environment Management of chemicals and waste generated in labs, safety measures while handling chemicals and instruments, familiarity about various symbols used on the bottles of chemicals etc. (12 lectures)

Practical
1. Preparation of a standard solution and standard curve in lab
2. To analyse the moisture content of a sample using gravimetry
3. Analysis of sample using titrimetry.
4. To analyse the pH of a sample
5. To analyse the sample Using Spectrophotometry
6. A visit to different labs to demonstrate the functioning of instrumentation as listed in the syllabi.
7. Separation of mixtures by Chromatography: Measure the Rf value in each case (combination of two compounds to be given) (a) Identify and separate the components of a given mixture of two amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography
8. Identification of organic compounds containing simple functional groups (alcohols, carboxylic acids, phenols and carbonyl compounds etc)
9. Extraction of various compounds by Soxhlet apparatus.
10. Sample analysis using flame photometer.
Suggested Readings


Paper III: Environmental Pollution

Objective: The students shall be equipped with the knowledge of different types of pollution; their sources and intensity and its consequence on man animal plants and monuments over a period of time.

UNIT-I


Indoor Air Pollution: Indoor air pollutants; Pollutants in the homes and work places, kitchen, living rooms. Control of indoor air quality

(12 lectures)

UNIT-II

Water: Types, sources and consequences of water pollution. Physico-chemical and bacteriological sampling and analysis of water quality; testing - turbidity, DO, pH, conductivity etc. The Water (Prevention and Control of Pollution) Act of India

Marine: Sources of marine pollution and control. Criteria employed for disposal of pollutants in marine system – coastal zone management

(12 lectures)

UNIT-III

Soil: Physico-chemical properties, sampling and analysis of soil quality; Industrial waste effluents and heavy metals, their interactions with soil components; Different kinds of synthetic fertilizers and their interactions with different components of the soil. Degradation of different pesticides in soil. Control of Soil Pollution; Phyto-remediation

Thermal Pollution: Sources and its impact on environment.

The Environment (Protection) Act 1986

(12 lectures)

UNIT-IV


Biological: Bio-pollutants- seeds, spores, bacteria, viruses trichomes

Microbial Pollutants and Sanitation: Bacterial, Viral, Mycoplamic pollutants interfering biological processes, man, plants and animals; Means of safety against them; Sanitation and Hygiene

(12 lectures)

Practical

1. To determine air pollutants from different locations (less polluted, heavily polluted) of city.
2. To study various Physico-chemical properties of water – pH, conductivity, total hardness, alkalinity
3. To determine various physico-chemical properties of soil collected from polluted and non-polluted areas: Soil pH, conductivity, bulk density, organic carbon and organic matter.
4. To study some bio-pollutant weeds like Parthenium, Ageratum or Eucalyptus plantations
5. To study the Impact of Urban air pollution.
6. Assignments/project as assigned by the teacher

Suggested Readings

Paper IV: Environmental Impact Assessment and Auditing

Objective: To acquaint the students with importance of Environment Impact assessment and various methodologies of impact assessment and auditing.

UNIT-I
Introduction to Environmental Impact Assessment, Environmental impact statement & environmental management plan, Strategic Environmental Assessment (SEA). EIA guidelines: notification of the Government of India, 2006; various appendices and forms for application.

UNIT-II
EIA in project planning and implementation; Component of EIA, EIA Methodology: Project screening, scoping, base-line data, impact identification; prediction, evaluation, Significant environmental impacts, stages of environmental impact analysis, mitigation, Public consultation, presentation, review and decision making, Checklist for EIA.

UNIT-III
Introduction to Environment Auditing, objectives of auditing, Environmental audit process, steps in environmental auditing, Benefits of auditing, Environmental Clearance, Types of Project activities requiring Environmental Clearance, Procedure of Public hearing, Composition of EAC, SEAC Influence of EIA on projects and organizations, Benefits and future of EIA, Generic structure of EIA Document.

UNIT-IV
Mitigation of Impacts, Measurement of environmental impacts, Impact assessment methods adhoc method, Overlay method, matrix and network method
Water quality impact analysis, Air quality impact analysis
Role of GIS in EIA
Case Studies: Construction project, Hospitals

Practical
1. Preparation of Public hearing notices
2. Project report on EIA
3. Prepare an environmental audit of hostel / institute / city
4. Assignments as suggested by teacher

Suggested Readings
SEMESTER III

Paper I: Environmental Technology

Objective: To acquaint the students with latest environmental technology on how to combat with common environmental issues and related problems without altering the natural environmental conditions.

UNIT-I

Scope, Purpose and Objectives of Air Quality Monitoring Programme; Guidelines for planning a survey; Period, frequency and duration of sampling; Averaging times; Sample size determination; Principles and instruments for measurement of – (i) ambient air pollutants; and (ii) stack emissions (monitoring).

(12 lectures)

UNIT-II

Meteorology and Dispersion of Pollutants: maximum mixing depth, lapse rate, stability conciliations, plume behaviour, calculation of effective stack height, Control of Stack gas emissions: General methods of control of Gaseous pollutants Control of Mobile Source Emissions. Automobile Exhausts, Type of pollutants: Indian auto emission standards: Problems associated with automobile pollution;

(12 lectures)

UNIT-III


(12 lectures)

UNIT-IV

Industrial Effluent Treatment: Standards of Stream, River and industrial discharge; Disposal of industrial wastes-on land, in creeks / sea / in inland streams/ impoundments; Importance of planning location of industries and industrial estates; Common Effluent Treatment plants, their economics and management. Sewage Treatment: Pre-treatment, Primary- secondary and tertiary treatment methods; Physical, chemical and biological methods of treatment.

(12 lectures)

Practical

1. To study the different methods of air monitoring
2. To study the different methods of water sampling
3. A visit to nearby Sewage Treatment Plant
4. A visit to nearby Effluent Treatment Plant
5. Ambient air monitoring for SO₂, NOₓ, CO, SPM
6. Case study of thermal power plants
7. Project work as assigned by the teacher

Suggested Readings

India, 2000.

Paper II: Regional and Global Environmental Issues

Objective: To provide assessments of the current status and trends in major developmental and environmental issues at the national, sub regional, regional and global levels.

UNIT-I
Major Environmental issues, Stockholm conference, Creation of UNEP and its role; World earth summits; Agenda 21, Convention on Biodiversity; Convention on Climate Change, CoPs; Climate Change and Global Warming; IPPC and its reports (a brief account). (12 lectures)

UNIT-II
Human Population and its implications: Impact of population explosion on the environment; PAT Formula; Population Regulation; Indian census; Problems of slums in urban cities, Environmental factors of Cancer and AIDS: Descriptive and analytical markers and indicators of pollutants in the body; Smoking and its impact on environment . (12 lectures)

UNIT-III
Stratospheric Ozone depletion, Ozone hole, history, reasons and Impacts on Biota; Concept of carbon trading; carbon credits; Ecological Footprints; Carbon Footprints; Basics of CDM, Green Buildings (12 lectures)

UNIT-IV
Food additives and Preservatives, Food Allergens, New emerging diseases (a brief concept), Water-borne, air borne, vector-borne, genetic, contagious and non-contagious diseases; Sanitation measures to control infectious diseases; Bio-terrorism and Eco-terrorism; Scheme of labeling of environmentally friendly products (Ecomark) (12 lectures)

Practical
1. To prepare a list of preservatives and additives used in candies, chocolates and toffees, curd, yoghurt and processed cheese available in the market.
2. To prepare a profile of smokers and analysis in terms of: Type of products like cigarettes, Bidis and Cigars, Number of persons in the family, Health effects, Number of cigarettes per person
3. Project file on a global environmental issues
4. To prepare a list of various eco-terrorism and bioterrorism events
5. To calculate the carbon footprint of some anthropogenic activities
6. Enlist various green buildings in India and world

Suggested Readings

Paper III - Environment and Energy Management

Objective: To provide the students with information on how to manage the natural resources on a sustainable basis, reducing the threat of degradation, and conforming to various environmental regulations.

UNIT-I
Environmental Economics and Management: Planning Levels, physical planning and development Cost-Benefit analysis, methods of economic evaluation of intangible environmental resources; contingent method, travel cost, opportunity cost concept of consumer behaviour, environmental consumerism
Disaster Management: Definition, nature, types and classification of disasters, risk analysis; Disasters - causes and effects; Factors affecting damage- Type, scale, population density, socio-economic status of population, Factors affecting mitigation measures- Prediction, preparation, communication, aerial extent, accessibility, population density
(12 lecture)

UNIT-II
Planning for disaster mitigation
Floods – River flooding, flood plains, drainage basins, nature and frequency of flooding, flood hazards, urbanisation and flooding, flood hydrographs, flood plain management and control.
Land slides – causes, human use and land slide analysis, determination of stability and safety factor.
Earth quakes – causes, intensity and magnitude of earthquakes, geographic distribution of earthquakes zones, seismic waves, travel-time and location of epicenter, nature of destruction, quake resistant buildings and dams.
(12 lecture)

UNIT-III
Watershed Management: Definition, concepts, principles; Classification by size; Rainfall and runoff; Water balance approach; Water budgeting; Topographic surveying; Water conservation and harvesting methods - Importance and techniques of Rain Water Harvesting; Agriculture and Water management- Participatory Rural Appraisal in watershed Programmes.
Energy Environment: Fossil fuels – classification, composition, physico-chemical characteristics and energy content of coal, petroleum and natural gas.
(12 lectures)
UNIT-IV

Principles of generation of hydroelectric power, tidal, wind, nuclear energy– fission and fusion, bio-energy– energy from biomass and biogas

Sun as source of energy; solar collectors, solar ponds (12 lectures)

Practical

1) Environment Protection movement (like Chipko and Narmada Bacho Andolan etc.)
2) NGT working and significance
3) Functioning of various Departments and Ministry in Environment promotion and protection.
4) Taj Mahal protection and its guidelines
5) Survey on environment related issues in surrounding
6) Preparation of questionnaire on environment related issues.
7) Cost benefit analysis of local area and assessment.
8) Biogas plant
9) Energy source location and working (coal or solar power plants)
10) Data analysis.
11) Field Visit

Suggested Readings
Paper IV: Industrial and Biomedical Waste Management

Objective: To acquaint the students to understand the difference in perception of hazardous and biomedical wastes management, applications and their limitations.

UNIT-I
Electronic waste, types and Management
E waste management and handling rules, 2011
Radioactive waste and its Management
Types and Environmental problems of hazardous wastes: Lead and Mercury poisoning
Hazardous wastes Generation, collection, segregation

(12 lectures)

UNIT-II
Hazardous wastes treatment, transport and disposal Waste destruction, separation and Immobilization Technologies
Industrial Effluent Treatment: Standards of Disposal of industrial wastes, Importance of planning location of industries and industrial estates; Common Effluent Treatment plants,
Basic Considerations of Wastes from Industries like textile, pulp and paper, distilleries, dairy, food processing, cement,

(12 lectures)

UNIT-III
Biomedical waste: Introduction: definition, Classification, types and composition, Types of solids, liquids, sharps, blood and blood tissue, radioactive material, biological and chemical material
Documentation of Biomedical waste types and guidelines
Storage of hospital waste; Types of bags and containers used for storage; Segregation of biomedical waste into different type; Handling and transport of hospital waste
Transport of medical waste: Authorization and accidental spilling reporting

(12 lectures)
UNIT-IV
Biomedical waste treatment/disposal methods: Incineration, autoclaving, microwave radiations, chemical treatments
Biomedical Waste Treatment Facility: record keeping, collection, transport and storage facilities

Hospital Effluent treatment plant: Its structure and Functioning
Hazardous waste (Management and Handling) Rules; Bio-medical wastes (Management and Handling) Rules; Green Hospitals
(12 lectures)

Practical
1. Survey of the town to make a list of various clinics / nursing homes / tertiary medical care centres / dispensaries / health care centers / multi-specialty hospitals and medical centres
2. Sterilisation using autoclave
3. Role of color coding in BMW management
4. Data on the various methods of handling and transport of hospital wastes in the city
5. A visit to the Hazardous waste Generation or disposal site.
6. Visit to University health centre/dental institute to study Biomedical waste management practices.
7. Preparation of Project report based on a case study of one hospital
8. Prepare list of E-waste and components
9. A visit to the Incinerator plant.

Suggested Readings
5. Williams, P.T. Waste Treatment and Disposal. John Wiley and Sons, USA. 2005
SEMESTER IV

Paper I Statistical Applications and Research Methodology

Objective: To acquaint the students with fundamentals of statistics and research methodology.

UNIT-I
Basic Statistics: Objectives and applications in environmental sciences; Collection, compilations and presentation of data; Basic tools of statistical analysis; Central tendency: mean (arithmetic), median and mode; Measures of variation (standard deviation and standard error); Probability; Distribution – Normal, t and chi square, Poisson and binomial; Moments, matrices, simultaneous linear equations
(12 lectures)

UNIT-II
Statistical Analysis: Tests for comparing means of one and two-samples; Analysis of Variance (one-way); Tests of hypothesis and significance (Null hypothesis); Regression Analysis; Chi square test
(12 lectures)

UNIT-III
Environmental system analysis: Approaches to development of models; linear simple and multiple regression models; models of population growth and interactions: Lotka-Volterra model, Leslie’s matrix model, Point source stream pollution model, Gaussian plume model
(12 lectures)

UNIT-IV
Research Methodology: Basic principles of research design; Significance of research design; Concept of research articles, research papers, reviews, scientific popular articles; Components of a Research Article (title, author-line, address, abstract, summary, hypothesis, keywords, introduction, methodology, observations, discussion, conclusion, citing relevant work of others); Reference styles; Copyright Act (in brief), Plagiarism, Cheating / academic frauds; process of reviewing; List of important journals in different fields of Environment; Concept of Impact factor; H-Index.
(12 lectures)

Practical
1. Collection of data
2. Calculation of mean, mode, median, standard error, standard deviation
3. Use of statistical softwares and their usage
4. Determination of F-value, t-value, one-way analysis of variance
5. Calculation of r value
6. Null hypothesis, Chi square test
7. Application of Duncan’s multiple range test; Dunnett’s and Tukey’s test

Suggested Readings
Paper II: Environmental Biotechnology

Objective: To acquaint the students with information on how to improve understanding, identification, and prevention of environmental problems, remediation & restoration through biotechnological methods.

UNIT-I
Bioremediation: Planning and management of bioremediation; In situ and Ex situ bioremediation; Constraints and priorities of bioremediation; Evaluating Bioremediation; Bioremediation of VOCs. (8 lectures)

Phytoremediation: Phytoremediation of xenobiotics and bioaccumulation of metals using plants. (4 lectures)

UNIT-II
Biodegradation: Factors affecting process of biodegradation; Methods in determining biodegradability; Contaminant availability for biodegradation. Xenobiotics; Persistence and biomagnification of xenobiotic molecules; Microbial interactions with xenobiotics; Phase I and Phase II reactions; Cytochrome P 450 mediated reactions; Xenobiotics and microbial biotransformation. Use of microbes (bacteria and fungi) and plants in biodegradation and biotransformation. (12 lectures)

UNIT-III
Biodegradation of petroleum constituents and associated heavy metal; Biodegradation of halogenated hydrocarbons; polycyclic aromatic hydrogen; Pesticides and Detergents. Biosorption: Biotechnology and heavy metal pollution; Oil field microbiology; Improved oil recovery; Biotechnology and oil spills; Hydrocarbon degradation (12 lectures)

UNIT-IV
Biotechnology for Management of Resources: Role of environmental biotechnology in management of resources; Reclamation of wasteland; Biomass production; Biogas and biofuel production; Microorganisms in mineral and energy recovery and fuel and biomass production. Application of Biotechnology in Environment. (12 lectures)

Practical
Based upon theory

Suggested Readings
Paper III Remote Sensing and GIS in Environmental Studies

Objectives: To introduce the students with the applications of Earth observation technology and Geoinformatics in environmental studies and research. This paper aims at developing students’ decision making capabilities for the management of environmental problems.

UNIT I
Fundamentals of Remote Sensing (12 lectures)
- Introduction to Remote Sensing: Meaning, Types and Applications
- Energy and radiation principles, Electromagnetic Radiation (EMR)
- Energy-atmosphere and Energy-earth surface interaction
- Sensor Platforms, Scanning System, Resolution and Spectral signatures

UNIT – II
Fundamentals of Geographic Information Systems (GIS) (6 lectures)
- GIS: Concept, Significance, Components and Applications
- Spatial data base: Types and Representations
Fundamentals of Global Positioning System (GPS) (6 lectures)
- Concept and Principles of Operation, GPS Segment
- GPS Positioning, GPS Receivers, GPS Accuracy and GPS Applications

UNIT-III
RS & GIS in Environmental Management (12 lectures)
- Water Resources Monitoring: Water pollution; Water logging
- Hydrological and Morphometric Assessment
- Deforestation and Forest degradation; Forest fires
- Land use/cover Change Detection; Flood-plain Management

UNIT-IV
RS & GIS in Disaster Management (12 lectures)
- Disaster Management: Geoinformatics Perspective
- Hazard Analysis and Mapping
- Risk and Vulnerability Assessment
- RS & GIS in Landslide Hazard, Flood hazard and Earthquake Hazard Analysis

Practical
1. Analysis of Spectral Signatures of surface features
2. Interpretation of Satellite Image
3. Digitization of Raster Map: Point, Line and Polygon Features in GIS Environment
4. Preparation of Attribute Table, Table Joining & Data Import in GIS Environment
5. Data Analysis, Classification and Layouts in GIS Environment

Paper IV: Training, Project report, Presentation (50 + 50 + 25 =125 marks)

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