

SYLLABUS
M.Sc. Environmental Sciences
First Semester

PAPER – 101: ECOLOGICAL PRINCIPLES AND APPLICATIONS

Unit-I: Principles of Ecology:

Definition Principles and Scope of Ecology – Energy Flows, Ecological Pyramids, Types and Diversity, Food Chains and Food Webs. Homeostasis – Theories of Limiting Factors- Ecological Succession – Population and Communities- Reproductive Strategies- r and k Factors. *Community Ecology*- Structure, Species Diversity and Species Interaction.

Unit-II: Ecosystem Ecology:

Ecosystem- Structure- Components (Abiotic and biotic) and Functions of an Ecosystem. *Ecosystem Types and Diversity*- Terrestrial and Aquatic (Fresh water and Marine) Ecosystems. Ecotones - Concept of Edge Effect, Ecological Niche- Classification Biomes - General Relationships Landscapes and Biomes – Climatic factors - Bio-geographical Regions of the World and Modern Biogeography.

Unit-III: Ecological Imbalances:

Human Ecology and Human Settlements- Evolution, Origin of life and Speciation - Population growth- Ecological Imbalances – Resources shortage – Earths carrying capacity – *Man Engineered Ecosystems* - Agriculture – Agro forestry – Biosphere Concept – Man and Biosphere – Future of the Biosphere.

Unit-IV: Ecological Applications:

Sustainable Development- Ecological Sustainability- Organic Farming, Bio fertilizers and Bio pesticides - Integrated Pest Management (IPM) - Biological Monitoring of the Environment- Indicator species - Ecosystem Development- Theory of Human Ecology- Ecology of Space Travel- Types of Life Supporting Systems- Exobiology.

PRACTICALS:

A. Ground Vegetation Analysis (*Quadrat Sampling*)

1. Fixation of minimum size of Quadrates
2. Fixation of minimum number of Quadrates
3. Determination of Frequency
4. Determination of Density and Abundance
5. Determination of Dominance
6. Importance Value Index (IVI)

B. Aquatic Ecology (*Lake and Pond Ecosystems*)

1. Hydro biological Characteristics of a Lake Ecosystem.
(pH, Temperature and Dissolved Oxygen)
2. Estimation of Primary Productivity
3. Identification of Eutrophication Characteristics

C. Field Study / Visits (*Visiting different ecosystems*)

- a. Rocky and Sandy coast
- b. Hilly terrain
- c. Marshy swamp
- d. Backwaters
- e. Forest Ecosystem
- f. Lake Ecosystem
- g. Riverine Ecosystem
- h. Mangrove Ecosystem.

Books for References:

- ❖ Turk J and Turk A. 1984 **Environmental Sciences 3rd Edn.** Saunders College Publications.
- ❖ Odum E. P. 1971 **Fundamentals of Ecology 3rd Edn.** W. B. Saunders Company London.
- ❖ Kendeigh S. G. 1961 **Animal Ecology** Prentice- Hall Inc. Englewood Cliffs, N. J, U.S.A.
- ❖ Southwick C. H. 1972 **Ecology and the Quality of environment** D. Van Nostard Company, London.
- ❖ Edmund Hillary 1984 **Ecology 2000 The Changing Face of Earth**, Michel Joseph Ltd. London.
- ❖ Sharma P. D. 1994 **Ecology and Environment Rastogi Publications.** Meerut.
- ❖ Santra S. C. 2001 **Environmental Sciences** New Central Book Agency (P) Ltd. Calcutta.

PAPER – 102: ENVIRONMENTAL SYSTEMS ANALYSIS AND BIOSTATISTICS

Unit-I: Introduction to Environmental Systems Analysis

Concepts, Definition and Scope – Formal basis of Systems Analysis – Types of problems and types of systems – Systems diagrams and concepts – *Systems Classification*: Weaver's, Chorley and Kennedy's, Miller's classifications – *Mathematical Modeling*: Nature and goals of Mathematical Models, Basic elements and tools, Anatomy of Mathematical Models, Analysis of Model properties, Approaches to development of Models- *Principles and Applications of Mathematical tools*: Coordinates, Functions, Differentiation, Derivatives, Successive differentiation, Maxima and Minima – *Matrices*: Simulations linear equations by Matrices.

Unit-II: Methods of Systems Theory Control and Planning.

'Methods' perspective for spatial analysis – Systems methods and spatial analysis – Mathematical representation – *Some Standard Methods*: Entropy maximization and Accounts based models in disorganized complexity – Optimum methods – *Control and Planning*: Definitions, Scope – *Aspects of control*: state, Law of requisite variety – Central nervous system as a 'model' for control systems – *Aspects of planning*: Basic concepts – Frame work and tools for planning: Cooperate planning, Lange Lerner planning.

Unit-III: Environmental Systems and Some Standard Examples

Ecological Systems: Models of population growth and interactions – Lotka-Volterra Model, Leslie's Matrix Model – Systems analysis of Moorland Ecosystems.

Water Resource Systems: Description and basic concepts – Point source stream pollution model, a basic Optimization Model, Optimization and Pollution Control.

Atmospheric Systems: Description and basic concepts – Box Model, Gaussian Plume Model, Source Emission determinations from ambient tools.

Urban Systems: Description and basic concepts – State of art of urban models – Spatial interaction model – Future developments in urban modeling.

Unit-IV: Biostatistics:

Basic elements and tools of statistical analysis: Measures of central value, Measures of Dispersion, Arithmetic, Geometric and Harmonic means. Distribution – Normal t and χ^2 Poisson and Binomial, Correlation and Regression Analysis. Tests of hypothesis and significance- Probability.

Sampling types: Selective sampling, Random sampling and stratified random sampling. Sampling design, Sample size determination and limitation of sampling. Types and uses of statistical diagrams and graphs.

PRACTICALS:

1. *Site Mapping*: Determination of points and objects – area and area classification
2. Water courses Mapping
3. Graphic Models for Niche breadth and overlaps
4. *Evaluation of Ecological variables*: Correlation and regression analysis
5. *Population Models*: Determination of growth rate and doubling time
6. *Population Model*: Leslie's Matrix Model
7. *Air Pollution*: Box Model
8. *Air Pollution*: Statistical Model
9. *Water Pollution*: Point Source Pollution in stream- QC Model
10. Compartment Model
11. *Urban Transport*: Disorganized complexity and Entropy Maximization Model
12. Basics of Computer Applications.

Books for References:

- K.E.F. Watt (1966): **Systems Analysis in Ecology**. Academic Press, New York.
- I. Chaston (1971): **Mathematics for Ecologists**. Butter Works, London.
- E.P. Odum (1971): **Fundamentals of Ecology**. W.B. Saunders Co., London.
- B.C. Patten (1971): **System Analysis and Simulation in Ecology. (2 Vols.)**, Academic Press, New York.
- R.V. Thomann (1972): **Systems Analysis and Water Quality Management**. McGraw – Hill Book Company, New York.
- R.W. Poole (1978): **An Introduction to Quantitative Ecology**. McGraw Hill Inc., Tokyo.
- A.G. Wilson (1981): **Geography and Environment: Systems Analytical Methods**. John Wiley and Sons, New York.

PAPER – 103: ENVIRONMENTAL MICROBIOLOGY AND SANITATION

Unit-I:

Microbial groups: Bacteria, Fungi, Algae, Viruses, and Protozoa; their place in the classification of living world; their biology, nutrition, metabolism and reproduction – (*General Treatment*) *Culturing of Microorganisms:* Types and composition of culture media and sterilization – *Environmental Selecting factors:* Physical factors (Temperature and light, Osmotic pressure, Hydrostatic pressure), Chemical factors (pH, O₂ and CO₂), *Diversity of Microbial Habitats:* (Air, Soil and Water), their general physical features.

Unit-II:

Microbial Interface – Competition for nutrients, Oxygen, Space, Antibiosis (antibiotic and bacteriocins); Intermicrobial relationships – symbiotic relationships (mutualism, commensalisms and parasitism), Lichens, Lysogeny, Paramecium-Chlorella association, Bacteria-Bdellovibrio-Virus association, Myco-Viruses, Cyanophages, Extramicrobial relationships – Microbial – ruminant association, Microbial-Insect associations, Microbial-Higher plant associations (Mycorrhiza, Rhizobium-Legume association), Microbial (bacterial, fungal and algal) toxins and their role in environment.

Unit-III:

Role of microbes in: Nitrogen, Sulphur, Phosphorus and Iron cycles – Microbes in the recovery of minerals (bioleaching of minerals) - *In energy production:* (Methane); Microbial biomass or single cell protein production – *Indicator organisms:* Sanitary examination of water - IMVIC test – *Environmental Biotechnology:* Fermentation technology – Vermiculture technology and Bio-fertilizer technology.

Unit-IV:

Human body as a habitat for microbes: Body defensive mechanisms, *Concepts of epidemiology of human microbial disease:* Epidemics, Pandemics, Disease triangle – *Sources of environmental pathogens:* Living reservoirs, inanimate reservoirs, Modes of pathogen transmission (direct transmission and indirect transmission), Transmission through food, water, air and biological vectors – *Some common diseases of humans:* *Bacterial:-* Boils and Carbuncles, 'Strep' sore throat, Pneumonia, Tuberculosis, Cholera, Salmonellosis, Typhoid fever, Anthrax, Brucellosis, Plague, Gonorrhoea, Syphilis - *Viral:-* Smallpox, Poliomyelitis, Measles, Hepatitis, Encephalitis, Rabies - *Fungal:-* Dermatomycoses, Systemic mycosis and *Protozoa:-* Amoebiasis, Malaria – Environmental Sanitation and Disease Control.

PRACTICALS:

1. Demonstration of air samplers used in microbial studies
2. Preparation of media for microbial growth
3. Techniques in culturing microbes
4. Microbial examination of potable waters:
(a). Detection of fecal pollution (E.Coli) (b). Standard Plate Count
 ©. Most Probable Number (MPN) of coliforms.
5. Gram staining
6. Identification of common pathogenic microbes:
(a). Salmonella (b). Vibrio sps. (c). Entamoeba sps.
(d). Shigella sps. (e). Mycobacterium sps. (f). Plasmodium sps.
7. Total Plate count of soil microorganisms
8. Isolation of Rhizobium sps. From root nodules
9. Microbial growth curves
10. Detection of microorganisms in spoiled foods (bread, rotten meat, fish, fruits etc..)

Books for References:

- Paul Edmonds (1978): **Microbiology: An Environmental Perspective**. Mac Millan Publishing Co. Inc. New York.
- Dart R. K. and Stretton R.J. (1980): **Microbiological aspects of Pollution Control**. Elsevier Scientific Publishing Company, New York.
- Atlas R.M. and Bartha R. (1981): **Microbial Ecology Fundamentals and Applications**. Addison Wesley Publishing Company, Massachusetts.
- Alexander M. (1977): Introduction to Soil Microbiology 2nd Ed., John Wiley and Sons, New York.
- Higgins I.J. and Bunns R.G. (1975): **The Chemistry of Microbiology of Pollution**. Academic Press, New York.

PAPER – 104: ENVIRONMENTAL POLLUTION AND INSTRUMENTATION

Unit-I: Fundamental of Environmental Chemistry

Stoichiometry, Gibbs energy, Chemical Potential, Chemical equilibrium, Acid base reactions, Solubility product, Solubility gases in water, The carbonate system, Unsaturated and saturated hydrocarbons, Radio nuclides, Concept of major trace and REE, Classification of trace elements, mobility of trace elements.

Unit-II: Atmosphere

Structure of Atmosphere: Temperature Profile – Influence of Meteorological factors on Air Pollution – *Air Pollutants:* Oxides of Sulphur – Oxides of Nitrogen – Carbon monoxide – Particulate matter, Dispersion and impacts – Photochemical smog – Green house effect – Ozone depletion – Acid Rains – Sources of noise pollution, measurement of noise and standards – impacts of Air Pollution on human health and structures.

Unit-III: Hydrosphere and Lithosphere

Classification of water and Water bodies – Abnormal properties of water – Water cycle- Water Quality Parameters – Water Pollution – Sources – Classification, nature and *Toxicology of water pollutants:* Trace metals – Lead – Mercury – Zinc – Cadmium – Organic substances - Pesticides – Oil surfactants – Nutrients – Phosphates – Nitrates – Eutrophication – Ground water pollution – Ocean Pollution by toxic wastes – Ecological and Economic impacts of water pollution.

Soil: Texture – Composition and distribution – Land use Classification and Patterns – Impacts of land use on soil ecology – Ecological and Economic impacts of soil erosion and soil pollution.

Unit-IV: Pollution Analysis and Instrumentation

Principles of Sampling of Air, Water and Soil: Samplers and Sampling Techniques – *Analysis of Pollutants:* Titrimetry – Gravimetry – Spectrophotometry – Chromatography and Flame techniques.

Instrumentation: Instruments for specific parameters – Principles and Applications of UV – VIS Spectrophotometer – Flame Photometer – Atomic Absorption Spectrophotometer – Gas Chromatography – GLC – HPLC – Instrumentation for Weather monitoring.

PRACTICALS:

1. **Soil Analysis:** Determination of soil types and texture, pH, Hydraulic conductivity.
Soil Moisture, Nitrogen, Potassium, Phosphorus and Organic matter.
2. **Water Analysis:**
 - (a). Determination of pH, Dissolved solids and Suspended solids, Dissolved Oxygen, COD, BOD, Alkalinity / Acidity, Nitrogen, Phosphorus and Potassium.
 - (b). Determination of Chromium and Zinc by Spectrophotometer.
3. **Solid Waste Analysis:** Characteristics of Waste.
4. **Liquid Wastes:** Characterization and suggesting Treatment Plan.
5. **Visits** to Industrial establishments to know more about pollution devices and pollution management.

Books for References:

1. Laurent Hodges – **Environmental Pollution**
2. C.S. Rao – **Environmental Science and Engineering**
3. Moore and Moore – **Environmental Chemistry**
4. H.C. Perkins – **Air Pollution**
5. M.N.Rao and A.K.Datta – **Waste Water Treatment**
6. Brady – **The Nature and Properties of Soil**
7. Willard, Merritt and Dean – **Instrumental Analysis**
8. APHA – **Analysis of Water and Waste Water**
9. JOM Bockins – **Environmental Chemistry**
10. H.C. Stern – **Air Pollution (Volumes I – IV)**
11. E.P. Odum – **Fundamentals of Ecology.**

Second Semester

PAPER-201: ENVIRONMENTAL PROBLEMS AND ECOFRIENDLY SOLUTIONS

UNIT – I: Environmental Education and Awareness

Environmental education and awareness; the environmental paradox; Ethics of Environment; *Outdated ethics* – The purpose ethic. The myth of super abundance, Dilution is not the solution. The idea of progress; *Updated ethics* – Attitude for survival, Reverence for all life, the right of existence for all environments, according the highest priority to environmental quality. *Environmental problems*: Understanding the nature of environmental problems and identifying the causative factors.

UNIT – II: Global Environmental Problems - I

1. *The threat to the Ozone layer* – National Ozone destroyers, Anthropogenic Ozone destroyers, Nuclear war and the Ozone layer, Supersonic transport and the Ozone layer, CFC's and the Ozone layer, Agricultural fertilizers, nitrous oxide and Ozone layer, Antarctica Ozone hole, The Montreal Protocol, Ozone depletion and related environmental problems, Eco friendly solutions and technologies.
2. *The greenhouse effect* – The carbon cycle and the greenhouse effect, Rising levels of carbon dioxide and temperature change, the contribution of other green house gases, Environmental and socio-economic impacts of increasing greenhouse gases, Global warming and related environmental problems, Eco friendly solutions and technologies, The Kyoto Protocol.

UNIT – III: Global Environmental Problems - II

- 1 *Atmospheric turbidity (atmosphere aerosols)* – Aerosol types, production and distribution, Aerosols and radiation, volcanic eruptions and atmospheric turbidity, volcanic activity on weather and climate. The human contribution to atmospheric turbidity. The atmospheric turbidity and related environmental problems, Cooling or Warming? Eco friendly solutions and technologies.
- 2 *Acid rain* – The nature and development of acid rain, the pH scale, The geography of acid rain, Acid rain and geology, Acid rain and the aquatic environment, Acid rain and the terrestrial environment, Acid rain and the built environment, Acid rain and human health, Eco friendly solutions and technologies.

UNIT – IV: Environmental Problems of India and some Ecofriendly Solutions:

Over population, Food security, Health security, Energy security, Environmental security, Negative side of green revolution, Desertification, Deforestation.

BOOKS RECOMMENDED:

1. Kemp D.D. 1990. Global Environmental Issues, A Climatological approach, Routledge, London.
2. Disaster Management: A disaster Manager's Handbook, ADB Publications, 1991.
3. Gopal Bhargava 1992. Environmental Challenges and Ecological Disasters, Mittal Publication, New Delhi.
4. Petak W.J and A.A. Atkisson 1982. Natural Hazard Risk Assessment and Public Policy – Anticipating the Unexpected Springer series on Environmental Management Springer – Verlag, New York.
5. Planning for human Settlement in Disaster Prone Areas, UNCHS – Habitat, 1983.
6. Santra S.. 2001. Environmental Science, New Central Book Agency (p) Ltd., Calcutta.
6. Sharma B.K and H. Kaur. Environmental Chemistry. Goel Publishing House, Meerut, 1997.

PAPER – 202: ENERGY RESOURCES AND ENVIRONMENT

UNIT – I: Energy Resources and Conservation

Energy forms, Laws of Conservation of Energy, Energy resources classification, Cultural changes and energy consumption patterns, solar radiation and its spectral characteristics.

UNIT – II: Non-Renewable Energy Resources:

Fossil fuels (Coal, oil, natural gas, Tar sand and Oil shale) and environmental problems, Nuclear energy and environmental problems.

UNIT – III: Renewable Energy Resources (Non-biological):

Hydropower and environmental problems, Tidal energy and environmental problems, Wind energy and its limitations, Geothermal energy, Solar energy, Solar cells and Solar ponds.

UNIT – IV: Renewable Energy Resources (Biological):

Fuel wood and environmental problems, Bio energy (Energy plantations and Biogas), and Organic solid waste energy.

PRACTICALS:

1. Enumeration of fuel wood species in a locality
2. Listing of Fossil fuels and related pollution problems
3. Listing of hydrocarbon plant species
4. Conversion of sea water into fresh water by using sunlight
5. Examination of biogas plant designs
6. Field visits to biogas plants
7. Electricity Diary
8. Energy Bill
9. Energy Audit
10. Fuel consumption pattern in different classes of an urban society

BOOKS RECOMMENDED:

- Encyclopedia of Environmental Sciences – Environmental Energy Resources, R.P. Trivedi and Gurudeep Raju, Vol. 7.
- Living in the Environment, G. Tyler Miller, Jr. 1996. Wadsworth Publishing Company, California.
- Renewable Energy Sources and their environmental impact, S.A. Abbasi and N. Abbasi 2002. Prentice’Hall of India, New Delhi.

PAPER – 203: BIODIVERSITY CONSERVATION AND MANAGEMENT

UNIT – I:

Introduction; Definition and concepts. *Significance of Biodiversity*: Ecological, Economical and Aesthetic importance.

Biogeographical regions of the World, Distribution of world climatic regions and Vegetation types, distribution pattern of flora and fauna at Latitudes and Altitudinal; Patterns of species diversity, species importance, species area relationships, theories of species diversity, Equilibrium theory, Biodiversities of Tropical and Temperate regions.

UNIT – II:

Measures of Biodiversity: Indices of diversity; Evenness Index, Shannon Wiener's Index of Diversity, The Simpson Index, *Estimating the diversity of large community*: Marglef's Index diversity, Similarity Index, Bray- Curtis measures (B), Morisitas's Index of similarity. Hierarchical diversity. Diversity on Environmental gradients- Alfa Beta and Gamma diversities.

UNIT – III:

Communities and Environment: Classification of Communities; Community structure and composition, *comparing zone patterns in different communities* - Diversity of habitats; Varying in structure, Climatic stability, and productivity. *Determinants of diversity*: local and global factors, the co-existence of competitors and diversity in heterogeneous habitats.

UNIT- IV:

Conservation and Management: Conventions on Biological diversity, Aims and Objectives, *Conservation strategies and legislations* - Forest and Environment Protection Acts, Wildlife (Protection) Act 1972, Biosphere reserves, National Parks, and Wildlife Sanctuaries, National Wildlife Action Plan, Man & Biosphere Programmes, conservation movements, Remote Sensing applications in Measuring Biodiversity. Introduction to Gene pools in forestry - Biodiversity Act, 2002 – Biodiversity Trade – Biopiracy issues.

PRACTICALS:

1. *Vegetation Analysis:*
 - a) Frequency
 - b) Abundance and Density
 - c) Cover and Basal area
 - d) Importance Value Index
2. *Vegetation Sampling*
 - a) Transects
 - b) Plot less Methods
3. Degree of Maturity of a plant community
4. Community Coefficients
- 3 Study of communities (Based of percentage, Density, Frquency, Basal area and size classes).
- 4 *Diversity Measure:* Shannon Wiener, Simpson and Brillouin's Index.
- 5 Listing of indicator species in a Forest, Ecosystem (Based on Field trip).
- 6 *Identification Techniques for wild fauna:*
 - a) Pug Marks
 - b) Hair sample
 - c) Faecal analysis
- 7 Diversity Measure of Birds fauna in different habitat conditions.
- 8 Listing of Threatened and Endangered Fauna in a Forest Ecosystem (Based on field trip)

BOOKS FOR REFERENCE:

1. Pianka, E.R. (1983). *Evolutionary Ecology* (Third Edition) Harper & Row Publishers, New York.
2. Mac Arthur, R.H. (1972). *Geographical Ecology: Patterns in the Distribution of Species*, Harper & Row Publications, New York.
3. Pielou, E.C. (1975). *Ecological Diversity*, A Wiley Inter Science Publications, John Wiley & Sons, New York.
4. Whittaker, R.H. (1975). *Communities and Ecosystems* (Second Editions) Macmillan Publishing Co., Inc.,m New York.
5. Samar Singh (1986). *Conserving India's Heritage*, Nataraj Publishers, Dehradun.
6. Frankel, O.H. and Bennett, E. (1970), *Genetic Resources in Plants. Their Exploitation and conservation*, I.B.P. Handbook No.11, Blackwell Scientific publications Oxford and Edinburgh.
7. Stracey, P.D. (1963) . *Wildlife in India – Its Conservation and control*, Ministry of Food and Agriculture, Govt. of India, New Delhi.
8. *The Wildlife (Protection) Act, 1972 (as Amended upto 1991)*, Nataraj Publications, Dehradun.
9. V.B. Saharia (1982). *Wildlife in India*, Nataraj Publishers, Dehradun.
10. B. Seshadri (1982), *Indian Wildlife Resources*, Sterling Publishers, New Delhi.
11. Subba Rao, M.V. 1993. *Bioresources, Conservation and Management*, Andhra University Press, Visakhapatnam.

204: REMOTE SENSING AND GIS APPLICATIONS

UNIT – I:

Definition and Overview of Remote Sensing and Remote Sensing Systems
Electromagnetic Radiation, terms and Definitions, Laws of Radiation, Electromagnetic Spectrum, Earth Observation Satellites (LANDSAT, SPOT, IRS etc) and their characteristics
Remote Sensing Systems – Active and Passive Systems, Imaging and Non Imaging System, Resolution – Spatial, Spectral and Temporal.

UNIT – II:

Spectral Response of vegetation. Spectral indices for vegetation analysis. Principles of visual interpretation of aerial photos and satellite imagery
Recognition Elements and interpretation keys for visual interpretation. Introduction to Digital image processing. Digital Data Formats. Fundamentals of Image Rectification and Registration.

UNIT – III:

Fundamentals of image Classifications - Satellite image interpretation (visual) of forest mapping - Satellite image interpretation (digital) of forest mapping - Fundamentals of GIS and its applications - Fundamentals of GPS

UNIT – IV:

Principles of inventory; sampling techniques - Preparation of Management Plan - Site suitability analysis - Sustainable management - Fire risk zoning – Vegetation change detection and monitoring - Microwave remote sensing - Wildlife habitat evaluation - Forest ecosystem analysis - Large scale mapping with GPS

PRACTIALS:

1. Study of Satellite Image Annotation (information) LANDSAT, SPOT and IRS
2. Study of Satellite data, identification and mapping of different surface features
3. Study of Ground Data collection instruments, Radiometers, Spectrometers etc.
4. Study of Satellite imagery (Black/White) in different bands and visual interpretation
5. Loading image data and display, identification of objects on video display, display of Histograms
6. Image enhancement techniques Contrast Enhancement, Band Rationing, Edge
7. Image Registration – Image to map, Image to Image, Image to user coordinates
8. Image classification techniques – supervised and unsupervised
9. Forest vegetation analysis & mapping using satellite images
10. Forest change detection
11. Site suitability analysis
12. GIS database creation

BOOKS RECOMMENDED:

- Jensen, JR.1996, Introductory Digital images processing: remote Sensing Perspective, (2nd Ed New Jersey: Pretince Hall).
- Lillesand, T.M., & Keifer, R.W.2000, Remote Sensing and Image Interpretation;(4th EdNew York:John Wiley&Sons).
- Richards, j.A., & Xiuping,Jail.1999,Digital image Analysis;(3rd Ed.New York:Springer).
- Wolf, PR.1974, Elements of Photogrametry,(New York;Mc GrawHill).
- Forestry and Ecology Division.1999, Manual on Biodiversity Characterization at Landscape of Remote Sensing).
- Champion, H.G.1968 Revised forest types of India
- Roy, PS,Ranganath,BK,Diwakar,PG,Bhan TPS,Singh.SK,1991,
- Tropical forest type mapping and monitoring using remote sensing. **Int. J. Remote Sensing**, 12(11) 2205
- Chacko, VJ. 1965. **A manual on sampling techniques for forest surveys.** (Govt. of India publications)
- Hamilinton, GJ. 1992. **Forest menstruation handbook**, (Delhi: Periodical expert book agency)
- Loetsch, F& Haller, KE. 1973. **Forest inventory.** (Muendhen: BL. Verlag-Gessellschaft)
- Food and agriculture Organization. 1984. **Land evaluation for forestry**, FAO, Rome
- Sing, IJ & Roy. PS 1990. Growing stock estimation through stratified random sampling, **Photonirvachak**, 18,29.

WEBSITES:

<http://www.ciesin.org>

<http://edcwww.cr.usgs.gov/landdace>

<http://daac.gsfc.nasa.gov>

<http://eosweb.larc.nasa.gov>

<http://ghx.insfa.nasa.gov>

Third Semester

PAPER-301: ECOTOURISM, ECORESTORATION AND SUSTAINABLE DEVELOPMENT

UNIT – I: Fundamentals of Ecotourism

Definition, historical background – Identification of potential sites for Ecotourism development - conventional and mass tourism, nature-based tourism, Role of parks and gardens in ecotourism – Communities involvement in Ecotourism development and management.

UNIT – II: Ecotourism Development and Management

Role of Photography and electronic media in ecotourism, Environmental Impacts, Measures for minimizing impacts, trends and future of ecotourism – Benefits of Ecotourism: Awareness, Education, Recreation, Conservation and Economic development.

UNIT – III: Ecorestoration

Definition, Restoration of degraded waste lands, forests and soil fertility, Ground water restoration, Restoration of wetlands and coastal ecology, Restoration of ecology in urban and industrial centers – Indicators for restoration and reclamation.

UNIT – IV: Sustainable Development

Definition and concepts of development and concepts of sustainability – Brundtland Commission - sustainable agriculture, sustainable forests and forestry, sustainable fisheries, sustainable earth economy, environmental worldviews, ethics and sustainability.

PRACTICALS

1. Collection and identification of insect fauna
2. Bird watching and identification
3. Field study of a local park/wild habitat
4. Examination of host plants of butterflies
5. Examination of life cycle of butterflies
6. Nesting habits of bees
7. Field visits to different areas to identify ecological degradation
8. Development of an ecorestoration strategy for denuded hills
9. Development of an ecorestoration strategy for aesthetic enhancement of beaches
10. Development of ecorestoration strategies for Visakhapatnam city

BOOKS FOR REFERENCE:

1. Hammitt, W.E. & Cole D.N. 1998. *Wildland Recreation: Ecology and Management*, 2nd Ed. New York: John Wiley & Sons. 361 pp. (ISBN: 0-471-19461).
2. Liddle M. 1997. *Recreation Ecology: The Ecological Impact of Outdoor Recreation and Ecotourism*. New York: Chapman & Hall. 639 pp.
3. Mieczkowski, Z. 1995. *Environmental Issues of Tourism and Recreation*. Lanham, MD: University Press of America. 552 pp.
4. Wall G. & Wright C. 1977. *The Environmental Impact of Outdoor Recreation*. Publication Series No. 11. Department of Geography. Waterloo, Ontario: University of Waterloo. 69 pp.
5. Higgs, E. 1997. What is Good Ecological Restoration? *Conservation Biology*, pp. 338-348.
6. Egan, B. 1998. *Ecological Restoration for British Columbia*. British Columbia Environmental Report, pp. 7-9.
7. Martha Honey 1999. *Ecotourism and sustainable development*, Island Press, Washington DC
8. Martin Mowforth and Ian Munt 1998. *Tourism and sustainability*, Routledge, U.K.
9. B.K. Tiwari, Surendra Singh 1995. *Ecorestoration of degraded hills*.
10. Robert U Ayres, Paul M Weaver. *Ecorestructuring: Implications for sustainable development*. IN-05457.
11. R.B. Jain. *Environmental Stewardship and Sustainable Development* IN-04021.
12. G. Tyler Miller, Jr. 1996. *Living in the Environment*, Wadsworth Publishing Company, California.

PAPER-302: RISK ASSESSMENT AND DISASTER MANAGEMENT

UNIT – I: Concepts of Environmental Risks

Definitions for Environmental Risk – concepts of Hazard, exposure, dose and response with special reference to Risk – Public perception of Environmental Risk – Communication of Risk – Developmental activities/projects/programmes required to carry out Risk assessments and propose Contingency Plans for Risk Management.

UNIT – II: Environmental Risk Assessment

Objectives of Environmental Risk Assessments – Concepts of Risk and Hazard Analysis – Hazard Identification, Dose-Response Assessment, Risk Exposure Assessment – Risk Characterization – Hazard Operability study: Hazard Assessment, Hazard Survey, Risk Analysis. New developments in quantifying risks and Risk Reducing measures.

UNIT – III: Environmental Concepts of Disasters

Disaster – Natural and Man-made, understanding the causative factors vulnerability, their analysis and evaluation. Environmental implications of Earthquakes, Avalanches, Volcanic eruptions, land slides, floods and tsunamis, cyclones, hurricanes, typhoons, tornadoes, Disasters due to nuclear chemical and biological weapons, Earthquakes in the areas of larger dams, forest fires and wild life destruction.

UNIT – IV: Disasters Mitigation and Management

Identification of Disaster prone areas and high risk groups - Disaster warning programmes, Disaster preparedness and prevention of loss to life, livestock, property, natural resources and ecology – Development of Disaster Mitigation Plans – Awareness programmes and capacity building among the Risk Groups - Post disaster environmental problems and their management.

REFERENCES:

1. Gilbert, M. Masters (2000) *Introduction to Environmental Engineering and Science*, Prentice Hall of India Pvt. Ltd., New Delhi.
2. Khitoliya, R.K. (2004) *Environmental Pollution: Management and Control for Sustainable Development*.
3. Santra, S. (2001) *Environmental Science*. New Central Book Agency (Pvt) Ltd., Kolkotta.
4. Susan, L.C. (Ed)(1999) *Environmental Risks and Hazards*. Prentice Hall of India Pvt. Ltd., New Delhi.
5. Gopal Bhargava 1992. *Environmental Challenges and Ecological Disasters*, Mittal Publication, New Delhi.
6. UNCHS (1983) *Planning for Human Settlements in Disaster Prone Areas*, UNCHS-Habitat.

PAPER-303: POLLUTION CONTROL, MONITORING AND MANAGEMENT

Unit-I: Air Pollution

Effects of Air Pollution on: (a) Physical properties of the Atmosphere (b) Economic materials and structures (c) Indoor Air quality and (d) Vegetation and Human health. Control methods for: (a) Particulates (b) Oxides of Sulfur (c) Oxides of Nitrogen and (d) Hydrocarbons. Air quality standards, Monitoring and management of Air Pollution.

Unit-II: Water Pollution

Water quality monitoring, River pollution-A case study of River Ganges, Effects of water pollutants on Human health, Ground water pollution, Effect of wastewater on environment, Water pollution control, water and wastewater treatment. Marine oil pollution and its impacts.

Unit-III: Soil Pollution

Soil Pollution-Sources and Effects, Soil erosion-Control methods, Soil Acidification, Monitoring and Control of Soil Pollution, Municipal Solid waste and Hazardous wastes, Problems associated with MSW and Hazardous wastes, Analysis and Management. Hazardous wastes rules, 1989.

Unit- IV: Monitoring and Management

Environmental monitoring-Purpose of monitoring, Types of monitoring, Monitoring and Management of Noise pollution, Thermal pollution, Radio active pollution.

PRACTICALS

1. Estimation of pollution load for wastewaters.
2. Characterization of Municipal Solid Waste.
3. Monitoring of Noise levels at strategic points.
4. Analysis of Soil for pollutants.
5. Industrial visits for hands on experience of Industrial Pollution Management.

Books for References:

- Air Pollution, **Arthur C. Stern**, Vol. I-IV, Academic Press, INC. New York.
- Principles of water quality control, **T. H. Y. Tebbutt**, Pergmon Press, New York.
- Air Pollution, **H. C. Perkins**, Mc Graw Hill series, New Delhi.
- The Nature and Properties of Soil, **Brady**.
- Analysis of water and wastewater, **APHA** publication.

PAPER-304: EIA, ENVIRONMENTAL ECONOMICS, AUDIT AND LAW.

UNIT – I: EIA (Environmental Impacts Assessment)

EIA Notification of the Govt. of India - Definitions and Objectives of Environmental Impacts Assessment; Scope and Advantages; *Legal requirements and compliance*: Screening and identification of projects; public involvement. Project criteria and thresholds; Environmental criteria and thresholds; Initial Environmental Evaluation; Practical Applications.

Methods and Tools for EIA: Activities in EIA and Impact characteristics; Map-overlay methods; Checklists Method (Descriptive and Scaling); Matrix Methods; Networks; Scoping Methods on Baseline Studies – Preparation of Environmental Impact Statement (EIS) – Development of Environmental Management Plan (EMP) - Role of Monitoring and Auditing in EIA.

UNIT – II: Environmental Economics

Concepts of Economics and scope of Environmental Economics – Developmental Indicators - Economics of Pollution Control – Cost Benefit Analysis and evaluating alternatives. Environmental Accounting: Production and Assets Boundaries of 1993 System of National Accounts – General Framework of Environmental Accounts and the SNA with Environmental Amendments to the framework. Trade and Environmental Issues and Complexities – Disputes at WTO – Trade and the Environment – The World Trade Organization – Globalization impacts on Environment and Economics.

UNIT – III: Environmental Audit

Definition; Objectives; Scope, Coverage – *Policy development*: Defining boundaries; Goals; Policy compliance – Organization and staffing of Audit team – Resources – *Approaches to Audit*: (a) Pre-visit Activity; (b) On-site Activities; (c) Post-Audit activities – Audit principles – Benefits to Industry.

Audit Report and Environmental Statement (ES): Importance of Audit Report – Reporting Environmental Audit Findings; Fundamentals; Coverage; Confidentiality; Opportunity for dialogue – Environmental Statement and Public Information; Definition and scope; Protocols; Preparation of Flow diagrams; Material Balance; Preparation of EIS.

UNIT – IV: Environmental Law

India's Legal Framework for Environmental Management – *Legislations enacted (as amended)*: (1) The Water (Prevention & Control of Pollution) Act, 1974; (2) The Air (Prevention and Control of Pollution) Act, 1981; (3) The Water (Prevention and Control of Pollution) Cess Act, 1977; (4) The Environment (Protection) Act, 1986; (5) The Motor Vehicles Act, 1939; (6) The Public Liability Insurance Act, 1991; (7) The Factories Act, 1947; (8) Wildlife (Protection) Act, 1972; (9) The Indian Forest Act, 1857 –Discussion: Objectives of Acts, Institutional arrangements for Implementation and Regulation.

PRACTICALS

1. Preparation of Activity-processes Flow diagrams.
2. Case study Analysis for EIA of a major Industry.
3. Case study Analysis for EIA of a Reservoir/Land Conversion/Mining activity.
4. Case study Analysis of Environmental Audit of a major industry.
5. Preparation of Environmental Statement.
6. Application of Matrices Method.
7. Cost-benefit Analysis for Resource Allocations: Transportation Method.
8. Visit to understand Institutional arrangements and functioning of Pollution Control Boards.
9. Visit to understand Environmental Management system of an Industry.

Books for REFERENCE:

1. L.W. Canter (2002). Environmental Impact Analysis, McGraw Hill Book Co., New York.
2. International Chamber of Commerce (1986) ICC Guide to Effective Environmental Auditing, ICC, New York.
3. A.D. Little (1990) Principles for conducting Environmental Health, and Safety Audits, Centre for Environmental Assurance.
4. Ministry of Environment & Forests (1992) Policy Statement for Abatement of Pollution, Govt. of India, New Delhi.

Fourth Semester
M.Sc. Environmental Sciences

401: PROJECT DISSERTATION:

Students appearing for M. Sc Environmental Sciences shall carry out a small project in a relevant field, during the IV Semester, in consultation with the faculty Incharge and submit a dissertation, which will be evaluated for **200 Marks**.

402: SEMINARS:

Students appearing for M. Sc IV Semester Examinations should submit the record (with a soft copy in the form of a CD) of the Seminars the candidate has presented during all the semesters period. The student should have presented at least TWO seminars in each semester. The record shall contain the text of the seminar presented with relevant data tables, figures, references of the information sources etc., incorporating all relevant discussions held on the topic and the record shall be evaluated by the faculty in charge during the Mid-semester Examinations of the IV semester. The candidate's performance in the seminars and the seminar record shall be evaluated for **50 Marks** by the faculty in charge.

403: EXTENSION:

Students appearing for M. Sc Environmental Sciences shall participate in the Extension programmes organized by the department and also shall take up at least ONE extension activity on their own in each of the semester, with prior informed consent of the Head of the Department. A record shall be maintained for the extension programmes and be submitted for evaluation at the Mid-semester Examinations of the IV Semester. The Head of the Department or his nominee shall evaluate the Extension record for 50 Marks.

404: ENVIRONMENTALIST'S DIARY and ASSIGNMENTS:

Students appearing for M. Sc Environmental Sciences shall maintain Environmentalist's Diary and also shall take up at least TWO curricular assignments every semester in the papers of their choice and submit the same at the end of each semester. The Environmentalist's Diary and the Assignments of the four semesters shall be evaluated for **100 Marks** at the Mid-Semester Examinations of the IV Semester.

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