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 Biotechnologies	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: Environmental controversies: Narmada dam, Almatti dam, Sardar sarovar dam, Tehri dam, Slilent vally, Bhopal gas tragedy, Chernobyl disaster;

UNIT-VI: 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.