SHIVAJI UNIVERSITY, KOLHAPUR.

B

Accredited By NAAC
2009
New Syllabus For

M.Sc. I &II

Environmental Science
(Sem.-I to IV)

Syllabus to be implemented from June 2012 onwards.

DEPARTMENT OF ENVIRONMENTAL SCIENCE,

SHIVAJI UNIVERSITY, KOLHAPUR

Revised Syllabus 2012 - 13

M. Sc. Environmental Science

Semester I

Paper I : Introduction to Environmental Science (60 Lectures)

Unit -1

a) Introduction to Environmental Science : **(15)**

Meaning, scope and interdisciplinary nature of Environmental Science, principles background and scope of environmental science, Environmental Science and technology, Media and people, decision making and applications of Environmental Science.

b) Environmental ethics:

Nature and origin of environmental ethics, ecological consciousness, western and eastern views, philosophy of environment, Environment community and equity, integrating ethical values and knowledge, self centred development and environment.

Unit- 2 Global and national environmental issues: (15)

Ozone depletion, Greenhouse effect, Acid rain, Global Warming, Carbon credits, Climate change, Deforestation, Biodiversity loss, Desertification.

Unit -3 Human impact on environment and its consequences (15)

Hunting and gathering, agriculture societies, industrial societies, impact of cultural change on environment, population explosion, degradation of natural resources, pollution of air, water and soil, urbanization, industrialization, food security, public health, energy crises.

Unit- 4 Concept of carrying capacity : (15)

Biotic and abiotic components of environment, The concept of Sustainability and carrying capacity, tragedy of commons, human population and food, water and energy security, present status of environment and future scenarios.

References;

1. Environmental Science - Arms Karen
2. Principles of Environmental Science-Watt, K. E. F. (1973) McGraw-Hill Book Company
3. Environmental Science –Noble, B .J. Kormandy, E.J.(1981),The way world works, Prentice-Hall Inc., N .J.
4. Environmental Science-Turk A. , Turk J. Wittes J.T. and Wittes, R.E.
5. Environmental Issues: Measuring, Analyzing, Evaluating, Abel, Daniel C. McConnell, Robert L. Abel, Daniel C. Edi. 2 Prentice Hall Publication

Paper II : Environmental Chemistry (60 Lectures)

Unit – 1

a) Concept and scope of Environmental Chemistry (**15)**

Concept and scope of environmental chemistry, Chemistry of environmental segments-lithosphere, hydrosphere, atmosphere.

b) Basic concepts of Environmental Chemistry:

Stoichiometry; Gibb's energy; chemical potential; chemical equilibrium; acid - base reaction; solubility product; the carbonate system; unsaturated and saturated hydrocarbons, radionuclides.

Unit -2

a) Chemistry of Air: (15)

Classification of elements in air; composition of air; chemical speciation; particles ions 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.

b) Chemistry of water and soil :

Chemistry of water, structure of water molecule, water quality parameters, solubility of gases in water, the carbonate system, Industrial water pollution,

Chemistry of soil, Inorganic and organic components of soil, Chemical factors affecting the soil quality, adsorption of contaminants in soil, Effect of modern agro-technology on quality of soil, General accounts on composition of industrial waste and urban waste.

Unit – 3

a) Chemistry of Organic and Inorganic chemicals in the Environment (15)

Organic chemicals in the environment, aliphatic aromatic hydrocarbons, soaps, detergents, polymers, drugs, dyes, oil and grease, Inorganic chemicals in the environment, Inorganic gaseous pollutants, Particulate matter, trace leave toxic metals, Inorganic pesticides and fertilizers, acids, alkalis.

b) Environmental monitoring and sample analysis

Sampling of air and water pollutants, Monitoring techniques and methodology, pH, Dissolved Oxygen (DO), Chemical oxygen demand (COD), Biological Oxygen Demand (BOD), Speculation of metals, monitoring and analysis of CO, NOx, CO2, SOx, pesticide residue, phenols and petrochemicals.

Unit -4

Instruments used in environmental monitoring (15)

Theory; principle; working and applications of following sampling instruments: pH meter; EC meter; DO meter; Nephlometer, Colorimeter; Atomic Absorption Spectroscopy (AAS), Flame photometry, X-ray Fluorescence, UV-Visible spectrophotometer, IR Spectroscopy, High performance liquid chromatography (HPLC), Gas chromatography (GC), NMR , Global Positioning System (GPS)

References:

1. Environmental Chemistry by B. K. Sharma S. H. Kaur Goel Publishing House, Meerut
2. Environmental Chemistry - A.K. De, New Age Intt. Pub. Co., New Delhi, 1990
3. Toxic Chemicals, health and the Environment, Lave, L.B and Upton, A.C. 1987. The Hopkins Press Ltd., London.
4. Vogel's Textbook of quantitative Chemical analysis, 5^{th} Edition-J. H. Basett, J. Nendham and Denny, R.C.
5. Instrumental Methods of analysis – Chatwal and Anand
6. Chemistry for Environmental Engineering, C. N. Sawyer and P L Mc Carty, McGraw Hill Kogakusha ltd., 1990
7. Fundamentals of Analytical Chemistry, 1982.Hobert H. Willard D.L. Merrit and J. R. J. A. Dean,

Paper III : Environmental Biology (60 Lectures)

Unit – 1

a) Ecology: (15)

Definition of ecology and sub divisions, Relation to other sciences, Relevance to civilization, levels of organization hierarchy, Cake and other ecological models, Concept of ecosystem, its structure and function, cybernetic nature and stability of ecosystem, Energy in ecological systems, concept of productivity, food chains, food web and trophic levels, ecological pyramids, Concept of habitat, niche and guild, concept of ecotone and edge effect, succession, natural selection, Concept of Gaia hypothesis.

b) Limiting factors and their tolerance

Liebig's law of minimum, Shelford's law of tolerance, limiting factors – temperature, radiation, and water, micronutrients etc.

Unit – 2

a) Population and community ecology (15)

Basic concepts of population ecology, population dynamics, characteristics of population: natality, mortality, fecundity, density, age distribution, relationships among organisms, population explosion, Community types and community composition.

b) System ecology and ecosystem modelling

Basic concepts of system ecology, Ecosystem modelling, compartmental system approach, Experimental components approach, simulation, System analysis.

Unit – 3 (15)

Biomes of the world:

Bio-geographical realms,Classification of biomes – Tundra, Taiga, Grassland, Desert, Evergreen and deciduous forests, Tropical rain forests and their characteristics, flora and fauna; Classification of Aquatic Habitats – Fresh water pond, Wetlands, Rivers – their characteristics, flora and fauna; Marine Habitats – Pelagic, Benthic, Inter-tidal Estuarine; Mangroves ecosystem, flora and fauna of India.

Unit – 4

a) Environmental Microbiology (15)

Prokaryotes, classification of microbes, microbial communities in nature interaction within microbial communities with man, animals and plants, dispersal of microorganisms in different environments, pure culture concept, techniques, preservation and maintenance of microbial culture.

b) Water microbiology:

Waterborne diseases, role of microorganism in treatment of wastewater.

Air microbiology:

aerobiology; allergy; role of microorganism in airborne diseases, Classification and enumeration of microbes in air, dust droplet and droplet nuclei.

Soil Microbiology :important microbes for soil fertility, biodegradation; soil borne diseases, Role of microbes in soil reclamation.

References :

1. Ecology - E.P. Odum, 1983, Holt-Saunders International Edition
2. Concepts of Ecology. E. J. Kormondey, 1984. Indian reprint 1991 Prentice-Hall of India.
3. Ecology and Environment, P. D. Sharma, Ashish publications, 1994.
4. Microbiology – Pelzar, Reid and Chan. Tata Mc Graw Hill Publishing Company Limited, 1996

Paper IV: Information Technology in Environmental Science

(60 Lectures)

Unit- 1

a) Use of information technology in environmental studies (15)

Definition, scope of information technology, history and present status of information technology, application of IT in environmental protection.

Futurology

Futurology and future science, impact of changing life styles and innovative technologies resource crunch and new challenges, future needs and humanity, new ethics, space travel, robotics etc.

b) Environmental Education

Concept of environmental education, history of nature education in India, environmental education and its principles, goals, need, objectives, awareness and action through environmental education.

Unit- 2

a) Environmental awareness through media (15)

Traditional journalism and environmental journalism, Print electronic media, Environment and media, electronic journalism, media environment portrayal in India, documents, Environmental awareness through mass media

b) Role and involvement of NGOs, women and youth in environmental protection

Environmental awareness through workshops, literature, exhibitions, displays, folk songs and folk lore, street plays, games, internet etc. Involvement of social, organizations, women groups, youths nature**,** etc. in environmental protection action.

Unit -3

Traditional knowledge, IPR, and patenting (15)

Traditional information , knowledge and wisdom, intellectual property right (IPR), definition, scope and need in context of liberalization, privatization and globalization, history, present status and regulations of IPR in India, technology, transfer and patenting , rules and regulations of patenting.

Unit -4 (15)

a) Principles of Remote Sensing, its Applications in Environmental Monitoring

Principles of remote sensing, EMR and its interaction with matter, types of sensors and platforms, IRS satellites and their sensors, aerial photography, satellite imagery, elements of aerial/satellite image interpretation, application of remote sensing in environmental studies.

b) Geographical Information System (GIS)

Concept of GIS, Maps and GIS, cartography, digital representation of geographic data, types of geographical data, raster and vector based GIS data processing, their disadvantages and disadvantages, GIS implementation and project management, Importance of GIS in environmental studies.

References:

1. Physical Geography - S. Strahler ,John Wiley and Sons,
2. Earth Science - Turbuck E. J.
3. Earths Dynamic Systems _ Hamblin W. K. and E. H. Christian
4. Planet Earth - Cesare Emiliani.

Semester II

Paper V: Environmental Engineering (60 Lectures)

Unit -1 Waste water Treatments (15)

Primary treatments-principle, flow measurement, screening, grit removal, skimming tank, equalization; sedimentation Secondary treatments- principle, coagulation, flocculation, filtration, chemical precipitation, membrane filtration, activated sludge process, aerobic lagoons, oxidation ponds, septic tank, imhoff tank; trickling filter, rotating biological contactors, Up flow anaerobic sludge blanket (UASB), sludge drying bed, Tertiary treatment - activated carbon filtration unit, disinfection of water -UV radiation, Ozonation, Chlorination, Water softening, Reverse osmosis.

Unit – 2 Design and functioning of treatment plants (15)

Methods of water treatment, 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.

Unit – 3

a) Air pollution control technologies (15)

Meteorology and plume Dispersion, laws governing behaviour of air pollutants, thermodynamics of major air pollutants, Ambient air quality monitoring, Stack monitoring; Particulate matter control equipment's- Settling chamber, Cyclones, Fabric filter, Electrostatic precipitator, Wet scrubber, Control of gaseous pollutants-absorption, adsorption and combustion recovery system, Principle, design and working of catalytic converters.

b) Noise pollution control technologies:

Noise monitoring, noise monitoring devices, ear muffs, silencers, noise absorbers, anti-noise device; Noise control methods.

Unit – 4 (15)

a) Municipal, Industrial and biomedical solid wastes and their treatment :

Need of solid waste treatment, dry and wet waste treatments recovery and recycling of metals, disposal methods for medical, industrial and biomedical wastes, Different methods of disposal and management of solid wastes; conversion of solid waste into energy / manure.

b) Innovative techniques for prevention and control of Pollution

Solar detoxification process, Carbon adsorption, Adsorption media filters, Micro-screening and other low cost treatment methods, Removal of chromium, phenol, mercury, nitrogen etc. from industrial effluents.

References:

1. Waste water engineering , Met Calf and Eddy, INC, Tata Mc Graw Hill
2. Indian Standard For Drinking Water, BSI, New Delhi.
3. Environmental Pollution Control, C.S.Rao, Wiley Eastern Ltd.,1993
4. Air Pollution Control and Engineering, De Nevers, Mc Graw Hills, 1993

5. Fundamentals of Air Pollution, Samuel, J.W., 1971, Addison Wesley Publishing
6. Fundamentals of Environmental Pollution, Krishnan Khannan, S. Chand and Company Ltd.,1994.
7. Noise Pollution, Vandana Pandey, Meerut Publishers,1995.

Paper VI: Environmental Pollution and Control (60 Lectures)

Unit – 1

a) Air pollution (15)

Concept of air pollution, natural and anthropogenic sources, Classification of air pollutants, Meteorological aspects of air pollution, types of air pollution – indoor air pollution, vehicular pollution, industrial pollution; air pollution episodes and disasters, Effects of air pollution on human health, animals, plants, material and climate, Formation of fog and smog, acid rain, Air quality standards, Monitoring of air pollution

b) Noise Pollution

Concept of noise, Sources of noise, Measurement of noise, Monitoring of noise pollution, Noise exposure levels and standards, Physiological and psychological effects of noise; control of noise, prevention of community noise control.

Unit – 2 Water Pollution (15)

Principal forms of water pollution, sources of water pollution, Eutrophication, Water pollution monitoring, Physicochemical and bacteriological sampling and analysis of water, water quality parameters, Water quality standards, Ocean pollution-sources of pollution, effects, control. Ground water pollution - sources of pollution, effects, control, consequences of water pollution, water pollution control.

Unit – 3

a) Solid Waste Pollution (15)

Concept and types of solid waste, Major sources of solid waste, Effects of solid wastes on environment, Classification of waste–Domestic , Industrial , Municipal, Hospital, Nuclear, Agriculture, Waste minimisation technologies,

b) Radiation Pollution

Types, sources- natural and manmade, Units of radiations, Measurement and detection of radiation intensity, effects of radioactive pollution, radioactive fallout; control of radiation pollution, Nuclear reactor safety.

Unit – 4

a) Soil Pollution (15)

Definition; causes of soil pollution; major soil pollutants;, analysis of soil key parameters, soil acidity, saline and alkaline soil, causes of soil salinity, Chemical and metallic pollution in agricultural soil, Mining and soil pollution, physicochemical and biological methods of soil reclamation.

b) Thermal pollution:

Definition; sources of thermal pollution; effects of thermal pollution; Control of thermal pollution.

References:

1. Environmental Pollution Control, C.S. Rao, Wiley Eastern Ltd.,1993
2. Air Pollution Control and Engineering, De Nevers, Mc Graw Hills, 1993
3. Fundamentals of Environmental Pollution, Krishnan Khannan, S.Chand and Company Ltd., 1994.

4. Environmental Chemistry, A.K.De.,New Age Intl. pub Co, New Delhi, 1990.
5. Environmental Pollution Anlysis- Khopkar

Paper VII : Environmental Geo-science and Climatology (60 Lectures)

Unit – 1

a) The universe, solar system and origin of earth (15)

Brief introduction to universe, Sun - its structure and atmosphere, physical characteristics of planets, brief description of – comets, asteroid, meteors, origin of earth.

b) Origin and evolution of biosphere

Origin and evolution of life, spontaneous generation of the life, abiogenic synthesis of low molecular weight organic compounds. Chemical evolution, prokaryotic and eukaryotic cellular evolution, Evolution of organelles and genetic basis for evolution, Theories of evolution.

Unit – 2

a) Atmosphere, structure, composition and dynamics (15)

The vertical structure of atmosphere, composition of earth's atmosphere, thermal stratification, the ionosphere, D.E.F. and G regions, energy transfer near earth's surface, insolation, terrestrial radiation and heat balance of the earth.

b) Definition of climate, weather, measurement of climatic parameters

Concept of Weather, Climate, Meteorology and Climatology, Elements of Weather, Measurement of premise – Temperature, Air pressure, Turbulence, Wind, Rain, Humidity and Radiation. Wind systems of the world, El Nino, Monsoon phenomenon and its role in Indian subcontinent.

Unit – 3

a) Lithosphere - Structure, Formation and processes of change (15)

Structure and composition of lithosphere, composition of soil, soil formation: physical, chemical, biological weathering, soil profile, properties of soil: physical, chemical and biological, soil erosion.

b) Hydrosphere, Composition and circulation of surface and ground waters

Global water balance, types of water, Physicochemical characteristics and composition of sea water, Rain water, River water, Ground water, Hydrological cycle

Unit – 4

a) Bio-geo-chemical Cycles (15)

Gaseous and sedimentary cycles: Carbon cycle, Nitrogen cycle, Phosphorous cycle, Oxygen cycle.

b) Bio-indicators of environmental degradation

Concept of Bioindicators, Bio-indicators as plants, animals, role of bioindicators in pollution control.

References:

1. Ecology and Environment, P. D. Sharma, Ashish publications, 1994.
2. .Ground water Hydrology by D..K..Todd John Wiley and Sons.
3. Ground water contamination (Transport and remediation) by Philp Bedient, Hanadi.
4. S. Rifai and Charles. Publishers: Prentice Hall.
5. Environmental Hydrology by Andy. D. Ward and William J..Elliot, Lewis
6. Environmental Geography, Valdia ,K..S(1987)
7. Environmental Geography, Savindra Singh
8. .Environmental Geology,Keller E.A. and Turk and Turk
9. Introduction to weather and climate-Trewartha
10. Physical Geography - S. Strahler, John Wiley and Sons,

Paper VIII : Environmental Monitoring and Energy Studies

(60 Lectures)

Unit- 1

a) Introduction to energy resources **(15)**

Human energy requirement, Energy use pattern in different parts of the world and its impact on the environment; Energy use pattern in India; Sources of energy and their classification; Energy forms and transformation energy use pattern in rural and urban area, role of IREDA and MEDA in energy generation.

b) Fossil Fuels: Fossil fuels – classification, composition, physiochemical characteristics; Energy content of coal, petroleum and natural gas; Formation, reserves, exploration/ mining and uses of Coal, Oil and Natural gas; Environmental problems associated with exploration/mining, processing, transportation and uses

Unit- 2 **(15)**

a) Solar Energy

Sun as source of energy: Nuclear fusion on sun, Solar spectrum, solar radiation – absorption, reflection, scattering and diffusion in the atmosphere, Albedo, Measurement of solar radiation, Harnessing of solar energy, Solar collectors and concentrators, Solar thermal energy, Solar electricity generation, Solar heaters, dryers, and cookers; Photovoltaic

b) Biomass Energy

Biomass composition and types; Conversion processes – pyrolysis, charcoal production, compression, gasification and liquefaction; Energy plantation; Biogas – production and uses, anaerobic digestion; Environmental constrains; Energy from solid Wastes - Sources, types, energy production

Unit- 3 **(15)**

a) Energy from water:

Principles of generation of hydroelectric power, hazard related to hydropower generation and distribution, environmental impacts, Energy from oceans- OTEC, Tidal energy, wave energy

b) **Wind Energy:**

Wind power, Harnessing of wind energy, Power generation – wind mills, concentrators, wind characteristics and siting, environmental considerations; Wind energy potential in India.

Unit- 4 **(15)**

a) Geothermal energy:

Sources – crust, high temperature aquifers, low temperature aquifers, reserves; Harnessing of geothermal energy – problems and prospect; Geothermal energy prospect in India.

b) Nuclear energy:

Fission and fusion, Nuclear fuels, – Mining and processing of Uranium –concentration, refining, enrichment, fuel fabrication and fuel cycle; Nuclear reactors and radioactive waste; Environmental implications Magneto Hydro Dynamic (MHD) power generation, Fuel cells.

References :

1. Remote Sensing and GIS - M. Anji Reddy.
2. Environmental Remote Sensing - F. Mark Danson.
3. Principles of GIS for Land - Burrough P.A. Resources Assessment.
4. Renewable Energy Environment and Development, Maheswar Dayal Konark Publishers pvt. Ltd.
5. Reneweable Energy Programmes in India : some recent developments , Sinha P.C., Natural Resource Forum, 18(3), 1994.
6. Renewable Energy Resources: Basic Principles And Applications Tiwari, G.N., Narosa Publishing House.
7. Conventional and Non conventional Energy sources G. D Rai.

Semester III

Paper IX: Natural Resources and their Conservation (60 Lectures)

Unit – 1

a) Introduction to natural resources (15)

Definition and concept of resources, types of resources, uses and values of a resource, Abiotic resources- minerals, fossil fuels, water, soil, Biotic resources - Wild animals, fisheries, domesticated animals, plants.

b) Abiotic resources :

Soil as resource, Soil classification, genesis, causes of soil degradation and their effects, Soil conservation practices, wasteland reclamation.

Mineral resource : important minerals; mineral exploitation; use of minerals; environmental problems due to mining; reclamation of mining areas;

Energy resources : conventional energy resources (fossil fuels, biomass), non-conventional energy resources (wind energy, solar energy) energy use patter; environmental problems due to energy use.

Unit – 2

a) Biodiversity conservation (15)

Biodiversity as life support system for man, types of biodiversity, ecosystem, species and genetic, Values of biodiversity, Indian ethos of wildlife conservation, Hotspots of Biodiversity, Causes for loss of biodiversity, measurement of biodiversity; listing of threatened biodiversity.

b) 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), Biodiversity conservation efforts in the country.

Unit – 3

a) Conservation of wetlands, ground water (15)

Wetlands : Definition and classification of wetlands, values of wetland, present status of wetlands in India, RAMSAR convention ,conservation of wetlands,

Ground water: Definition – soil moisture, Water table, Aquifers, Geology of aquifers; Ground water flow; Environmental influences on ground water overuse, Ground water recharging and rain water harvesting.

b) Watershed Management: Concept, objectives, planning and measures; Land use planning for watershed management; Water harvesting and recycling; flood control and watershed management; Socioeconomic aspects of watershed management

Unit – 4

a) Forest resources (15)

Forest as a resource in the past and present, causes of deforestation, Silviculture, Energy plantation, Social forestry, Joint forest management programme (JFM), Agro forestry Systems

b) Natural resource conservation and Natural Resource Accounting

Concept of resource conservation and its importance, economic aspects of resource conservation, planning for the conservation of resources, NRA for soil, water, air and biodiversity resource, Environmental Action Plan (EAP).

References:

1. Environmental Conservation: R. F. Dasman (1968) John Wiley and Sons , New York .
2. Environmental Science , Miller T. G. Jr., Wadsworth Publishing Company.
3. Environmental Biology and Toxicology, P.D. Sharma, Rastogi Publications , Meerut 1985
4. Global Biodiversity Assessment , V. H. Heywood and Watson , R.T.,
5. Essentials of Ecology and Environmental Science , Rana S.V.S ,Prentice Hill Publications , New Delhi

Paper X : Environmental Statistics and Computer applications

(60 Lectures)

Unit – 1 : Data analysis : **(15)**

a) **Population**, Sample, variable, parameters, primary and secondary data, screening and representation of data, frequency distribution, histogram, frequency polygon, ogive curves. Mean, median, mode, quintiles, percentiles.

b) **Measures of dispersions :** range, quintile deviation, mean deviation, standard deviation, coefficient of variation, moments, skew ness, kurtosis Bivariate data : Scatter diagram, correlation coefficient, properties (without proof) interpretation of correlation coefficient, linear regression, Fitting of lines of regression regression, coefficient, Coefficient of determination, partial and multiple correlation coefficient

Unit – 2 : Probability and distributions **(15)**

a) **Probability :** Sample space, events, Definition of probability (mathematical and frequency approach) independent events, addition and multiplication laws, conditional probability examples

b) **Probability distributions :** Random lea viable p.m.f. Expectation and variance, Bernoulli, Binomial, Poisson, uniform, Normal distributions, mean and variance of these distributions (without proof) use of these distributions to describe biological medals. Example.

Unit – 3 : Testing of hypothesis **(15)**

a) Simple random and stratified random sampling, sampling distribution, standard deviations of sample statistic, hypothesis critical region, errors, large sample test for mean, proportion, equality of means (when variance is known and when it is unknown)

b) Chi-square test for variance, t-test for population mean and equality of population means, chi-square test for goodness of fit and independence of attributes, p-value of a statistic.

Unit – 4 : Mathematical models and computer applications : **(15)**

a) **Mathematical models :** Exponential, logistic models for population growth, Lotka-Voltera Prey and predator model, box model, Gaussian plume, point source stream model Leslie's matrix model.

b) **Computer applications :** Introduction to computer : Input and output devices, computer software's, types of software's, hardware storage devices, Operating systems, programming languages ,Introduction to MS – EXCEL, use of worksheet to enter data edit data, copy data, move data, use of in built functions for computations of various statistical constraints, use of charts, Introduction to MS-Word, word processor, editing, coping, moving, formatting, table, insertion, etc.

References :

1.Bio-statistic : A Foundation for analysis in the health sciences : Wayne W – Daniel John Wiley and sons Inc

2. Survival models and data analysis : Elandt – Johnson and Johnson, John Wiley and sons Inc.

3. Statistical Method for the analysis of Biomedical data : Wool son John wiley and Sons Inc.
4. Statistical Methods for Environmental and Agricultural Sciences A – Reza Horseman CRC Press Boca Raton Network
5. Text book of Environmental Engineering : P. Venugopala Rao, Prentice – Hall of India Pvt. Ltd. Delhi
6. Computer Fundamental : P. K. Sinha BPB Publications New Delhi
7. Digital Computer fundamentals : Thomas C. Bastee, Mc Graw Hall international book Company Tollyo.
8. Mathematical models in Biology and Medicine : J. N. Kapur Affiliated East-west Press Pvt. Ltd., Bangalore.

Paper XI : Environmental Policy and Legislation (60 Lectures)

Unit – 1

a) International Environmental Policies (15)

Nature of Environmental Policies, Stockholm Conference (1972), Rio Conference (UNCED, 1992), merits of the Conference Agenda 21.

b) International Agreements and Treaties

Concept of agreement and treaty, Johannesburg treaty, GAAT and Environment, CITES, Montreal Protocol, Kyoto Protocol.

Unit – 2

a) National Policy on Environment (15)

National Committee on Environment and Planning (NCEP), Tiwari committee, Establishment of MoEF, National Forest Policy, National Water Policy, National Energy Policy, CPCB and SPCBs.

b) Constitutional provisions for Environmental Protection

Historical Background of constitutional provisions, Article 14, 15, 19, 21, 32,39, 47, Article 48(A), Art. 49, Art. 51A (g) as fundamental duties of citizen and directive principles of state policy, Art. 243, 243(G) and (W), Art. 246, 248 and other articles related to Environment, Writ provisions for the protection of environment.

Unit – 3

a) National Environmental Legislation related to water, air, mining etc. (15)

The Water (Prevention and Control of Pollution) Act, 1974.

The Air (Prevention and Control of Pollution) Act, 1981.

The Environment (Protection) Act, 1986 , Sec. 12 of Mining Act, 1952.

b) National Legislation on Forest, Wildlife etc.

The Forest (conservation) Act, 1980, The Wildlife (Protection) Act, 1972,

The Biodiversity (Protection) Act, 2002

Unit – 4 Environmental Legislation related to CRZ, PIL and PIL (15)

Concept and need of Public Interest Litigation, jurisdiction of High Courts and Supreme Court, Need of CRZ rules for regulation the activities in coastal zone, Statutory provisions in IPC and CRPC, Environment related provisions in Public Liability Insurance Act

References:

1. Environmental Law and Policy of India ,Diwan,S. and Rosencranz, A,2001, Oxford University Press.
2. Environmental Policy in India, Shekhar Singh, IIPA, New Delhi
3. Declaration of :The Stockholm Conference,Rio, Rio+5 and Rio +10
4. Our Common Future,WECD,1991
5. Universal Environment and Pollution Law Manual , S.K.Mohanty,1998
6. Legal Aspects of Environmental Pollution and Management ,S.M.Ali,1992

Paper XII: Environmental Toxicology and Public Health (60 Lectures)

Unit – 1

a) Introduction to Environmental Toxicology (15)

Definition, classification, Sources of toxicants in environment, Evaluation of toxicity, Bioassay, factors affecting toxicity, mutagenesis, spermatogenesis, carcinogens, hallucinogens, phyto-toxins, animal toxins.

b) Ecotoxicology

Introduction to ecotoxicology, Principles of toxicology, Types of toxic substances - degradable and non-degradable; Influence of ecological factors on the effects of

toxicity.

Unit – 2

a) Toxicants in the Environment: (15)

Toxic substances in the environment, their sources and entry roots, Eco-system influence on the fate and transport of toxicants; Transport of toxicants by air and water; Transport through food chain - bio-transformation and bio-magnification

b) Man and Environmental Toxins: Routes of toxicants to human body – entry through inhalation, skill absorption, indigestion and injection; Response to toxin exposures – Dose response, Frequency response and cumulative response; Lethal and sub-lethal doses; Dose-Response relationships between chemical and biological reactions. Analysis of NOEL, LD 50, LC 50 and MLD; Detoxification in human body - detoxification mechanisms, organs of detoxification

Unit – 3

a) Occupational health hazards (15)

Stress, man, machine and environment, Ergonomics -Introduction, Definition, Objectives, Advantages, Occupational physiology and hazards of working environment, Occupational diseases, Personal Protective Equipment's, Respiratory personal protective devices, Non respiratory personal protective devices: Head protection, Ear protection, Hand protection , Foot protection, Body protection.

b) Epidemiology

Definition, principles of epidemiology, endemic and pandemic diseases, epidemiologic methods, Respiratory infections, Intestinal infections, Arthropod borne infections, Zoonosis.

Unit–4

a) Sanitation and public health (15)

Sanitation, hygiene and human health, concept of social and public health, sanitation, practices and related problems, case studies.

b) Biomedical waste Management:

Definition biomedical waste, Sources of generation, different categories, colour coding, related health hazards, Treatment and disposal methods.

References:

1. Environmental Sanitation, Ehlers, V.M., add Steel, E.W., McGraw-Hill Book Co., Inc.
2. Toxic Chemicals, health and the Environment, Lave, L.B and Upton, A.C. 1987. The HopkinsPress Ltd., London.
3. Basic Environmental Toxicology, Lorris G. Cockerham and Barbara S. Shane, CRC Press.
4. Introduction to Environmental Toxicology Wayne G.Landi Ming-Ho Yu.
5. Patty's Industrial Hygiene and Toxicology, Ed.by Lewis J.Cralley, Lester V. Cralley, James S. Bus.
6. Hazardous waste management - Charles A. Wentz, 2nd Edition, 1995, Mc Graw Hill International
7. Integrated Solid waste management - George Tchobanoglous, Hilary and Samuel A. Vigil
8. Standard handbook of hazardous waste - Harry M. Freeman, Mc Graw Hill 1997. treatment and disposal
9. Environmental Sanitation, Ehlers, V.M., add Steel, E.W., McGraw-Hill Book Co., Inc.
10. Toxicology- The Basic Science of Poisons, Louis J Casarette, John Doull. Mc Millan Publishing Co. Inc. New York.
11. Modern Toxicology, Gupta , Salunkhe, Metropolitian Book Co. Pvt. Ltd.

Semester IV

Paper XIII: Socio- Economic Aspects of Environment (60 Lectures)

Unit -1

a) Environmental problems in India: (15)

History and human ecology, Industrial development – impact on resources depletion and pollution (case studies), Human development and modern day ecological crises-depletion of natural resources, resource crunch, environmental problems of slums, population poverty and environment in India, destruction of flora and fauna, pollution, Unplanned urban growth, social conscience and humanism.

b) Environmental and developmental priorities in India, past and future

Developmental priorities in India, pre independence and post-independence period, urban –rural relation in India, agro-climatic planning and regional development in India, identification of natural and biological resources including gene

Unit -2

a) Global and national environmental movements (15)

Global environmental movements and initiatives - Green Peace, IUCN, WWF, World Watch Institute, Wetland International etc.

b) People's participation and role of NGOs in environmental protection

People's participation in environmental protection, history of role of women in environmental protection in India, Role of NGOs in environmental protection, Individual efforts for environmental protection.

Chipko, Narmada Bachao Andolan, Save Western Ghats, Silent Valley, Bhopal Gas Tragedy, Rehabilitation and resettlement issues, Government policies and social awareness for the protection of environment

Unit- 3

a) Philosophy of nature conservation and co-existence (15)

Man nature relationship, cultural heritage and man's place in Nature, philosophy of nature conservation and co-existence, human responsibility in maintaining nature equilibrium and harmony, concept of trusteeship.

b) Cost- benefit analysis of developmental projects

Concept of cost benefit analysis, applications, costs of developmental projects, tangible costs and benefits, invisible environmental costs, differed costs, incremental costs, case studies.

Unit -4

a) Environmental Audit, Social Audit (15)

Definition of environmental audit, social audit and socio-economic surveys,

Social Impact Assessment (SIA) methods and steps in SIA.

b) Environmental economics, eco-politics and accounting

Ecology and economy, economic principles, role of environmental economics at local, regional, nation and global level, polluter pays principle, natural resource accounting,

trade and environment, eco-politics - have's and have nots, north south divide, restructuring of global politics on environmental justice.

Reference:

1. Environmental Economics in theory and practice – Hanley , Shogren and White.
2. Cost benefit analysis and the environment – Hanley, Splash.
1. 3.Environmental Economics- Karpagam.
3. Environmental Economics- G.N. Singh.
4. Environmental Economics- R.N. Bhattachary

Paper XIV: Environmental Hazards and Disaster Management

(60 Lectures)

Unit – 1

a) Introduction to Hazards and Disasters (15)

Definition - Hazard, vulnerability and risk, differences between disaster and hazards, types of hazards and disasters, natural disasters and man made hazards.

b) Man made hazards

Industrial accidents, causes and effects of hazardous waste, toxic chemical waste and their disposal control, Acid rain and its control, Ozone depletion, Green house effect, Radiation hazards, Oil spills, fire, forest and industrial fires and control, environmental degradation due to wars.

Unit – 2 (15)

a) **Earthquake** - causes of occurrences, consequences, measurement, distribution of earthquake in world and India , mitigation.

Volcanoes - Origin and types of volcanic activities, Volcanic belts; causes of occurrences, consequences, distribution in world and Indian subcontinent, mitigation**.**

Tsunami - causes of occurrences, consequences, distribution in world, mitigation.

Land slides - Causes and types**,** human induced; Landslide prone areas in India distribution, rock/soil type, protective measures

Unit – 3

a) Cyclones and Epidemics (15)

Cyclones – types -tropical and temperate, distribution in world and India, role in Indian subcontinent,

Storms - causes of occurrences, distribution in world, consequences, mitigation.

Epidemics - types and causes and major epidemic's in India**.**

b) Floods and Droughts

Floods – occurrences, Floodplains and Flood-Prone Areas; nature and frequency of flooding; urbanization and flooding; Flood hazard assessment - environmental effects of flooding, role of man and nature, Consequences, Mitigation.

Draught - reason of occurrences, draught prone areas in India and world, consequences, mitigation

Unit – 4

a) Disaster management (15)

Strategies for mitigation – warning system, forecasting, Emergency Preparedness,

Education and Training Activities, planning for Rescue and Relief works, National and state level planning for hazards mitigation,

b) Use of remote sensing in disaster management, Disaster management plan**,** Social and economic impacts of disasters.

References:

1. Environmental Hazards: Assessing Risk and Reducing Disaster Smith, Keith, Routledge Publication
2. Environmental Geology, K.Valdia, Tata McGraw Hill Publishing House
3. Lal D.S. ,Climatology, Parag Pustak Bhavan,Allahabad
4. Hillary , Sir Edmand , Ecology,2000, The changing face of Earth, Multimedia Publication,1984

Paper XV: Environmental Planning and Management (60 Lectures)

Unit – 1

a) Environmental Management Plan (EMP) ISO 14000 Series (15)

Scope of environmental management, importance, Principles, environment and enterprise, objectives and need for training for staff, criteria for EM instrument, project management, production management.

Background and Development of ISO 14000, Environmental Management System, Principles and elements.

b) Environmental planning, micro and macro planning, rural and urban planning

Concept of and need for environmental planning, levels of planning - micro planning, macro planning, National and regional Planning, Rural and urban planning, Demographic considerations, dynamics, requirements, available resources, Gandhian concept of self reliant villages.

Unit – 2

a) Fair environmental practices in trade, commerce and industry (15)

Total Quality Management (TQM) and business ecosystems, business ethics and environmental principals, traditional trade and commerce practices, fair environmental practices, Quality management and its impact of human society in India.

b) Global environmental initiatives, National Environmental Policy (NEP)

Environmental initiatives at the national and global level, case studies, National Environmental Policy - basis, regulatory structure for policy implementation, role bureaucrats, problems in formulation of policy, policy implementation and analysis, strategies for policy implementation.

Unit – 3

a) Environmental Impact Assessment (15)

Need of EIA, Scope, objectives, types of environmental impacts, steps involved in conducting the EIA Studies, Environmental Impact Assessment techniques-Ad-hoc method, checklist method, overlay mapping method, network method, simulation and modeling technique, matrix method, system diagram technique.,

b) Environmental Audit

Preamble, scope and objectives of environmental auditing, applicability of satutary environmental statement audit, contents of EA report,

Consumption Audit, Pollution Audit, Hazardous waste audit ,Disposal Audit, Cost audit investment audit ,Voluntary audit

Unit – 4

a) Concept of eco-development Vs growth (15)

Concept of eco-development, Integrating economic and ecological principles, definition of physical and economic growth, cost benefit ratios, development processes and growth, Integrated approach to environment and development, Western Ghats eco-development plan, developmental models for hilly area, river basins lands, growth centres.

b) Concept of sustainable Development

Concept, Definition of sustainable development integrating economic and ecological principles, Concept of wise use and sustainable development, integrated approach to environment and development, Planning Vs perspective planning.

References:

1. Environmental Impact Assessment, Canter, L.W., 1977, McGraw Hills New York.
2. Environmental Impact Assessment, Peter Wathern , Unwin Hywin, London
3. Environmental Impact Assessment, P. R. Triwedi, APH Publishing Corporation, New Delhi
4. A Handbook of EIA, V.S. Kulkarni, S.N. Kaul and R. K. Trivedi, Scientific Publication (India).

Paper XVI: Environmental Biotechnology (60 Lectures)

Unit -1

a) Role of biotechnology in environmental science (15)

Introduction to biotechnology, concept of environmental biotechnology, public perception of biotechnology,

b) Applications of some important technologies

Genetic engineering, Genetic concept in environment management, Fermentation technology, Tissue culture, Animal biotechnology, Concept of bio-safety, Fate of GEM'S in the environment, Vermi-technology, Role of biotechnology in conservation of species

Unit- 2

a) Use of biotechnology in innovative practices

Concept of bio-leaching, methods of bioleaching, microorganisms involved, advantages and disadvantages of bioleaching.

Concept of bio-absorption, factors affecting bio absorption, mechanism of bacterial metal resistance, limitations of bio absorption,

Concept of bioremediation, microorganisms involved, bioremediation processes and technologies, landfill technologies

Environmental applications of immobilized cells

Unit -3

a) Use of different technologies (15)

Aerobic Vs anaerobic degradation, testing of biodegradability, Bio-oxidation of phenolic compounds, Bio-degradation of specific hazardous wastes, biodegradation of hydrocarbons.

b) Biotechnology in agro-industry and forestry

Plant biotechnology, Biological control, Organic farming, Bio-fertilizers - types and production technology, Applications of biotechnology in forestry, Concept of biofuel, advantages, production. Animal Biotechnology and its application.

Unit- 4

a) Microbial degradation of chemical pesticides. (15)

Important micro-organisms in degradation of chemical pesticides mechanism of degradation of chemical pesticides and herbicides, concept and types of bio-pesticides and their significance.

b) Biotechnology for industrial pollution control

Application of biotechnology in wastewater treatment - Tanning industry, Distilleries, Dairies, Dye industries, Pulp and paper industry, sugar industry.

References

1. Introduction to Environmental Biotechnology, A. K. Chatterji, Prentice Hall of India Pvt. Ltd, New Delhi
2. Environmental Biotechnology-Basic Concepts and Applications Indu Shekhar Thakur I.K. International Pvt. Ltd. New Delhi.
3. Environmental Biotechnology S.K. Agawal,APH Publishing Corp., New Delhi.
4. Elements of Biotechnology, P. K. Gupta, Rastogi Publishing House, New DELHI.
5. Environmental Biotechnology, Jogdand S.N., Himalaya Publishing House, New Delhi
6. Biotechnology, B.D. Singh, Kalyani Publishers , New Delhi
7. Molecular Biotechnology- Principles and Applications of Recombinant DNA, Glick and Pasternak. Panima Publishing Corporation, New Delhi
8. A Text Book of Biotechnology, R.C. Dubey, S. Chand and Company Ltd., New Delhi.