DR. BABASABEB AMBEDKAR MARATHWADA UNIVERSITY
AURANGABAD

Syllabus

Of

M.Sc. (Environmental Science)
Ist and IInd Year

In

Credit & Semester Pattern

Effective From

Academic Year

June 2009-2010 onwards

Introduction and Scope

Environmental science is an interdisciplinary subject, which includes both the theoretical and applied components. Every environmental component is affecting on the living organism including human population. The human's developmental activities are responsible for the changing environmental components of planet earth and responsible for emerging new kind of environmental problems affecting locally and globally. To understand the environmental problems in total there is a need to give an interdisciplinary approach, even though to mitigate or to minimize the environmental problems this approach is helpful.

Today many of the environmental problems are inherent, because man has to exploit the environmental component for the fulfillment of basic needs. Therefore there will be some degradation of environment. The intensity of degradation of environment can be mitigated by proper environmental awareness, for which there is a need of environmental movements in the society.

The problems natural resource depletion and degradation can be mitigated through the environmental movements. Today different kinds of environmental movements are launched locally and globally for protecting the environment, where true environmentalist and environmentally awared society members are working actively. As a par of movement different kind of days and weeks are celebrated such as earth day and environment day etc.

With considering the interdisciplinary nature of the environmental science subject, there is a need to understand the principles and concepts from a variety of subject such as Botany, Zoology, Ecology, Chemistry, Physics, Geology, Microbiology, Geography, Mathematics, Statistics Laws, Sociology, Economics, Agriculture, Philosophy, computer science and Engineering etc.

The main objective of environmental education is to make the individual environmentally aware and to develop the skilled manpower for solving the environmental problems. Simultaneously environmentally educated students should motivate to aware the social groups for protecting the environment through the participation in environmental conservation and management programmes. The social group should acquire awareness and knowledge about the environment, develop attitude, skills and abilities for solving real-life environmental problems.

The common public in rural, tribal, slum and urban areas, women, students and teachers from schools, colleges and universities as well as planners and decision and policy markers should be environmentally aware.

It has wide scope as it concerns with the problems from all walks of life. After the completion of post graduation, the students may get opportunity in the State Pollution Control Board, Central Pollution Control Board and Research based Environmental project. The students are also getting jobs in the field of energy, forestry, agriculture, land use planning, industrial processes, ETP operations, wild life management, Sanitation etc.

Resolution:

Government of Maharashtra Environmental Department Resolution No. MPN 1090/1250/CR – 169/D-III, Dated 12th June 1991.

By the Government Resolution. Urban Development and Public Health Department No. WPB-2476/1787/UD-18 (506) dated 01.03.1977 Recruitment Rule for the various post in the Maharashtra Pollution Control board have been prescribed. In the recruitment rule for the post of field officer mentioned in Annexure III to the said Government that some universities in Maharashtra are conducting Post Graduate course in Environmental Science and it should be recognition as one of the qualifications for the recruitment to the post of Field Officer in the board. Government has carefully considered this request and directs that the recruitment to the post of Field Officer in the Maharashtra Pollution Control Board. The qualification M.Sc. Environmental Science of a statutory university should also be recognized as the minimum qualification for the post.

Eligibility conditions:

Admission to M.Sc. Environmental Science shall be made on the basis of aggregate percentage of optional subjects of three years. The weightage of 1% will be given to the candidates who offered Environmental Science as one of the optional subject at the B.Sc. level for seeking the admission to the M.Sc. Environmental Science.

B.Sc. with Environmental Science, Botany, Zoology, Physics, Chemistry and especially the subjects from the biological sciences as one of the optional subjects, shall be held eligible for the admission to M.Sc. in Environmental Science.

Dr. Babasaheb Ambedkar Marathwada University,

Aurangabad.

M.SC. [ENVIRONMENTAL SCIENCE] IN SEMESTER PATTERN

Year	Semester	Course Code	Paper Number	Paper Title	Credits	Marks
I Year	I	ENVS-111	Paper-I	Concepts of Ecology	4	50
		ENVS-112	Paper-II	Environmental pollution	4	50
		ENVS-113	Paper-III	Biodiversity and Natural Resources	4	50
		ENVS-114	Paper-IV	Environmental Instrumentation and Environmental Microbiology	4	50
		ENVS-115	Paper-V	Lab Course - I	4	50
		ENVS-116	Paper-VI	Lab Course - II	4	50
	II	ENVS-121	Paper-VII	Bio-informatics and System Analysis	4	50
		ENVS-122	Paper-VIII	Environmental Chemistry	4	50
		ENVS-123	Paper-IX	Environmental Priorities and Sustainable Development	4	50
		ENVS-124	Paper-X	Air, water and noise pollution Control Technology	4	50
		ENVS-125	Paper-XI	Lab Course - III	4	50
		ENVS-126	Paper-XII	Lab Course - IV	4	50
II Year	III	ENVS-231	Paper-XIII	Waste Treatment Technology	4	50
		ENVS-232	Paper-XIV	Toxicology and Hazardous Waste Management	4	50
		ENVS-233	Paper-XV	Industrial Safety and Policies	4	50
		ENVS-234	Paper-XVI	Environmental Biotechnology	4	50
		ENVS-235	Paper-XVII	Lab Course - V	4	50
		ENVS-236	Paper-XVIII	Lab Course - VI	4	50
	IV	ENVS-241	Paper-XIX	Environmental Impact Assessment and Environmental Audit	4	50
		ENVS-242	Paper-XX	Environmental Monitoring and RS, GIS	4	50
		ENVS-243	Paper-XXI	Environmental Issues and Legislation	4	50
		ENVS-244	Paper-XXII	Environmental Education and Environmental Economics	4	50
		ENVS-245	Paper-XXIII	Lab Course - VII	4	50
		ENVS-246	Paper-XXIV	Lab Course - VIII	4	50

Note: For theory paper 1 credit = 15 hours
For practical paper 1 credit = 30 hours

M.Sc Environmental Science, Part I, Semester – I

ENVS-111 (Paper - I): Concepts of Ecology

UNIT- I: Introduction: Definition, principles and scope of ecology, history of ecology, subdivisions of ecology , relation to other sciences, relevance to civilization, levels of organization types of ecology – syn ecology, aut ecology,

UNIT-II Concept. of Ecosystem: Concept, structure and functions of ecosystem ; energy in ecological system, concept of productivity, energy flow in ecosystem, food chain, food web, ecological pyramids, cybernetic nature and stability of ecosystem.
Kinds of ecosystems,

i) terrestrial: forest, grassland, Desert
ii) Aquatic: lentic and lotic
iii) Earth major biomes.

UNIT-III: Community: Concept of community, characteristics of community, composition and structure of community, interspecific and interaspecific competition.
Concept of Habitat, ecological niche, guild, concept of ecotone, edge effect, ecological succession, mechanism of succession, concept of climax , concept of Gaia hypothesis.

UNIT – IV: Population: Basic concepts of population ecology, population dynamics, characteristics of population: natality, mortality, fecundity, density, age distribution, prey predator relationship, population explosion.

UNIT – V: Components of Environmental Complex:
Atmosphere: structure and composition. Atmosphere as a life support media.
Lithosphere: structure and composition of lithosphere, soil: definition and composition of soil, soil formation: physical, chemical, biological weathering, soil profile, properties of soil: physical, chemical and biological soil erosion, soil conservation.
Hydrosphere: global water cycle. Structure and composition of hydrosphere, global water balance, types of water, factors influencing the surface water, ground water exploration, ground water management. Rain water harvesting, water shed management,
Biosphere: Man and Biosphere

Recommended Books:

1. Fundamentals of Ecology – E.P. Odum, Revised Edition 1995-96
2. Principles of Ecology – P.S. Verma, V.K. Agarwal, S. Chand and Co. Delhi.
3. Principles of Environmental Science – Wart K.E.F. (1973) Mc Graw Hill Book Company.
4. Ecology – M.P. Arora
5. Basic Ecology – E.P. Odum
6. Concept of Ecology – E.J. Koromondy, 1996, concept of modern biology series, prentice Hall.
7. Modern Concepts of Ecology – H.D. Kumar
8. Principles of Environmental Biology – P.K.G. Nair, Himalaya pub. House, Delhi
9. Environmental Biology – P.D. Sharma, Rastogi Publication, Meerut.
10. Ecology and Environment - P.D. Sharma, Rastogi Publication, Meerut.
11. Basic concepts of soil science – A.K. Kolay, Willey estern ltd., New Delhi.
12. Environmental Science – Enger, Smith, Smith, W.M.C. Brown company publishing
13. Principles of soil environmental science – Watt, K.E.F. (1973), Mc Graw Hill Book Company, New Delhi.
14. Practical Method in Ecology – R.K. Trivedi, P.K. Goel and Trisal., Enviro Publication, Karad.
15. Chemical methods for Environmental Analysis Water and sediments – R.Ramesh, M. Anbu. Macmillan India Ltd. New Delhi.
16. Fundamental of Ecology – Dash M.C. Tata McGraw Hill Pub. Co. Ltd. New Delhi.
17. Concepts of Ecology (Fourth Edition)- Edward J. Kormondy, Prentice Hall of India Pvt. Ltd. New Delhi.
18. Environment forest, ecology and man – Dixit R.K. Rastogi Publication, New Delhi.
19. Physical geography – Dasgupta
20. Environment, energy, health planning for conservation – V. Vidyanath, Gyan Publishing House, New Delhi.

ENVS-112 (Paper - II): Environmental pollution

UNIT – I: Air pollution: Classification; sources of air pollution; major air pollutants; types of air pollution – indoor air pollution, vehicular pollution, industrial pollution; effects of air pollutants on plants; effects of pollutants on animals; effects of air pollutants on human; effects of pollutants on materials; status of air pollution in India.

UNIT – II: Water pollution: Definition; sources of water pollution; major pollutants; types of water pollution – fresh water (rivers, streams, ponds, lakes and underground water resources); marine water (coastal and estuarine); effects of water pollution on plants, animals and human beings; eutrophication; water pollution status in India, drinking water quality standards

UNIT – III: Land pollution: Definition; causes of soil pollution; major soil pollutants; effects of soil pollutants on plants and animals; nutrients in soil (NPK); domestic, municipal, industrial and agricultural wastes and their relation with soil degradation; soil salination;

UNIT – IV: Noise pollution: Definition; sources and effects of noise pollution; physiological and psychological effects of noise pollution; unit of noise; monitoring of noise pollution; noise pollution standards Techniques of measurements of noise pollution; Indian scenario of noise pollution.

UNIT – V: Radiation pollution: Definition; major radioactive isotopes; nuclear fusion ad fission reactions; units of radiations; application of radioactive isotopes in various fields; sources of radioactive pollution; effects of radioactive pollution; effects of nuclear weapons; radioactive fallout; health and environmental effects of radioactive fallout, control of radioactive pollution.

UNIT-VI: Thermal pollution: Definition; sources of thermal pollution; effects of thermal pollution; Control of thermal pollution.

Recommended books:

1. Air pollution – M. N. Rao
2. Air pollution – A. C. Stern, Academic press Vol. I-X.
3. Guidelines of micro meteorological technique in air pollution studies – ISI (1978).
4. Air pollution – V. P. Kudesia
5. Pollution control in process industry – S. P. Mahajan
6. Global air pollution – Brijman
7. Environmental pollution and management – L. Mohan
8. Environmental analysis – P. R. Trivedy and Gurdeep Ray
9. Measurement of air pollutants – M. Katz Who (1969)
10. Air pollution control – NEERI
11. Air pollution – Leadbetter Vol. I and II
12. Air pollution – Magill Holder and Ackely
13. Water pollution – A. K. Tripathi and S. N. Pande
14. Waste water engineering, treatment, disposal and reuse – Metcalf and Eddy.
15. Water supply and sanitary engineering – R. C. Rangwala
16. Water pollution – V.P. kudesai
17. Soil pollution and soil organism – P.C. Mishra
18. Environmental radiation and thermal pollution and their control – G.R. Chhatwal, M. C. Mehra, M. Satake, T. Katyal.
19. Environmental air pollution and its control – G.R. Chhatwal.
20. introduction to waste water treatment process – Ramalho R.S.

ENVS-113 (Paper - III): Biodiversity and Natural Resources

UNIT- I: Biodiversity: Definition of biodiversity; types of biodiversity - ecosystems, species, genetic diversity; importance of biodiversity; biodiversity and ecosystem stability; value of biodiversity; biodiversity as life support system for man- food, fiber, fodder medicine etc; alpha and beta diversity

UNIT – II: Loss of biodiversity: Biodiversity hot spot in India; Causes for loss of biodiversity, causes for loss of genetic diversity; measurement of biodiversity; listing of threatened biodiversity; Current status of biodiversity in India.

UNIT – III: Biodiversity Conservation: Need of conservation; National policy and goals; methods of biodiversity conservation - in situ conservation (sanctuaries, national parks and biosphere reserve); ex situ conservation (zoo, botanical gardens; gene/germ plasma banks); convention on biological diversity (CBD);

UNIT – IV: Natural Resources: Definition; classification of natural resources; concept renewable and nonrenewable resources; Forest and wild resource – its important to human life, causes of deforestation, forest conservation, social forestry and agro-forestry; causes of degradation of wildlife; wildlife conservation and management; Water Resource – water use pattern, conservation of water resource, management of water resources,

UNIT – V: Mineral and energy resources: Mineral resource - important minerals; mineral exploitation; use of minerals; environmental problems due to mingling; reclamation of mining areas; Energy resource – conventional energy resources (fossil fuels, biomass), non-conventional energy resources (wind energy, solar energy) energy use patter; environmental problems due to energy use.

Recommended Books

1. Fundamentals of Ecology – E.P. Odum, Revised Edition 1995-96
2. Principles of Ecology – P.S. Verma, V.K. Agarwal, S. Chand and Co. Delhi.
3. Environmental Biology – P.D. Sharma, Rastogi Publication, Meerut
4. Ecology and Environment - P.D. Sharma, Rastogi Publication, Meerut.
5. Principles of Environmental Biology – P.K.G. Nair, Himalaya Pub. House, Delhi.
6. Basic concepts of soil science – A.K. Kolay, Willey estern ltd., New Delhi.
7. Environmental Science – Enger, Smith, Smith, W.M.C. Brown company publishing
8. Principles of soil environmental science – Watt, K.E.F. (1973), Mc Graw Hill Book Company, New Delhi.
9. Practicle Method in Ecology – R.K. Trivedi, P.K. Goel and Trisal., Enviro Publication, Karad.
10. Chemical methods for Environmental Analysis Water and sediments – R.Ramesh, M. Anbu. Macmillan India Ltd. New Delhi.
11. Fundamental of Ecology – Dash M.C. Tata McGraw Hill Pub. Co. Ltd. New Delhi.
12. Concepts of Ecology (Fourth Edition)- Edward J. Kormondy, Prentice Hall of India Pvt. Ltd. New Delhi.
13. Environment forest, ecology and man – Dixit R.K. Rastogi Publication, New Delhi.
14. Physical geography – Dasgupta
15. Environmental Science –Emger Smith
16. Environmental Science – Nebel
17. Elements of Biotechnology – P. K. Gupta, Rastorgi Publication, Meerut.
18. Biodiversity and environment – S. K. Agarwal
19. The Biological Diversity Act. 2002 and Biological Diversity rules 2004 – National Biodiversity Authority India. 475, 9th South cross street, Kalpalocwar Nagar, Neelangarai, Chennai – 600041.
20. biodiversity measurement and estimation – D. L. Hawks
21. Biodiversity conservation – Global agreements and national concerns. RAMSAR sites CBD, Quarantine, Regulation, National Forestry policy, Biodiversity Act, Wild life protection Act,

ENVS-114 (Paper-IV): Environmental Instrumentation and Environmental Microbiology

UNIT- I: Introduction to Environmental Microbiology: Definition; introduction of microbiology and environmental microbiology; classification of microorganism; prokaryotes and eukaryotes; microbial communities in nature; influence of environmental factors on growth of microorganism; interaction of microorganism with environment; pure culture concept; techniques, preservation and maintenance of microbial culture.

UNIT-II: Microbiology of air, water and soil:

Air microbiology – aerobiology; allergy; role of microorganism in airborne diseases; airborne diseases.

Microbiology of water – role of microorganism in treatment of water and wastewater; trickling filter, activated sludge process, septic tanks, imhoff tanks, lagoons and oxidation ditch, bioreactors.

Soil Microbiology - biodegradation; soil borne diseases;

Water born diseases – Cholera; typhoid; amoebiasis; hepatitis; joundis; dysentery.

UNIT-III: Industrial Microbiology:

Dairy and dairy products – curd, cheese, yogurt.

Food industry – fermented products, food spoilage, food adulteration

Breviary and distilleries: alcohol, spirit and wine.

Pharmaceutical – antibiotics, vitamins,

UNIT-IV: Instrumentation: Theory; principle; working and applications of following sampling instruments; air sampling – high volume sampler (HVS), respirable dust sampler (RDS), stack monitoring kit, Tilak air sampler; Water sampling – simple and modified water sampling bottle, Vandorne sampler, Nensons reversible bottle; Ekmans grab.

UNIT-V: Analytical Instrument: Theory; principle; working and applications of following sampling instruments: pH meter; EC meter; DO meter; Nephlometer; Flame photometer; colorimeter; spectrophotometer; AAS, Chromatography – TLC, GC, HPLC; NMR;

UNIT-VI: Microbiological instruments and equipments: Theory; principle; working and applications of equipments: Colony counter; autoclave; oven; incubator; laminar air flow; BOD incubator.

Recommended Books:

1. General microbiology – Power and Dagniwala
2. Microbiology – P.D. Sharma
3. Fundamental principle of bacteriology – P.C. Salle
4. Microbiology – Pelczar, M.S. Chand.
5. Introduction to Microbiolgoy – Kappor and Touro
6. Microbiology – Maheswari and Dubey
7. Encyclopedia of environmental microbiology – P. Hotter
8. Industrial microbiology – K.C. Daa
9. Medical microbiology – Anant Narayana
10. Chemical analysis –kenneth A. Rubinson
11. Analytical chemistry – Gary D. Christian.
12. Mass spectrometry of pesticides and pollutants:
13. Hand book of analytical instruments –Khandpur R.S.
14. Chemistry for environmental engineering Sawyer, Mclarty and Parkin.
15. Instrumentation methods for chemical analysis – B.K. Sharma.
16. Instrumentation methods for chemical analysis – Chatwal and Anand.

ENVS-115 (Paper - V): Lab Course – I

1. Identification and classification of phytoplankton's from water sample (any 8).
2. Identification and classification of zooplankton's from water provided sample (any 8).
3. Quantitative analysis of zooplanktons and determination of percentage composition by Sedgwick Rafter cell method.
4. Quantitative analysis of phytoplankton's and determination of percentage composition Lacky's drop count method.
5. Estimation of biomass from grassland by harvest method.
6. .Productivity study of grassland ecosystem by harvest method.
7. Determination of species area curve for deciding minimum size quadrate for plant community study.
8. Determination of relative density of species by using simulation.
9. Determination of relative frequency of species by using simulation.
10. Determination of relative abundance of species by using simulation.
11. Determination of chlorophyll content from plant species.
12. Determination of IVI Index of plant species.
13. Determination of primary production by light and dark bottle techniques.
14. To study the ecological adaptation in plants to aquatic habitat (Hydrophytes)
15. To study the ecological adaptation in plants to mesophytes.
16. To study the ecological adaptation in plants to desert conditions (Xerophytes)
17. Determination of rate of transpiration in mesophytic plants.
18. To study the ecological adaptation in animals to aquatic habitat
19. To study the ecological adaptation in animals to desert conditions.
20. Determination of Shannon Weiner Species diversity index to terrestrial animal communities.
21. Determination of Margalef diversity index to terrestrial animal communities.
22. Determination of Kothe's Species Deficit index to aquatic organisms.

ENVS-116 (Paper -VI): Lab Course – II

1. Study of energy plants for the production of bio-diesel, alcohol , biomass, biogas etc.
2. Calculation of total population by using Method –B table of capture-recapture method (simulation).
3. Staining of bacterial suspension by simple staining method (monochrome)
4. Staining of bacterial suspension by Hooker's modification or by Gram's staining.
5. Study of microorganisms by Standard Plate Count (SPC) methode.
6. Isolation of bacteria from water, soil, decaying matter.
7. Isolation of fungi from soil/ water/ decaying matter.
8. Identification and classification of bacteria.
9. Study of allergenic and non allergenic pollen grains.
10. Study of laboratory instruments used for microbiological study.
11. Study of preparation of sterilization of culture media.
12. Determination of MPN from drinking water resource for potability.
13. Determination of hydrogen sulfide (H_2S) from sewage sample.
14. Determination of NOx in ambient air by high volume sampler (HVS).
15. Detection of carbon monoxide by CO detector.
16. Measurement of SO_2 by high volume sampler (HVS)
17. Measurement of SPM by using high volume sampler (HVS)
18. Measurement of RSPM by using high volume sampler (HVS)
19. Estimation of residual chlorine from water by titrometric method.
20. To study the principle, function and application of Colorimeter: i) Estimation of NO_3-N by using colorimeter.
21. To study the principle, function and application of Flame Photometer: i) Estimation of Na and K by using Flame Photometer.
22. To study the principle, function and application of TLC: i) Separation of organic compounds by using TLC.

M.Sc Environmental Science, Part I, Semester – II

ENVS-121 (Paper - VII): Bio-informatics and System Analysis

UNIT- I Biostatistics: Population and samples, tabulation of data, frequency tables and frequency curves, mean(arithmetic, harmonic and geometric), mode and median; variance and standard deviation, coefficient to variation, data presentation techniques, probability, binomial distribution, posson's distribution and use of normal probability table.

UNIT-II Test of Significance: Concept of simple random sampling; random sampling and stratified random sampling; concept of testing of hypothesis; critical region-two types of errors; level of significance; large sample; tests for single mean and difference of means; single proportion and difference of proportion. Chi-square test for goodness of fit and for independence of attributes, students t-test for single mean and difference of means and F-test for equality of variances. Concept of ANOVA-examples on one way and two way classification.

UNIT-III: Environmental system analysis and modeling: Approaches to development of models, line simple and multiple regression models, validation and forecasting, models of population regression models, validation and forecasting models of population growth and interactions – Lotka – Voltrra model. Leslie's matrix model, point source stream pollution model, box model, Gaussian plume model.

UNIT-IV: computer applications: Structure, function, capabilities and limitations of computer, computer packages, MS-Office (MS-Word, MS-Exel, MS-Powerpoint) introduction to internet; applications of computer in environmental science; use of computer in environmental modeling;

Recommended books:

1. Fundamental of applied statistics – S.C. Gupta and V.K. Kappor.
2. Elements of statistics – Donald R. Byrkit.
3. Mulitivariance analysis- Hunt and Shelly
4. computer fundamentals
5. computer – Newman Ed.
6. computerized environmental modeling – J. Hardstay, D.M. Tailor & S.E. Metcalf

7. computerized aided environmental management – S.A. Abbassi and F.I. Khan.

ENVS-122 (Paper - VIII): Environmental Chemistry

UNIT- I: Basic concepts of Environmental Chemistry:
Stoichiometry; Gibb's energy; chemical potential; chemical equilibrium; acid - base reaction; solubility product; solubility of gases in water; the carbonate system; unsaturated and saturated hydrocarbons radionuclides.

UNIT-II: Composition of air: Classification of elements; composition of air; chemical speciation; particles irons and radicals in the atmosphere; chemical processes for formation of inorganic and organic particulate matter; thermo chemical and photochemical reactions in the atmosphere. Oxygen and ozone chemistry; chemistry of air pollutants; photochemical smog.

UNIT-III: Chemistry of water and soil: Chemistry of water; structure of water molecule; solubility of compounds in water; redox potential; dissociation constant; water quality parameters.

Chemistry of Soil: composition of soil; biogeochemical cycles (nitrogen, oxygen, carbon, sulphur, phosphorus etc); micronutrients of soil; factors affecting the soil quality; adsorption of contaminant in soil; toxic chemicals present in soil.

UNIT-IV: Green House Effect: Introduction; sources of green house gases; major green house gases; emission of CO2; impact of green house gases on global climate; consequences of green house effects; remedial measures of green house effects; impact of global warming on – human health, agriculture, biodiversity etc.

UNIT-V: Chemistry of ozone layer depletion: Formation of ozone; depletion of ozone layer; mechanism of ozone depletion; effects of ozone depletion; climatic effects of ozone depletion; protection measures of ozone layer

UNIT-VI: Chemical aspects of acid rain and photochemical smog: Concept of acid rain; formation of acid rain; adverse effects of acid rain; chemistry of photochemical smog; Nox, HC and PAN.

Recommended Books:

1. Environmental Chemistry – A.K. Day
2. Environmental Chemistry – R.C. Rasswell
3. Fundamentals of environmental chemistry –Stanley E. Manahan
4. Limnology – Wetzel
5. Photo chemistry and spectroscopy – J.P. Simmons
6. Fundamentals of photo chemistry – K.K. Rohatgi - Mukherjee.
7. Elements of environmental chemistry – H.V. Jadhav
8. Environmental chemistry – B.K. Sharma
9. Environmental chemistry – B.K. Sharma and H. Kaur
10. Environmental pollution analysis – S.M. Khopkar
11. Environmental chemical analysis – Lanin L. Marr, Malcom S.
12. Environmental Geology – Lundgran,
13. Environmental Geology – Barbara, Wim Brain, J.S. Stephen.
14. Environmental Chemistry – Kanan Krishnan.

ENVS-123 (Paper - IX): Environmental Priorities and Sustainable Development

UNIT- I: Sustainable Development: Concepts of sustainable development; definition of sustainable development, integrating economic and ecological principles; definition of physical and economic growth; development process and growth; integrated approach to environment and development; instigation of economic, social and environmental sustainability

UNIT-II

Principles of sustainable development; barriers to sustainable development – health aspect of sustainable development; practices of sustainable development in India; international mechanism of sustainable development;

UNIT-III: Priorities in developmental planning: Project planning, land use and agriculture, urbanization, population control planning, equity approaches, collective self reliance, corporate accountability; consumerism, world environment- a holistic developmental perception, human ecology and rural development, urban –rural relation in India, agro-climatic planning and regional development in India, identification of natural and biological resources including gene pool.

UNIT-IV: Industrial and urban environmental problems in India: Industrial development – impact on resources depletion and pollution (case studies), environmental problems of urbanization, environmental problems of slums, population poverty and environment in India, international trade and economic reforms on the environment, industrial growth, environmental and ecology in India, major issues in sustaining growth and development in less developed countries.

UNIT-V: Conservation of wetland, wastelands and mangroves

Recommended Books:

1. CEE towards a green future – CEE Ahamedabad 1999.
2. Waste minimization – Prasal Modak
3. Towards an agro-ecosystem policy for India – A Damodharan
4. environmental economics for sustainable development – Kumar
5. Ecology and economics: an approach to sustainable development – Sengupta
6. environment, Development and sustainability – Bhaskar Nath
7. Water technology management challenges and choices – A.K. Barua.

ENVS-124 (Paper - X): Air, water and noise Pollution Control Technology

UNIT- I: Air pollution control technology: Air pollution monitoring – ambient air quality monitoring, stack monitoring; control methods for particulate matter – gravity settling chamber, scrubbers and washers, electrostatic precipitator, cyclone dust collector; control of gaseous pollutants – absorption, adsorption and combustion recovery system.

UNIT-II: Waste water collection systems: Strom sewer system; sanitary sewer system; measuring and sampling in sewers; sewer testing; lift stations in wastewater collection

Sampling of wastewater for physico-chemical and bacteriological analysis;

UNIT-III: Design and functioning of treatment plants: Concept of water treatment plant (WTP), sewage treatment plant (STP), effluent treatment plant (ETP), common effluent treatment plant (CETP); design aspects of major units in treatment plants and their functions – coagulation tank, sedimentation tank, aeration tank; trickling filters, bioreactors, sludge drying bed, activated carbon filtration unit, multimembrane filters;

UNIT-IV: Water pollution control technology: Primary treatment – screening, grit removal, skimming tank, sedimentation, equalization; secondary treatments – coagulation, flocculation, filtration , chemical precipitation, membrane filtration, water softening, activated sludge process, aerobic lagoons, oxidation ponds, septic tank, imhoff tank; Advance treatment technology – nutrient removal, reveres osmosis, UV radiation, ozonization, chlorination, Up flow anaerobic sludge blanket (UASB), suspended solid removal,

UNIT – V: Noise control technologies: Noise monitoring, noise monitoring device, ear muffs, silencers, noise absorbers, anti noise device; Noise control methods.

Recommended books:

1. water pollution: A.K. Tripathi and S.N. Pandey
2. Waste water engineering treatment, disposal and resue – Metcalf and Eddy.
3. Water supply and sanitary engineering – R.C. Rangawala.
4. Introduction to waste water treatment process – Ramalho R.S.
5. Water pollution – V.P. Kudesia
6. Eco-technology for pollution – R.K. Trivedi and Arvind Kumar
7. Environmental engineering control and environmental management – Arcadio. P. Sincero and Gregoria.
8. water and wastewater technology – Mark J. Hammer.

ENVS-125(Paper - XI): Lab Course – III

1. Determination of soil moisture by using soil moisture meter.
2. Determination of light intensity by using Lux meter.
3. Study of water and waste water sampling devices and sampling techniques in water analysis.
4. Study of preservation techniques in water sample for different analysis.
5. Determination of total solids from sewage sample.
6. Determination of total suspended solids from sewage sample.
7. Determination of volatile solids from sewage sample.
8. Determination of redox potential from water sample.
9. Determination of acidity from water sample.
10. Determination of alkalinity from water sample.
11. Determination of calcium carbonate content from the soil sample
12. Determination of Calcium content from water sample
13. Determination of Magnesium content from water sample
14. To study the design, working and problems of primary clarifier.
15. To study the design, working and problems of trickling filters.
16. To study the design, working and problems of septic tank.
17. Problems on calculation of capacity of aeration tank in activated sludge process.
18. Determination of sludge volume Index of waste water.
19. MS-Word
20. MS-Power Point.
21. MS – Excel
22. Introduction of internet.

ENVS-126 (Paper - XII): Lab Course – IV

1. Determination of biochemical oxygen demand (BOD) of water sample
2. Estimation of organic matter from soil by ignition method..
3. Estimation of organic matter and organic carbon from soil by Walkle's – Black method.
4. Estimation of sulphate from water sample.
5. Estimation of nitrates from soil sample.
6. Estimation of ammonia from water sample.
7. Estimation of chromium from water sample.
8. Estimation of soluble and leachable Calcium and Magnesium from soil sample
9. Estimation of total hardness from water sample.
10. Calculation of mean, mode and median from data.
11. Calculation of standard deviation from data.
12. Calculation of variance from data.
13. Calculation of standard error (SE) from data.
14. Problems on correlation coefficient.
15. Problems on probability.
16. Problems on t- test.
17. Problems on z-test.
18. Problems on F- test.
19. Problems on ANOVA.
20. Problems on ANCOVA.
21. Problems on chi-square test.
22. Problems on Regression equation.

M.Sc Environmental Science, Part II, Semester – III

ENVS-231 (Paper -XIII): Waste Treatment Technology

Unit – I: Introduction to Solid waste: Definition, type's- ashes, residues, grit, debris, garbage, trash, dead animal, abonded vehicles etc., classification (municipal, industrial, biomedical, agricultural, commercial), characterization – physical and chemical characteristics; percent composition study of solid waste.

Unit – II: Collection, transportation of solid waste: waste storage devices – waste collection bin, collection system pattern, collection equipments, storage transportation equipments, waste dumping grounds.

Unit – III: Solid waste Treatment methods: Physical - Open dumping, sanitary land filling, ocean dumping and incineration; chemical methods – pyrolysis; biological methods - composting.

Unit – IV: Eco-technology for solid waste treatment: Composting of solid waste (aerobic & anaerobic). Vermiculture and Vermicomposting methods. Recycling & Reuse – paper, plastic, rubber, glass and metal.

Unit – V: Biomedical waste treatment: Definition, classification, color coding, collection and transportation of biomedical waste, methods of biomedical waste disposal –sterilization, Incineration, pyrolysis.

Reference Books

1. A. D. Bhide and B. B. Sunderson, Solid Waste Management in developed Countries, INSDOC, New Delhi (1983).
2. Sinha R. K., Sinha A. K., Saxena V. S., A book on Waste Management INA, Shri Publishers, Jaipur (2000).
3. Robert A. Corbett, Standard Handbook of Environmental Engineering, Mc-Graw Hill, (1989).
4. E. D. Enger, B. F. Smith, Environmental Science – A study of interrelationship. 5th Edn W.C.B. Publn., London (1995).
5. D. Botkin and E. Keller, Environmental science – Earth as living Planet John Wiley and Sons Inc., New York, (1997).
6. Integrated Solid waste Management: George Techbanoglow Theisen and Vigil.
7. Environmental Pollution and Engineering : C. S. Rao
8. Environmental Engineering: Arcadvo. P. Sincero & Gregoria A. Sincero Prentice Hall of India Pvt. Ltd.

ENVS-232 (Paper-XIV): Toxicology and Hazardous Waste Management

UNIT- I : Scope and concept of ecotoxicology and toxicology, paracelsus's view of poison; clinical, environmental, economic toxicology; xenobiotic concentration and dose, calibration of dose response curve, lethal dose, LC_{50} and safe concentration, acute toxicity, chronic toxicity; bioconcentration and biomagnification of toxicants, toxicity Vs chemotherapy; Neurotoxicity, carcinogenicity and mutagenicity.

UNIT-II: Bio-assay techniques; protocol of toxicity evaluation of toxicants, Tests for assessing carcinogenicity and mutatoxicity of toxic compounds, TLC techniques for determination of toxicants in water and vegetables samples.

UNIT-III: Classification of toxicants; natural and synthetic toxins; chemicals classification and mode of action of pesticides; Recent trends in the use of pesticides; Plant toxins- Aflatoxins, ergots, pyrethroids; Heavy metal pollution caused by lead, arsenic, mercury, cadmium and chromium; Heavy metals effect on human health; Factors affecting metabolism of xenobiotics.

UNIT-IV: Hazardous waste management: Nature and scope of hazardous wastes, classifications of hazardous substances and wastes, hazardous waste and air and water pollution, physical forms and segregation of wastes, hazardous substances and health problems, Dumping up of garbage from houses, hotels and hospital and their effects on soil substratum and public health; Separation of waste at sources of generation for recovery plastic, paper and metal etc; Need of hazardous waste management; type of waste-biodegradable, refractory and inorganic; Radio actives waste- sources characteristics and disposal methods safe to environment; Industrial wastes-Industrial sludge; Safe disposal of insecticides, caustic soda, chlorine plants.

UNIT-V: **Waste treatment and disposal:**
Treatment and disposal of hazardous wastes; reduction, recycling and reuse methods of waste; waste treatment methods- neutralization, oxidation, reduction, precipitation, solidification, stabilization, incineration, pyrolysis and wet-oxidation etc.; land filling of hazardous waste; leachate management, land farming, bioremediation, degradation of recalcitrant xenobiotics; Transportation of hazardous wastes; import and export of hazardous wastes.

Reference Book

1. Principles of Environmental toxicology:-Ian C.Shaw and John Chadwick, Taylor and Francies
2. Environmental Toxicology and Chemistry:-Donald G. Crosfy 1998
3. Text book of modern Toxicology:- David A. Wright and Pamela Welbourn Cambridge University Press 2002.Ernest Hodgsen and patricia E.levi Appleton and Lange Stamford etc U.S.A.1995.
5. Basic Toxicology:- Frank C. Lu, Homisphere publishing Corporation, New York, Washington 1993.
6. Essentials of Toxicology:- Loomis TA, Leae Fabiger.
7. Toxicology:-Hayes.
8. Principles of toxicology:-Cassarett and Doulls.
9. Environmental Engineering:- M.Narayanrao.
10. Solid Waste Management in developing countries:-A.D.Bhide
11. Integrated Solid Waste Management:-George Tehbanoglous Theisen and Vigil.
12. Guide lines for setting up operating facility:-Hazardous waste management CPCB Manual, 1998.
13. Environmental Pollution and Toxicology:-S.P.Ray, Chaudhari, D.S. Gupta.
14. Environmental Engineering designing approach:-Arcadia P. Sincero Gregoria A.Sincero Prentice hall of India Pvt. Limited.
15. Encyclopedia of Environmental control technology (9 Vols. Set):- Paul N.Cheremisinoff Technip Book International.

ENVS-233 (Paper - XV): Industrial Safety and Policies

Unit I: Industrial Safety
Safety management: General principles of safety management; need for safety humanitarian; economics, legal and social consideration of industrial safety; role of management in industrial safety; safety management-principle and practices.

Unit II: Safety and Housekeeping:
Typical accidents due to poor housekeeping; disposal of scraps and other trade wastes; Prevention of spillage; marking of aisles. Space and other locations, use of colors as an aid for good housekeeping. Housekeeping contest. Inspection and checklist.

a) Ventilation and heat control:
Purpose, physiology of heat regeneration. Thermal environment and its measurement. Thermal comfort. Heat stress indices. Natural and mechanical ventilation. Engineering control methods.

b) Noise and vibration
Effect of noise, measurement and evaluation of noise. Noise isolation, noise absorption techniques, silencers, control of noise. Vibration effect, measurement and control by vibration damping.

c) Hazards identification techniques:
Hazard analysis – inductive deductive. Fault tree analysis, event tree analysis

Unit III: Factors contribution towards Fire:
Chemistry of fire, Classification of fires, Common causes of industrial fires. Determination of fire load, Major industrial disaster –case studies.

Unit IV: Environmental policy:
Government policies in the protection and development of environmental – environmental considerations in economic planning and development in India. Public policy strategies in pollution control. Environmental policy resolution. NCEP and district environmental committee**.**

Reference Books

1. Frank Lees Book on loss prevention in process industry, vol. 1 & 2.
2. Industrial safety / safety management – K.G. Mistry
3. Safety Management – Grimandi and siemens.
4. Safety supervision – Peterson
5. Eleventh edition of NSC, USA
6. IS 14489 On Safety Audit
7. Factories Act 1948
8. Environmental Protection & Law – H. V. Jadhav & V. M. Bhosale
9. Law Science & Environment – R. P. Ananad
10. Instrumental Methods of chemical analysis – Willard Merrit Dcan.
11. Analytical Spectroscopy – Chhatwal
12. Analytical Instrumentation – NEERI Publication
13. Analytical Chemistry – Kennedy
14. Instrumental Method –Sharma
15. A text Book of Quantitivative Inorganic Analysis – A. L. Vogel
16. International Environmental Policy emergence and Dimension by L. K. Caldwel 1990.

ENVS-234 (Paper - XVI): Environmental Biotechnology

Unit – I: Biodegradation of waste:
Degradation of biopolymers cellulose, hemicelluloses, chitin, degradation of lignin, degradation of hydrocarbons, biodegradation of agricultural produce, mycotoxins in biodeterioration. Biodegradation of pesticides environmental use of microorganisms in pest control: - microbial pesticides, microbial herbicides. Biodegradation of industrial waste**.**

Unit - II: Bioremediation:
Need and scope of bioremediation, environmental applications of bioremediation; types of bioremediations, types of bioremediation, bioremediation efficiency testing, approaches to bioremediation; bioremediation of contaminated soils and aquifers; bioremediation of marine oil pollutants; bioremediation of industrial waste. Bioremediation of air pollutants; Phytoremidiation – root zone technology, bioindicators; bio-markers; biosensors in waste treatment.

Unit - III: Biofertilizers and biopesticides:
Rhizobium and Azospirillum blue green algae and Azolla, composting process, nitrogen fixing microorganisms, VAM fungi, Cacillus thuringesis; nuclear polyhodrosis virus; biopolymers and bisurfactant. Advantages and limitation of Biofertilizers. Vermicomposting technology**.**

Unit – IV: Industrial microbiology:
Fermentation technology – biofermentors, role of fermentation in alcohols, antibiotics, amino acid, dairy products enzymes, vitamin productions and other organic acids. Immobilization technology:- immobilization of enzyme and cells hydrogen evolving bacteria. Methods of biogas generation and process of biogas production. Microcosm technology; ecotechnology.

Unit – V: Microbial Biotechnology:
Role of microbes in biodegradation of xenobiotic compounds:- halocarbons, polychlorinated biophenyls, alkyl benzyl sulphonates, oil mixtures and public health, microbes and food; role of microbes in the recovery of metals, papers industry, medicines, synthetic fuels and biomedical waste. Novel methods in environmental biotechnology and their management.

Reference Books

1. Eco-informatics Vol 1 – V: S. K. Agrawal A. P. H. Publishing Corporation 5, Ansari road, Darya Ganj New Delhi – 110002.
2. Microbiology methods for Environmental Biotechnology: Grainer, J. M. and Lynch, J. M. 1984, Academic Press.
3. Microbiological methods for environmental scientist and engineers: Gaidy A. F. and Guady, E. T. 1980. Mc Graw Hill.
4. Microbiological Ecology fundamental and applications: Ronald M. Atlas and Richard Bartha 4th Edition Aimprint of Addison Wesley Longman Inc. – 1998.
5. environmental Biotechnology Principal and Applications : Bruce E. Rittmann and Perry L. Mc carty Mc Graw Hill Int. 2001.
6. Environmental Biotechnology: S. K. Agrawal APH Pub. 1998.
7. Biotechnology (Application & Research) Edition 1985 : Paull N. Cheremisioneyr, Robero. Ovelleate, technomic publishing co. Lancaster.
8. Biotechnology I Edition (1998) : B. D. Singh Kaylai Publishers, New Delhi.
9. Biotechnology a New Industrial revolution: Steve Prentis.
10. A text book of Biotechnology : G. K. Chatwal Amol Publications, New Delhi
11. Advances in Biotechnology: Jogdand S. N. Himalya publishing New Delhi.
12. An Introduction to Biotechnology: S. C. Jain, Kitab Mahal, allhabad.
13. Biotechnology: Keshav Trehan New age international Hyderabad.
14. Elements of Biotechnology: P. K. Gupta, Rastogi Publication, Merrut.
15. Biotechnology & Environment: Trivedi R. N.
16. Biotechnology and Pollution Control : Prabhaakar V. K.
17. A text book of Biotechnology: S. K. Thimmaih, Himalaya publishing house, New Delhi.
18. Biotechnology the biological principles: M. D. Trevan, S. Boefty, Tata McGraw Hill New Delhi.
19. Environmental Biodegradation, 2000: Ram Kumar, Sarup & Son's publisher New Delhi.
20. Eco-informatics Vol 1-V: S. K. Agrawal A. P.H Publishing corporation 5, Ansari Road, Darya Ganj New Delhi – 110002.

ENVS-235 (Paper - XVII): Lab Course – V

1) To study the common test animals of toxicity assessment and their acclimation.
2) To study he dose response curve of toxicant with respect to different concentration and exposure time in same size test animals.
3) To study the dose response curve of toxicants with respect to different body size and exposure time in same concentration of toxicant.
4) Determination of lethal dose of toxicant (pesticides / heavy metals compounds) in test animal (Channa fish) in 24 hours.
5) Determination of LC_{10} LC_{50} & LC_{90} of toxicant (pesticide/heavy metal compound) in aquatic animal (fish/snail) for 24, 48, 72 & 96 hours exposure.
6) Determination of lethal dose of toxicant (pesticide / heavy metals) in test animal.
7) Determination of safe concentration of toxicant (pesticide/heavy metals) in test animal.
8) Toxicity assessment of solid/powdered form of toxicant in solid-solid mixture and determination of LC_{50} value for 24 hours.
9) To study the effect of acute exposure of toxicant on oxygen consumption in aquatic test animal.
10) To study the chronic effect of toxicant on carbohydrate/ protein content of tissue in test animal.
11) Qualitative detection of pesticides in tissue of pesticide exposed test animal by TLC method.
12) To study the bioaccumulation of toxicant in test species (plant/animal).
13) Qualitative detection of toxic substance in waste water by TLC.
14) To study the solid waste from house, hotel, garden, market and from industry.
15) To study the percentage composition of degradable and non-degradable material from solid waste.
16) Comparative study of physical parameters of solid waste i.e. pH, Moisture content and Ash content.
17) To study the percentage of potential recycling material from municipal solid waste.
18) Determination of total organic carbon present in compost prepared from solid waste.

19) Preparation of vermicompost from garden waste and municipal solid waste.
20) To study the pH & moisture of vermicompost prepared from solid waste.
21) Determination of total nitrogen content from vermicompost of solid waste.
22) Determination of total phosphorous content from vermicompost of solid waste.
23) To study the leachable calcium and magnesium content from vermicompost prepared from municipal solid waste.
24) To study the calorific value of organic biomass from solid waste by titrometric method.

ENVS-236 (Paper -XVIII): Lab Course – VI

1) Solid and liquid hazardous waste collection from different sources (industries).
2) To study and list the laboratory safety and industrial safety principles and practices.
3) To study the impact of solid hazardous waste (toxic substance)on germination and growth of crop plants.
4) To study the dissolve oxygen content from industrial waste water by modified Wrinkler's method.
5) To study the potential plants for phytoremidiation and their collection
6) The reduction of TS and TSS level from waste water by using phytoremidiation technique.
7) The reduction of COD of waste water by using phytoremidiation technique.
8) Determination of oil and grease from waste water collected from vehicle servicing centers.
9) Determination of iron content from waste water sample in which iron material is corroded.
10) Determination of lead (Pb) content from wastewater sample by using spectrophotometer method.
11) Determination of Mercury (Hg) from industrial waste water sample.
12) Determination of Zinc (Zn) from industrial waste water sample.
13) Estimation of Nickel from industrial effluent.
14) Estimation of cooper from industrial effluent.

15) Estimation of Aluminum from industrial effluent.
16) To study the rate of settling of suspended material form waste water.
17) Determination of residual chlorine content from chlorinated water samples.
18) Determination of sludge volume index of waste water.
19) Determination of available chlorine from bleaching powder.
20) Determination of sodium hydroxide content from caustic soda.
21) Determination of sulphates from caustic soda.
22) Determination of moisture content from lime powder.
23) Determination of chlorides from caustic soda.

Note: The project work is to be allotted at the beginning of the IIIrd semester.

M.Sc Environmental Science, Part II, Semester –IV

ENVS-241 (Paper - XIX): Environmental Impact Assessment and Environmental Audit

Unit I: Definition of EIA:

Concept, scope and objectives, sustainable development and EIA – Need for environmental impact assessment, Impact assessment methodology, environmental impact statement, EIA notification of 1994. environmental assessment guidelines of various categories of EIA, rapid EIA, compressive EIA, Regional EIA, Strategic EIA, Various components in EIA.

Unit II: Assessing Impact

Baseline data evaluation, risk assessment and mitigation with respect to flora and fauna, ground and surface water, air quality and climate, transport, social and economic impacts etc. environmental management plan (EMP) and environmental monitoring, Public participation in EIA., Role of remote sensing and GIS in EIA studies.

Unit III Environmental Audit

Introduction – Designing and implementation of audit tools – pre audit activities – on site activities – post audit activities – Environmental statement – benefits of environmental audit – EA scenario in India – submission of Environmental Audit report in MoEF format – form VB.

Unit IV:

Life cycle assessment, life cycle analysis, eco – labeling eco-marks, eco-tourism, eco-feminism, Environmental management, ISO 9000 and 14000; Eco-regulation, eco-accountability, green management, green accounting, green products, green claims, eco wars.

Unit V:

Environmental performance evaluation, Competitive evaluation, competitive intelligence, decision making in environmental management, environmental risk management, Patenting and intellectual property rights, The world's intellectual property organization (WIPO) convention.

Reference Books

1. Environmental Impact Assessment: A. Eillpin.
2. Environmental Impact Assessment and Management: H. Kumar (1998).
3. Environmental Impact Assessment of Tehri Dam: V. Govardhan.
4. Practical guide to Environmental Impact Assessment: Belly Bowers and Marriott (1977).
5. Environmental Impact Assessment: A. K. Shrivastava APH Publication 2003.
6. Law of Intellectual Property: Dr. S. R. Mysani Asia Law House (2nd Edition) Law Book Sellers, Publishers and Distributors Hyderabad.
7. Environmental Impact Assessment, L. W. Canter, McGraw Hill publication, New Delhi.
8. Proceedings Indo-US workshop on environment impact analysis and assessment (1980) NEERI, Nagpur.
9. Environment & Social impact assessment, Vlcany, F., Bronsetin DA (1995), John Wiley & Sons, New York.
10. EIA – A Biography. B. D. Clark, B. D. Bissel, P. Watheam.
11. Second world congress on engineering and environment 1985, Institution of engineers.

ENVS-242 (Paper - XX): Environmental Monitoring and RS, GIS

Unit I Remote sensing:
Fundamentals and concepts of remote sensing, active and passive remote sensing, elements of photographic remote sensing, Types of aerial photographs, scale of photographs.

Unit II Interpretative aspects of aerial photographs – principle and techniques:
Application of aerial photographs, Mapping from satellite imagery - forest, water resources, agriculture and land use; Applications of remote sensing to study the change in land use/land cover pattern, Indian scenario of remote sensing.

Unit III: Role of remote sensing in studying deforestation, soil erosion, flood mapping, flood damage assessment, drought assessment, and water shed management and in studying oceanic resources.

Unit IV: Geographic information system: Definition, principles and scope of GIS, capabilities and advantages of GIS, use of GIS in spatial analysis, graphics output, Raster and vector data structure, Introduction to GIS and software packages, GIS softwares application in environmental management and EIA studies, Digital Terrain Model, data base concepts for GIS data quality, data classification multivariate analysis, Use of image processing and GIS in environmental studies, GIS and economic models as information system for sustainable development, Geographical positioning system.

Reference Books

1. Remote Sensing and Image Interpretation:-Tomas M.Lillesand and Ralph W.Keifer john Wiley and sons Inc.New Yark.
2. Introduction to Remote sensing:-James B. Campbell, Tylor and Franeis Ltd.Londan.
3. Fundamentals of GISN:-Michael N.Demers..
4. Remote Sensing application in applied geosciences:-Sumitra Mukherjee, Milton Book Company.
5. Environmental Geography:-H.M Saxena, Milton Book Company.
6. Principles of Photogeology:-Singh.
7. Principles of Remote Sensing:-Currain.
8. Fundamentals of Photogeology:-S.N.Pandey.
9. PC Software made simple:-Taxali.
10. Illustrated lotus 1-2-3:-by Muller.
11. Principles of Remote Sensing:-A.N.Gatel and S.Singh, Scientific Publishers (India). Jodhpur (1999Edition).
12. Remote Sensing for Environment and Forest Management:-A.Mehrotra and R.K.Suri.Indus Publishing Co.New.Dehli(1994 Edition)
13. Remote sensing for large wildfires:-E.Chuvieco, Springer, New York (1999 Edition).
14. Remote Sensing in Geoscience:-Tripathi N.K.
15. Remote sensing and GIS for site characterization;-Application and standard:-Singhroy, Technip Books International New Delhi.
16. Environmental Remote Sensing:-Saumirta Mukherjee.

ENVS-243 (Paper - XXI): Environmental Issues and Legislation

Unit – I: Global environmental Controversies:
Environmental movements and peoples responses; social, political and economic issues in the controversies over natural resources, silent valley, Narmada Project, Almatti dam project, Sardar Sarovar project, Tehri dam, Koyna dam, MIC gas tragedy, Chernobyl tragedy, impact of Mahtura refineries on Taj Mahal.

Unit – II: Global Environmental Issues: climate change, green house emission rate; ozone layer depletion; global warming, loss of biodiversity.

Unit – III: International Organizations & Events :
Stockholm conference, 1972; Earth Summit, Agenda – 21, World Commission of Environment & Development (WCED); World Water Council (WWC); World Health Organization (WHO); United Nations Environment Programme (UNEP); International Union for Conservation of Nature and Natural resources (IUCN); Tbilisi Declaration, Montreal Protocol; Kyoto Protocol; World Wide Fund for Nature (WWF).

Unit- IV: Environmental Legislations:
The Water (Prevention & Control of Pollution) Act 1974; Air (Prevention & Control of Pollution) Act, 1981, Environment (Protection) Act, 1986; Wild Life Protection Act 1972; Indian Forest act, 1927 and ; The Forest (Conservation) Act 1980; Solid Waste (Management & Handling) Rules, 2000; Hazardous Waste (Management & Handling) Rules, 1989; Biomedical Waste Management Rules, 1998; Public Liability Insurance Act 1991.

Reference Books

1. Hand Book of Env. Laws, Acts, Rules, Guidelines, Compliance and Standard Vol. 1 & 2: R. K. Trivedy Environmental Edition: 1st 1996.
2. Pollution control Acts, Rules and notifications issued there under: Central Pollution Control Board April. 1995.
3. Environmental Protection and the Laws: C. N. Mehta, 1991.
4. Legal aspects of Environmental Pollution and its Management: Ed. S. M. Ali, 1992.
5. International Environmental Policy Emergence and Dimensions: by L. K. Caldwel 1990.
6. Lal's Commentevis on water, Air pollution laws along with the environmental (Protection) Act and rules 1986, 3rd Rd. 1992: Law Publisher India.
7. Universal Environment and Pollution law manual: S. K. Mohanty 1998.
8. Pares Distn. Environmental Laws in India: (Deep, Lated Edn).
9. Environmental Problems, protection and control Vol I & Vol II Ed: Arun Kumar.

ENVS-244 (Paper - XXII): Environmental Education and Environmental Economics

Unit – I: Environmental Education: Definition, background, need, principles and objectives of environmental education, Types of environment education (Formal & Non Formal), stages of environment education, current status of environment education in India.

Unit – II: Environmental Education & Awareness: Concept of environmental awareness, methods of environmental awareness, role of environmental education in awareness programmes, Role of NGO's in environmental education; environmental awareness thorough mass media.

Unit – III: Environmental Economics: Definition & Scope; Interlink age between economy and environment, Circular flow diagram, Concept of spaceship earth, material balance and Eutrophic law.

Unit – IV: Theories of Environmental Economics: Economic growth and environment – limit to growth model, Market failure, optimum level of pollution, polluters pay principle; pollution taxes Vs direct controls, cost benefit analysis of the environmental amenities, direct and indirect methods, concept of sustainable development.

Unit –V: Sustainable economic development and economics of environment in the context of SAARC countries; Economics of minerals production in India; Willingness to pay and accept compensation, use, option, existence and Bequest value, tax on emission, tradable pollution permits

Reference Books

1. Indian Economy in International Perspective, 1994: Gaur K. D, Meshram P. J. Shashidharan K.L. ed. Sarup and Sons publishers Ansari Road, Darya Ganj New Delhi.
2. Environmental Economics, 2001: Madhu Raj ; Sarup and sons publishers, New Delhi.
3. Environment & Social Issues, 2000: Sunit, Gupta Sarup and Sons Publishers, New Delhi.
4. Global Environment: Current Status, 2000: Sunit, Gupta Sarup and Sons Publishers, New Delhi.
5. Environmental economics for sustainable development accounting and valuation 2001: Some issue in modeling Kumar (Pushpam).
6. Environmental Crisis and Management: Sunit, Gupta Sarup and Sons Publishers, New Delhi.
7. Ecology & economics: An approach to sustainable development and sustainability: Bhaskar Naath, Luc Hens, David Pimental.
8. Environmental Remote sending By: Saumitra Mukharajee.

ENVS-245 (Paper - XXIII): Lab Course – VII

1) Marginal information of Toposheet.
2) Indexing of Toposheet.
3) To study the conventional signs and symbols from Toposheet.
4) Interpretation of Toposheet.
5) To study of conventional signs and symbols from weather map.
6) Interpretation of weather map.
7) To study the principle and application of stereoscope and parelex bar.
8) Scale determination of aerial photograph.
9) Cover study with the help of aerial photography.
10) Identification & mapping of the land use patterns with the help of aerial photographs.
11) To study the change in land use pattern of an area with help of aerial photographs and survey if India Toposheet.
12) Determination of height of object from aerial photograph by using parelex bar.
13) Ground trouthing of objects form aerial photograph/ Toposheet by using GPS.
14) Use of the stereoscope for the identification of closer and far floating objects.
15) Introduction to GIS SOFTWARE used for satellite imageries processing.
16) To study the landuse and land cover pattern with the help of satellite imageries.
17) Monitoring of sound level from silent zone(Educational institution, library, hospital) and from commercial and heavy traffic zone.
18) Immobilization of cultured bacterial sample.
19) To study the principle, working and application of water, waste water & sediment sampling equipments : i) simple water sampling bottle; ii) modified water sampling bottle; iii) Nenson's reversible sampling bottle; iv) Van Dorne's sampler; v) Ekmen's grabe ; vi) Paterson's dredge; vii) core sampler; viii) Ooze sucker
20) Determination of insoluble material from non ferric alum.
21) Determination of water soluble Aluminum compound as (Al_2O_3) from alum by volumetric method.
22) Determination of relative humidity of air.
23) Determination of percentage of calcium from lime.

ENVS-246 (Paper - XXIV): Lab Course – VIII

Inplant Training and Project Work

The distribution of marks of this paper is as follow:

i) Inplant training – 10 marks.
ii) Project Work – 40 marks.

Note: i) The Inplant training is to be given in summer vacation.
ii) The project work is to be allotted at the beginning of the IIIrd semester.