

SYLLABUS

PAPER - I
CONCEPTS OF ENVIRONMENTAL SCIENCES

- i) Concepts of environment, scope of environmental sciences, evolution of environment (universe), earth as a planet - and its historical evolution. Biosphere - structure and composition - Classification of rocks; common mineral.
- ii) Atmosphere : Earths radiation balance, composition of air, vertical structure of the atmosphere, meteorological parameters, wind, rainfall, temperature, light.
- iii) Hydrosphere : Environmental role of natural water, Physico-chemical properties of water, Hydrological cycle, vertical distribution of Ground water, factors controlling water movement.
- iv) Lithosphere : Internal structure of earth, distribution of elements in earth crust, geological hazards - earthquakes, volcanic activity, flood, land slides, siltation, coastal erosion, soil and its formation.
- SSV v) Chemical aspects : Particles, ions and radicals in the atmosphere, chemical and photochemical reactions in the atmosphere, Pure water and wastewater, chemistry of corrosive compounds, DO, BOD, COD, pH, Salinity, Heavy Metals (Pb, Hg). Basic concepts of analytical methods - Colorimetry, Spectrophotometry, potentiometry.

References

- 1. Environmental Science - B.J. Nobel.
- 2. Introduction to the Structure of Earth - B.W. Spencer.
- 3. Earth Resources, Energy and Environment - D.G. Brookins.
- 4. General Hydrogeology - P.P. Klimentov.
- 5. Text book of Environmental Chemistry - Tyagi and Mehra.
- 6. Environmental Chemistry - A.K. De.
- 7. Dynamical and Physical Meteorology - G.J. Haltins and F.L. Martin.
- 8. Environmental Geoscience - A.N. Strahler and A.H. Strahler.
- 9. Physics of Environment - Herbert Inhuber.
- 10. Advanced Inorganic Chemistry II - Gurdeep Raj.
- 11. Groundwater Hydrology - D.R. Todd.
- 12. Applied Hydrogeology - C.W. Teltz.
- 13. Bio-resources Conservation & Management - Prof. M.V. Subba Rao.

PAPER - II
ECOSYSTEM ECOLOGY

- CHS i) Structure and function of Ecosystem, Production and decomposition, Ecosystem homeostasis and ecological balance, limiting factors and their combined concept. Ecosystems Types : forests, grasslands, desert, fresh-water, marine and estuarine ecosystems; their characteristics and biota.
- MAS ii) Biogeochemical cycles, Gaseous cycle (nitrogen cycle and oxygen cycle) Sedimentary cycle (phosphorus cycle and sulphur cycle) concepts of ecological niche, competition, predation, symbiosis, ecological succession. MAS

- iii) Population characters - natality, mortality, intrinsic rate of natural increase, population growth, Age dispersion density dependant and independent factors, community organisation, patterns in community, ecotone.
- iv) Wild species biodiversity and protection - Value of wild species - biological wealth - Sources for medicine, commercial value, consequences of losing biodiversity - Biodiversity Vs. biotechnology. Sustainable development.
- v) Microorganism in soil, air and water; methods of sampling and monitoring, role of organisms in decomposition and nutrient cycling, N₂ - fixation, soil, water and air borne microbial diseases.

References

1. Fundamentals of Ecology - E.P. Odum.
2. Elements of Ecology - G.L. Clarke.
3. Ecology and Environment - P.D. Sharma.
4. Basic Concepts of Ecology - C.B. Knight.
5. Ecology - C.S. Krebs.
6. Ecology and Field Biology - R.L. Smith.
7. General Microbiology - Vol. II - Power and Dagainwale.
8. General Microbiology - P.G. Sharma.
9. Microbial Ecology - M. Alexander.
10. Ecology for Environmental Sciences - J.M. Anderson.
11. Ecology and the Quality of an Environment - C.H. Southwick.
12. Principles of Ecology - R.J. Pidman and S.D. Wratten.
13. Soil Organisms and Litter Decomposition in the Tropics - M. Vikram Reddy.

PAPER - III

ENVIRONMENTAL STATISTICS, COMPUTATION, DEMOGRAPHY AND ECONOMICS

- i) Sampling and planning of experiments, randomisation, replications, Data presentation, probability, frequency distribution, binomial and normal distribution, test of significance, students "t" test, chi-square test, correlation, analysis of variance, regression.
- ii) Computation Methods : Basics of Computer, PC Operating Systems - Dos Commands; Editing data/source files; Introduction to packages for performing statistical and data Base management operations - excel spreadsheets (Lotus, 1-2-3) and dBase; Basics of modelling.
- iii) Balancing among population, soil, water and agriculture. The global human population explosion - causes and consequences - Dynamics of population growth, population profiles and projections.
- iv) Micro-economic theory of environment - pricing of the environmental variables, problems of resource allocation and environmental function, impact of environment on GNP. Production and distribution of food, hunger, malnutrition and famine.
- v) Interaction of environment, agriculture and economic, impact of new technology (industrial and HYV) on environment, economics of exhaustible resources and corrective action.

References

1. Statistical Methods in Biology - Bailey, N.J.
2. Fundamentals of Applied Statistics - S.C. Gupta and V.K. Kapoor.
3. Statistical Methods for Biologists - S. Palanichamy and M. Manoharan.
4. Software Manual - Math CAD.
5. Operating Manual - DOS, M.S.

6. Economics of Environmental Quality - E.S. Mille and P.E. Graves.
7. Economics and Environmental Policy and quality of Life - Baumol, W.J.
8. Theory of Environmental Policy - Baumol, W.J.
9. Introduction to Basic Programming - Balaguruswami.
10. Introduction to Fortran Programming - Balaguruswami.
11. Principles of Computer Programming. II Edition by V. Rajaramaiah, Prentice-Hall India Pvt. Ltd. New Delhi.

PAPER - IV

ENVIRONMENTAL TOXICOLOGY AND MONITORING

- i) Toxicants and Toxicity, Dose, dose - response relationship, and statistical concept, factors that affect environmental concentration of toxicants, factors that influence toxicity, single and multispecies tests.
- ii) Environmental behaviour of pollutants: Abiotic processes and biotic processes, estimation of doses, integrated doses, Biotransformation and its types, biotransformation of DDT.
- iii) Toxic chemicals in the environment impact of toxic chemicals As, Cd, Pb, Mg and CO, toxic effects of pollutants on plants, animals, ecosystem response to pollution, bioaccumulation and biomagnification and their significance in food-chain.
- iv) Ecotoxicological effects on man, bio-chemical effects of pesticides, insecticides and fungicides and heavy metals (Mercury, Chromium, Cadmium and Lead) environmental carcinogens, teratogenic and mutagenic action of carcinogens, Environmental toxicology in India.
- v) Uses of environmental monitoring, Environmental monitoring in practice, types of Environmental monitoring, remote sensing, Biological monitoring, indicator species and diversity indices.

References

1. Elements of Toxicology - Pandey and Shukla.
2. Environmental Biology and Toxicology - P.D. Sharma.
3. Introduction to Environmental Toxicology - Guthincer, Perry (Ed.)
4. Principles of Ecotoxicology - Scope Publ. 12. Ed. G.C. Butler.

PRACTICAL

PAPER-V : NATURAL SCIENCES

1. Determination of Bio-chemical oxygen Demand (BOD) in sewage and industrial waster waters.
2. Biomonitoring of aquatic habitats through identification and enumeration of phytoplankton.
3. Estimation of Gross primary productivity, Net primary productivity and Respiratory consumption in a pond ecosystem.
4. Isolation, identification and enumeration of soil micro-organisms in polluted and non-polluted habitats.
5. Collection, preservation and identification of zooplanktons.
6. Identification, preservation of benthic macro-invertebrates.
7. Community study by quadrat method: Calculation of frequency, density and abundance. Infer the climate using Raunkiaers life-form properties.

8. Identification of soil macro-fauna and estimation of their community structure.
9. Estimation of secondary productivity.
10. Recording of rainfall (rain gauge) and preparation of graphs.
11. Mechanical analysis of soil (grain size)
12. Identification of common rocks (about 10)
13. Identification of common rock forming minerals (12)
14. Enumeration of micro-organisms in air with roto-rod sampler/ Tilak Sampler.
15. Estimation of organic content in agriculture, polluted and degraded soils.

PRACTICAL
PAPER-VI : PHYSICAL SCIENCES

1. Determination of Hardness of water (Ca^{++} , Mg^{++} ions)
2. Determination of fluoride in water.
3. Determination (colorimetric method) of iron or chromium in water.
4. Verification of inverse square law using G.M. Counter.
5. Determination of absorption co-efficient.
6. Estimation of mean and standard deviations of a given set of data and their computation.
7. Estimation of linear correlation of given sets of data and their graphical presentation.
8. Potentiometric titrations of acids and bases.
9. Exploration of nuclear radiation in the environment.
10. Determination PK_a of weak acids by Potentiometric method.
11. Conductometric titrations of strong and weak acids and bases.
12. Determination of metal ions by conductometric methods.



SCHOOL OF DISTANCE LEARNING AND CONTINUING EDUCATION
Kakatiya University, Warangal 506 009 AP India

M.Sc. Environmental Sciences (Final) Syllabus

PAPER - I

AIR AND NOISE POLLUTION, ENVIRONMENTAL HEALTH AND ANALYTICAL METHODS

- i) Classification of air pollution, particulates and their sources in mining and other solid processing industries thermal power stations and other solid fuel fired boiler sites and their effects.
- ii) Vapours and gases from chemical industries, hydrocarbons, oxides of nitrogen, carbon, sulphur, organic cyanates, photochemical oxidants, ozone and ozone layer depletion, CFCs, greenhouse gases and their effects.
- iii) Control measures of air pollution, air pollution stacks, settling chambers, scrubbers electrostatic precipitators, gas adsorption, removal of SO₂ and oxides of nitrogen. Noise and its hazards, noise measurement and standards.
- iv) Principles of environmental health and occupational health, analysis of environmental health problems at community level, medical records on the study of health problems in a given environment, epidemiology.
- v) Analytical methods : IR spectroscopy - principles, application of IR spectroscopy in the identification of functional groups. Non-dispersive IR spectroscopy in the monitoring of CO in an air sample / atomic absorption spectroscopy, nephelometry, chromatography (HPLC, ion-exchange chromatography), light scattering techniques, electro analytical techniques, radio analytical methods, bio-indicators of environmental pollution.

References :

1. Air Pollution, Vol. 1, A.K. Tripathi.
2. Global Environmental Problems, Vol.III, A.K. Tripathi.
3. APHA Hand Book.
4. Principles of Environmental Science and Technology - Jorzenxen and I.Johanson.
5. Environmental Pollution - Hodges.
6. Environmental Pollution Control Engineering - C.S. Rao
7. Air Pollution - R.K. Trivedy and P.K. Poel.
8. Air Pollution Hand book - Magill, Holden and Ackley.
9. Analytical Methods applied to air pollution measurements - Stevan, R.K. and W.E. Herget.
10. Quantitative inorganic analysis - A.I. Vogel.
11. Instrumental methods of analysis - Williard, Meritt & Dean.
12. Instrumental methods of analysis - Chatwal & Anand.

PAPER - II

SOURCES OF WATER AND SOIL POLLUTION - EFFECTS AND ABATEMENTS

- i) Water pollution by organic wastes, microbes, plant nutrients, synthetic organic chemicals, inorganic chemicals and minerals, sediments, oil pollution, ground water pollution and their effects.
- ii) Sewage collection systems, design of water and waste water treatment plants, concepts of bio-oxidation processes, trickling filters, activated sludges, aerated lagoons, oxidation ponds and anaerobic digestion.

- iii) Water pollution control screens, grit chambers, chemical precipitation, micro screening & odour control. Thermal pollution - sources, effects, control measurement of thermal pollution.
- iv) Soil pollution : solid wastes - nature and chemical composition, municipal solid waste and their effects, garbage grinders, compaction instruments, flotation electrostatic separation, incineration, recycling and recovery and reuse of solid wastes.
- v) Agrochemicals : fertilizers and pesticides, their impact on environment, degradation of pesticides in soil. Soil erosion, environmental effect of geotechnical structures (dams and highways) - Deforestation : its causes, effects and abatement.

References :

1. Pollution Control Hand book, 1984.
2. Waste water engineering, treatment and disposal - Metcalf and Edds.
3. Solid waste - NEERI publications.
4. Solid waste Management - Gotax.
5. The treatment of industrial wastes - E. Basselievre and M. Schwart.
6. Water pollution and management - C.K. Varshney.
7. Environmental Chemistry - J.W. Moore and E.A. Moore.
8. Groundwater assessment, development and management - K.R. Karanth.
9. Water pollution Control Engineering - C.S. Rao.
10. Environmental Chemistry - A.K. De.
11. Environmental Engineering - G.N. Pandey and G.C. Carneg.
12. Manual on water and waste water analysis : NEERI Publications.

PAPER - III ENVIRONMENTAL MANAGEMENT - LEGISLATION, AUDITING AND IMPACT ASSESSMENT

- i) Definition, processes, and key concepts of environment management (EM), characteristics, approaches and importance of EM, negligence of EM, priorities of EM.
- ii) Definition, classification, principles and objectives of environmental education, formal and non-formal environmental education, recommendations concerning to environmental education, environmental education in India.
- iii) Importance of environmental legislation, protection laws in India, merits and demerits of environmental protection Act, 1986, National Environmental Tribunal Act of 1995, 97 - Role of state and central pollution control boards, Green benches.
- iv) Environmental impact assessment : Environmental audit, environmental impacts of human activities, administration procedures, sequence of environmental planning and decision making. Environmental impact and environmental management with special reference to mining.
- v) Methods and techniques of environmental impact assessment, approach to forecasting environmental impact, environmental forecasting models, case studies : urbanisation and thermal power stations.

References :

1. Man, Nature and Environmental Law - Muthawat.
2. Environmental Planning - Sapru
3. Environmental Management - Dashbandhu
4. Environmental factors in Economics and Industrial Management Rajshekharan.
5. Environmental Impact Assessment - Principles and Application P.A. Erickson
6. Environmental Quality Management - G.H. Sewall.
7. Environmental Protection and the Law - Mehta
8. Pollution Control Acts - (PCB, Delhi, 1992).
9. Environmental Law - Dr. Padma.

PAPER-IV

ENVIRONMENTAL RESOURCES AND CONSERVATION WILD LIFE MANAGEMENT

- i) Definition and classification of natural resources non-renewable (fossil and nuclear fuels, minerals) resources, composition and classification of fossil fuels, mining and mineral exploitation - Management of mining sites. Mineral conservation.
- ii) Renewable resources, living resources and forests, agriculture, aquaculture and their conservation. Environmental problems of use of natural resources.
- iii) Non-conventional energy sources - solar energy, wind energy, biogas, ocean energy, geothermal energy - sources and effects, energy conservation techniques.
- iv) Concepts of conservation, importance of conservation, national, international conservation strategies, IUCN, UNEP Red data book, earth summit, concepts and Role of biodiversity.
- v) Forest management and conservation - wild life conservation national parks and wild life sanctuaries, bio-sphere reserves, endangered species, impact of environmental degradation on wild life, wild life legislation.

References :

1. Ecology of Natural Resources - Rehede, M
2. Environmental Conservation, Management and Planning.
3. Ecology and Environment - P.D. Sharma
4. Energy Resources and Supply - McMullan Mergen and Murray
5. Forest, Wildlife and Environment - M.V. Subba Rao
6. Bioresources Conservation and Management - M.V. Subba Rao.

PAPER - V

CONCEPTS OF ECO-TECHNOLOGY

- i) Definition of eco-technology and related ecosystem principles, rules of eco-technology and their application, examples of eco-techniques, ecotechnology and eutrophication.
- ii) Afforestation of waste and degradable land. Social forestry, shelter belt, afforestation ameliorating soil and air environment. Pollution control and plantation programmes.
- iii) Bio-conversion with reference to vermicomposting of organic solid waste and agriculture waste, vermicomposting and abiotic factor, selection of verms for vermi-technology, verms and their pests.
- iv) Principles, technology and processes of bio-purification, eco-friendly micro-organisms, use of micro-organisms for environmental clean-up, role of aquatic plants in environmental purification process.
- v) Treatment of drinking water, defluoridation of water, removal of dissolved solids and metal ions from industrial waste water by in exchange and adsorption methods, reclaiming and reuse of metal ions from industrial waste.

References :

1. Principles of Ecotechnology - G. Jorgeson
2. Environmental Biotechnology - S. Omen
3. Earthworm Ecology from Darwin to Vermiculture - J.E. Satchell
4. Environmental Pollution Control Engineering - C.S. Rao
5. Soil Organisms and the Litter Decomposition in the Tropics - M. Vikram Reddy
6. Environmental Engineering - G.N. Pandey and G.C. Carner.

**PRACTICAL
PAPER - VI: NATURAL SCIENCES**

1. Use of algal indices in assessing water pollution.
2. Air pollution tolerance index (APTI) of plants in industrially polluted and unpolluted areas.
3. Determination of Most Probable Number (MPN) of faecal coliforms in Sewage water.
4. Effect of pesticides on earthworm community.
5. Bio-conversion of biodegradable municipal waste by vermiculture.
6. Effect of fertilizers on soil micro arthropod communities.
7. Impact of pesticides on pollen germination.
8. Estimation of eco-functional enzymes in polluted soil-protease.
9. Estimation of ecofunctional enzyme in polluted soil - alpha amylase.
10. Identification of metallic minerals (about 12).
11. Identification of non-metallic minerals/industrial minerals (12).
12. Effect of insecticides on termite population.
13. Effect of afforestation on beneficial soil arthropods.
14. Study of wild animals with special reference to wild life sanctuaries of Andhra Pradesh.
15. Environmental monitoring with foliar epidermal traits.

**PRACTICAL
PAPER-VII: PHYSICAL SCIENCE**

1. Determination of chemical oxygen demand of polluted water.
2. Determining phenols of polluted water.
3. Determination of cadmium in industrial wastewater.
4. Estimation of ammonia of polluted water by colorimetric method.
5. Determination of Iron by potentiometric method.
6. Experimental study of characteristics of solar cell.
7. Spectrophotometer: Estimation of concentration of solutions.
8. Experimental study of wind velocity using anemometer.
9. Experimental determination of frequency and amplitude of sound waves using CRO.
10. Experimental determination of noise pollution.
11. Determination of a heavy metal (Zn or Hg or Pb) in an industrially polluted water sample by atomic absorption spectroscopy (Demonstration expt.).
12. Determination of metal pollutants by EDTA method.

Scheme of Examination of M.Sc. (Final) Environmental Science

Distribution of Marks			
Each theory paper (I to V)	: 80 marks (5 x 80)	:	400 marks
Practical Paper-VI (Natural Science)	: 70 marks (60 + 10 Record)	:	70 marks
Practical VII (Physical Science)	: 70 marks (60 + 10 record)	:	70 marks
Project Report	: 60 marks (50 + 10 viva)	:	60 marks
TOTAL	:		600 marks

PROJECT WORK

(Each candidate has to submit a project report for evaluation which is compulsory)

The projects to be undertaken should be research and development oriented, but not be case studies. These project can be on any environmental problems. The students are advised to obtain a certificate stating that they are bonafied students of Environmental Science (M.Sc. Final Year) from the Director, SDLCE in order to get themselves associated with any organisations dealing with environmental problems and work for the project and submit the project report before the final year practical examinations for evaluation. The reports will be evaluated by an external and internal examiner.