BHARATHIAR UNIVERSITY, COIMBATORE.
M.Sc. Environmental Sciences (UD)
(From the academic year 2014-15 onwards)

SCHEME OF EXAMINATION

			Durn	Int.	Ext.	Total	Credit
SEMESTER I							
CORE 1	14ENVA13A	Basics in Chemistry and Biology for Environmental Sciences	3	25	75	100	4
CORE 2	14ENVA13B	Environmental Pollution	3	25	75	100	4
CORE 3	14ENVA13C	Statistics and Research Methods in Environmental Management	3	25	75	100	4
CORE 4	14ENVA13D	Instrumental Methods of Analysis	3	25	75	100	4
Elective I	14ENVA1EA	Environmental Toxicology (or) Occupational Health and Industrial Safety	3	25	75	100	4
Supportive I*			2	12	38	50	2
Practical I	11ENVA13P1	Practical I	6	25	75	100	4
SEMESTER II							
CORE 5	14ENVA23A	Environmental Impact Assessment	3	25	75	100	4
CORE 6	14ENVA23B	Waste Management and Bioremediation	3	25	75	100	4
CORE 7	14ENVA23C	Biodiversity and Conservation	3	25	75	100	4
CORE 8	14ENVA23D	Green Products	3	25	75	100	4
Elective II	14ENVA2EB	Concepts of Industrial Ecology (or) Natural Disaster Management	3	25	75	100	4
Supportive II*			2	12	38	50	2
Practical II	14ENVA23P1	Practical II	6	25	75	100	4
SEMESTER III							
CORE 9	14ENVA33A	Remote Sensing and GIS	3	25	75	100	4
CORE 10	14ENVA33B	Environmental Engineering	3	25	75	100	4
CORE 11	14ENVA33C	Environmental Laws and Policy	3	25	75	100	4
CORE 12	14ENVA33D	Natural Resources Management	3	25	75	100	4
Elective III	14ENVA3EC	Environmental Biotechnology (Or) Environmental Management and Sustainable Development	3	25	75	100	4
Supportive III*			2	12	38	50	2
Practical III	4ENVA33P1	Practical III	6	25	75	100	4
SEMESTER IV							
		Project work and viva-voce Examination				200	8
		Industrial visit and Viva-voce examination				50	2
Summer project						50	2
Total						**2250**	**90**

SUPPORTIVE PAPERS OFFERED FOR OTHER DEPARTMENT STUDENTS:

Semester	Subject Code	Title of the Paper	Durn.	Int.	Ext.	Total	Credit
I	14ENVGS01	Ecotourism	**2**	12	38	50	2
II	14ENVGS02	Natural Disaster Management	**2**	12	38	50	2
III	14ENVGS03	Environmental Education and Awareness	**2**	12	38	50	2

Note :

1. Practical paper is offered as one single paper with a common code, encompassing all core papers for a given semester, for the University examination with 4 credits.

2. Equal number of experiments to be fixed for all papers.

SEMESTER I CORE 1: 14ENVA13A
BASICS IN CHEMISTRY AND BIOLOGY FOR ENVIRONMENTAL SCIENCES

Objectives: To expose the students from non-chemistry and non-biology background to the chemistry and biology aspects required for environmental sciences

UNIT I

Periodic table, elements, compounds, IUPAC nomenclature of simple organic and inorganic compounds, chemical bond, chemical reactions. Normality, molarity, molality, molecular weight, equivalent weight, mole concept, stoichiometric Equations. Volumetric analysis, calculations, acid-base indicators. Avogadro hypothesis, isotopes, oxidation, reduction, oxidation number. Solutions - types, ionization, primary and secondary standards - preparations, calculations of concentrations of solutions using specific gravities and molecular weights, units of concentration of solutions – interconversions. Colligative Properties, Ionic product of water, pH and pOH, buffer solutions.

Unit II

Laws of thermodynamics, reversible and irreversible processes, thermodynamic functions, exothermic and endothermic reactions, spontaneous and nonspontaneous reactions. Order and Molecularity of a reaction, basic kinetic laws - zero, first, second, pseudo-first, pseudo-second and third order reactions, determination of rate constants, Arrehenius equation. Faraday's law of electrolysis-conductance (equivalent and molar conductance), variation of equivalent conductance with concentration, common ion effect, ionic product of water.

Unit III

Laws of mass action and Applications, Le-Chatlier Braun principle. Principles of photochemistry, fluorescence, phosphorescence, photochemical and photosensitized reactions, energy transfer – examples. Coordination complexes - terminology, ionization energy. Organic compounds - hydrocarbons, functional groups, nucleophiles and electrophiles. Surface and interface chemistry - Adsorption, absorption, catalysis, colloids, surfactants, examples, types of adsorption, desorption.

UNIT IV

Cell structure and function- structure and function of cell wall, structure and composition of cell membrane, ultrastructure and function of cell organales, eukaryotic and prokaryotic cells, Nucleic acids-DNA structure and replication, structure of RNA and role in protein synthesis, cell growth and division-Meiosis and Mitosis, genotypes and phenotypes, permeability, diffusion, osmosis, absorption of water, transpiration, photosynthesis, Respiration, translocation of solutes, Photoperiodism and vernalisation, plant movements, Dormancy, senescence, Tissue Culture: Regeneration of plants from tissue culture, Types of culture, Cryopreservation.

UNIT V

Introduction to Animals, Importance of systematics, Using Taxonomic Keys, Identification Procedure, Identification of a New Taxon; Naming of New Taxa; Theories of animal classifications and their history; Procedure in classifying; Phylogeny; Zoological Nomenclature; Animal diversity; Animal form & function; Animal systems: skeletons and mussels, circulatory and respiratory systems, nerves systems. Botanical nomenclature: Need for scientific names,

history of botanical nomenclature, principles of ICBN , the type method , author citation, publication of names, principles of priority, names of hybrids, names of cultivated plants and draft biocode. Process of Identification: Specimen preparation, herbarium methods, and identification methods; Botanical library; Botanical gardens.

REFERENCES

01. Vogel's Text Book of Quantitative Inorganic Analysis, Barnes, J.D. J., Denney, R.C., Jeffery, G.H and Mendham, J. (1999), 6th Edition, Pearson Education Ltd., U.K.
02. Fundamentals of Analytical Chemistry, Skoog, D.A and D.M.West, (2004), Thomson Asia Pvt Ltd, Singapore.
03. Instrumental Methods of Chemical Analysis, Ewing G.W, (1985), 5th Edition McGraw Hill, U.K.
04. Instrumental Methods of Chemical Analysis, B.K. Sharma, (2001), Goal Publishing House, Meerut, India.
05. Standard Methods for the Examination of Water and Wastewater, (1998), 20th (Ed.) APHA, Washington, D.C.
06. Modern Inorganic Chemistry, R. D. Madan (2010), S. Chand & Company Ltd, New Delhi, India.
07. Atkins' Physical Chemistry, P. W. Atkins and Julio de Paula (2006), Oxford University Press, NY, USA.
08. Environmental Chemistry, S. E. Manahan (2000), CRC Press, USA.
09. Surface Chemistry, A. Singh and R. Singh (2005), Campus Book International, New Delhi, India.
10. Cell Biology, Genetics, Evolution and Ecology, Verma, P. S., Agarwal, V. K. (1983), S Chand and Company Ltd, New Delhi, India.
11. Plant Physiology, Pande S. N., Sinha B. K. (2006), Vikas Publishing House PVT Ltd, New Delhi, India.
12. Taxonomy of Angiosperms, Pande, B. P. (1995), S Chand and Company Ltd, New Delhi, India
13. General and Comparative Physiology Williams S. Hoar (1991), 3rd edition. Prentice Hall of India- New Delhi.
14. Animal Physiology, Neilson, K. S. (1997), Cambridge University Press, Pergamon Press, Oxford.
15. Comparative Animal Physiology, Prosser, C.L. and Brown-Jr. F.A, (1961), W.B. Saunders, Philadelphia, USA.
16. International Code of Zoological Nomenclature, Ride, W. D. L. (1985), Univ of California Pr; 3rd edition, USA.
17. An aid to the International Code of Botanical Nomenclature, Henry, A.N. and Chandra Bose, (1980), Today & Tomorrow's Printers & Publishers, Delhi.
18. Plant Systematics – Theory and Practice, Singh, G. (1999), Oxford and IBH Publishing Co. Pvt Ltd., New Delhi.
19. Plant Taxonomy, Pullaiah, T. (2007), Regency Publications, New Delhi.
20. Plant Classification, Bensen, (1957), Oxford & IBH Publishing Co., New Delhi.
21. Plant Taxonomy, Sharma, O.P. (1958), Tata McGraw Hill Publishing Company Ltd., New Delhi.
22. Plant Taxonomy and Biosystematics, Stace, C.A. (1989), 2nd E,. Edward Arnold, London.

CORE 2: 14ENVA13B ENVIRONMENTAL POLLUTION

Objectives: To educate the students on pollution of water, air and soil, impacts of pollution and control measures.

UNIT- I

Structure of the atmosphere, Sources and Classification of Air Pollutants. Transport and Diffusion of Pollutants. Plume behavior and stack dispersion, Reactions of hydroxyl radical with O2, N2, CO2 and Oxides of Nitrogen, Sulphur and Carbon. Sinks of Air pollutants – Acid rain: Ozone depletion – Montreal protocol; Global warming – Kyoto protocol; Gaseous pollution control measures; photo chemical smog; Automobile pollution in India; Zero emission standards; Noise pollution – Sensing, Measurement, Abatement measures.

UNIT - II

Properties of water – Characteristics of water bodies; Heavy metals, Speciation and Complexation, water quality. DO, BOD, COD, acidity, alkalinity, salinity, hardness; drinking water quality standards; Water pollution; Classification of water pollutants, Ground water pollution, Sources and sinks, Eutrophication. Purification of water by adsorption, flocculation, ion exchange and reverse osmosis methods. Alternatives of end of pipe treatments, Radioactive pollution and control measures.

UNIT - III

Soil pollution; Sources, sinks and broad classification, movement and sorption mechanisms of organic and inorganic contaminants and their impacts on physio-chemical and biological properties of soil and plants, Sediment Pollution – Black carbon – formation and fate, Black carbons as adsorbents for organics, Soil pollution control measures – Physico-chemical and Biological methods.

UNIT – IV

Hazardous Solid Wastes – Hospital Wastes, Radioactive Wastes - Sources, Transport, Disposal. Municipal solid wastes - hazards, disposal and energy production- Case studies; Light pollution and control measures; and Thermal pollution and control measures.

UNIT V

Industrial Disasters and Pollution - remedial measures – Case studies-Chemical Industries – Pesticide Industries, Bhopal Disaster, Chernobyl accident, Love canal Disaster, Oil Disasters – Exxon, British Petroleum- Gulf of Mexico; e-wastes, Impact and Remedial Measures.

REFERENCES

1. Chemistry for Environmental Engineering and Science, Sawyer C.N., Mc Carty P.L., and Parkin,G.F (2003), Tata McGraw-Hill Publishing Company Ltd., New Delhi.
2. A text book of environmental chemistry and pollution control, Dara S S,.(1998), S. Chand & Company Ltd, New Delhi
3. An Introduction to Soils and Plant Growth, 5th Ed, Roy I Donalue, Raymond W Miller and John C Shiekluna (1987) Prentice Hall of India.
4. Environmental Engineering, Howard S Peavy (2003), Tata Mc Graw Hill Publishing Company Ltd., New Delhi.
5. Environmental Chemistry, A.K. De (2001), New Age International Publishers, New Delhi.
6. Environmental Chemistry, S. E. Manahan (2000), CRC Press, USA.

CORE 3: 14ENVA13C

STATISTICS AND RESEARCH METHODS IN ENVIRONMENT MANAGEMENT

Objective: To impart understanding on the concepts of statistics and to improve the Computing knowledge of the statistical methods related to environment

UNIT - I

Fundamentals of Statistics (Basic concept) – Collection of Data – Classification and Tabulation – Diagrammatic Representation – Measures of Central Tendencies and Dispersion – Probability and Monte Carlo Analysis – Moments, Skewness and Kurtosis – Normal, Poisson and Binomial Distributions.

UNIT - II

Tests of Significance – Mass and alternative hypothesis – error level of significance – Equal and Unequal Sampling - t, z, x2 test, Analysis of variance – One way ANOVA – Two way ANOVA – Regression and correlation - simple and multiple.

UNIT - III

Modeling – Computer Modeling – Lotka – Volterra Model, Leslie's Matrix Model – Point Source Stream Pollution Model – Air Quality Model. Thermal Plume and Dispersion models.

UNIT - IV

Applications of Computer in Environmental Science and Management – Data Analysis using packages (SPSS): Editing, Data Tabulation, Descriptive statistics – Correlation – Regression – Factor analysis – Cluster analysis – PCA, Graph Plotting

UNIT - V

Scientific documentation: Methods of literature collection, design, planning and execution of investigation, Statistical methods in biological research, Preparation of scientific documents, general articles, research papers, review articles, editing of research papers, methods of citation, collection of literatures, including web based methods, bibliography and thesis writing. Presentation techniques, effective communication skill, Discussion and critic.

REFERENCES

1. Business Mathematics and Statistics, Vittal, R.R. (1986) Murgham Publications.
2. Programming with C, Byron S Gottfried (1996) Hill Publishing Co, New Delhi.
3. Statistical Methods, Gupta, S.P. (1996) Sultan Chand & Sons Publications, New Delhi.
4. Environmental Science Methods, Haynes, R (1982) Chapman & Hall, London.
5. Fundamentals of Bio-Statistics, Khan, I.A and Kanum, A., (1994) Ukaaz Publication, Hyderabad.
6. Quantitative Techniques, Kothari, C.R (1996) Vikas Publishing Housing Pvt Ltd, Hyderabad.
7. Statistics for Advanced Level, Miller, J., (1989) Cambridge University Press.
8. Statistical Methods, Snedcor, G.W. and Cochran, W.G. (1982) Academic Press.
9. Statistics in Biology. Bliss, G.I. (1970). Mc Graw Hill Book Company, Vol. I and II. New Delhi.
10. Practical Statistics for Experimental Biologists. Wardlaw, A.C. (1985), Wiley Chichester.
11. Research Methods in Social Sciences. Sharma, B.A.V., Ravindra Prasad, D. and Satyanarayana, P (1989), Sterling Publishers Pvt. Ltd.
12. Research Methodology – Methods and Techniques. Kothari, C.R., (1989), Wiley Eastern, New Delhi.
13. Introduction to Research Methodology in Agricultural and Biological Sciences, V. Venkatasubramanian (1999), New Century Book House (P) Ltd., Chennai

CORE 4: 14ENVA13D INSTRUMENTAL METHODS OF ANALYSIS

Objectives: To impart understanding on principles, instrumentation and applications of various instrumental methods in the analysis of chemicals responsible for the pollution of the environment

UNIT - I

Spectroscopic Techniques: Properties of EMR – Basic Principles, Instrumentation and applications of: Ultraviolet – visible (UV-VIS) Spectroscopy. Flow injection analyzer; Infrared spectroscopy, Non-Dispersive IR Spectrometer, FT-IR, Flame Spectrometry; Atomic Absorption spectroscopy (AAS) – Inductively Coupled Plasma Emission Spectroscopy, Flourimetry – Chemiluminescence's Detector System, X-Ray Fluorescence, Microscopy, SEM, TEM, Online analyzers.

UNIT - II

Chromatographic Techniques: Basic principles, Instrumentation and applications of Chromatography – paper, thin layer chromatography (TLC), Gel permeation chromatography, Ion exchange chromatography – High performance liquid chromatography (HPLC) and Gas Chromatography (GC)-Electrophoresis-SDS-PAGE, Agarose gel electrophoresis.

UNIT – III

Radiochemical analysis: Types of radiation – radioactive decay; Carbon dating; Radioactive labeling – Isotope dilution, Radiation detectors – Geiger Muller Counter, Scintillation counters; Neutron activation analysis.

UNIT - IV

Electrochemical Techniques: Introduction to Techniques – Basic principles, Instrumentation and applications of Conductometry, Potentiometry – Ion selective meter – Voltammetry – Polarography; Coulometry.

UNIT - V

Turbidimetry and Nephelometry, Elemental analyzer, TOC analyzer, Portable Gas Analysis – H2S, CO2, SO2, O3, HC, Particulate analysis, Stack monitoring, Meteorological equipments.

REFERENCES

1. Vogel's Text Book of Quantitative Inorganic Analysis, Barnes, J.D. J., Denney, R.C., Jeffery, G.H and Mendham, J. (1999) 6th Edition, Pearson Education Ltd., U.K.
2. Fundamentals of Analytical Chemistry, Skoog, D.A and D.M.West, (2004) Thomson Asia Pvt Ltd, Singapore.
3. Instrumental Methods of Chemical Analysis, Ewing G.W, (1985) 5th Edition McGraw Hill, U.K.
4. Instrumental Methods of Chemical Analysis, B.K. Sharma, (2001) Goal Publishing House, Meerut., India.
5. Standard Methods for the Examination of Water and Wastewater, (1998) 20th (Ed.) APHA, Washington, D.C.
6. Environmental Monitoring and Instrumentation, Bucholtz, F., (1997) Optical Society of America, Washington D.C.
7. Environmental Sampling Analysis: A Practical Guide, Xeith, L.H., Boca Raton, F.L. (1991), Lewis Publication.

ELECTIVE I 14ENVA1EA : 1. ENVIRONMENTAL TOXICOLOGY

Objectives: To impart understanding on the basic concepts of toxicology, the mode of action of chemicals and their fate in the environment

UNIT – I

Toxicology – Definitions, Classification, Origin and General Nature of Toxicants in Environment. Basic Probit analysis, concepts – Toxicants – Toxicity, Acute, sub acute, chronic, dose effect, LD 50, LC 50 and response safe limits. Dose response relationship, graphs, concentration response relationship, Safe Limits. Biological, chemical Factors that influence. Influence of route of administration abnormal response to chemicals; basis of selective toxicity; laboratory determination of toxicity of chemicals.

UNIT – II

Pest – Pesticides – Classification of pesticides – Pest surveillance, resistance, residual effects, toxic effects of insecticides and on man and mammals. Metals- Toxicity, Properties, occurrence, Production, Industrial uses, Metabolism, Physiology, Toxicology, Prophylaxis and Therapy - Aluminium, arsenic, cadmium, chromium, lead and mercury. Mutagenesis and carcinogenesis - case studies.

UNIT – III

Chlorinated xenobiotics in environment – Bioconcentrations – Volatilization – Biological and nonbiological degradations, Detoxification. Chlorinated organics in environment and their fate. Short chained chlorinated hydrocarbons – Toxicity – Ecotoxicological relevants and degradation. PCB – Dioxins levels, fate, toxicity and their global distribution. Toxaphene – occurrence and degradation. Environmental risk assessments- Biomonitoring - Bioindicators- Environmental specimen banking.

UNIT – IV

Bioaccumulation – Bioconcentration – Biomagnifications –mechanisms in biota – Significant influence, mechanisms and Kinetics of Bioconcentration. Cellular response to chemical stress – membrane process; intracellular fate of chemicals, cell receptors, cell injury and apoptosis. Long-term impact of chemicals in aquatic organisms, soil invertebrates and Avian species.

UNIT – V

Ecotoxic modes of action of chemicals: Biotransformation – Molecular mode of action – Aromatic compounds, Alcoholics, Phenolics and heavy metals. Toxicity Testing Methods – Microbiol, algal, invertebrates and alternative toxicity tests. Multimedia mass balance models – fugacity – nonfugacity models – applications of multimedia models. Future test strategies in Ecotoxicology – Legislative perspectives. Animal management in Toxicological Evaluation: Animal extrapolation; Animal ethics.

REFERENCES

1. Introduction to Environmental Toxicology- Wayne .G. Landis, Ming Ho Yu, 3rd Ed. (2002) Lewis Publishers, CRC press , NY.

2. Ecotoxicology, Schuurmann, G., and Market, G., (1998), A. John Wiley & Sons, In.
3. Hand book of Environmental Risk Assessment and Management, Peter Callow (1998), Blackwell Science, London.
4. Environmental Impact of Chemicals: Assessment and Control, The Royal Society of Chemistry, Cambridge.
5. Health and Environmental Risk Assessment, Ricci, P and Rowe, M.D., (1985) Pergamon Press, New York.
6. Environmental Risks and Hazards, Cutter, S.L (1994), Prenctice - Hall of India, New Delhi.
7. Environmental Risk Assessment Report, Benjamin, S.L., and Bellurk, D.A., (2001).
8. Information Resources in Toxicology: Wexler, Philip et al, 2000. 3rd ed. Academic press, 2000.
9. The Basic Science of Poisons Companion Handbook, Klassen, Curtis. D and John.B. Watkins Casarett and Doull's Toxicology 6th Ed. Newyork, N.Y: McGraw-Hill, (2001).
10. Environmental Toxicology and Chemistry. Crosby, Donald. G. 1998. Oxford University Press.
11. Introduction to Environmental Toxicology: Impacts of chemicals upon Ecological systems: Landis, Wayne and Hing-hoYu, Baca Raton, 1995. Lewis Publishers.
12. Essentials of Toxicology – Klassen CD, Watkn J.B (2003) 3rd Ed., Mc Grew Hill, New York.

ELECTIVE I 14ENVA1EA : 2. OCCUPATIONAL HEALTH AND INDUSTRIAL SAFETY

Objective : To impart knowledge on various occupational health hazards and safety measures to be taken in the work place.

UNIT - I

Occupational Health - Hazards and Safety –Physical, Chemical and Biological hazards. Occupational Diseases and Occupationally induced illness - Prevention and Control. Health problems in different types of industries – construction, textile, steel and food processing, pharmaceutical, Occupational Health and Safety considerations in Wastewater Treatment Plants. Measures for Workers. Health Education Medical First-Aid and Management of Medical Emergencies. Epidemiological approaches. Ergonomics – Need, Task Analysis, Preventing Ergonomic Hazards, Ergonomics Programme. Definition and Role of Ergonomics in Designing Work Place - Work Environment - Effects of Light, Ventilation, Vibration, Noise and stress - Performance Evaluation of Man.

UNIT – II

Industrial Safety Management Techniques – Industrial Safety Standards. Industrial Accidents and Disasters - Frequency Rate, Prevention and Control. Dispersion of Radioactive material and release of Toxic and inflammable materials. Work Study - Method of Study and Measurement. Measurement of Skills. Safety - Cost of Expenses. Principles and Functions in Safety Management. Case Study - Preparation of report on safety and remedial measures followed in Industry.

UNIT III

Hazards Exposure evaluation: Sampling techniques, Personal monitoring, Biological monitoring; Threshold Limit Values (TLV), STEL; List of Industries involving Hazardous process Occupational Hazards under the First Schedule of the Factories Act,1948; Permissible Limits of certain Chemical substances in work environment under the Second Schedule of the Factories Act,1948; Hazards Control : Elimination, Control , Substitution, Isolation, Personal Protective Equipment(PPE).

UNIT IV

Hazards Control- Causes of Accident - Accident statistics - Accident Reporting system, Safety Audit, Accident prevention, Disaster Planning, Safety Committee, Case studies on Bhopal, Chernobyl and similar disasters - Control of Hazards Substitutions, Engineering control, Administrative control, Behaviour control, integrated control, Elimination, Control , Substitution, Isolation, Personal Protective Equipment (PPE).

UNIT V

Labour laws - Occupational Safety and Health Act and Health Administration, Right to know Laws- Indian Acts – Labour Act, Factories Act, OSHA. Parameters of safety – Factors affecting the conditions of occupational and Industrial safety – Concept of safety organization and Management - Safety Regulations - Supervisors and safety department in motivation.

REFERENCES

1. Goetsch D.L., (1999), “Occupational Safety and Health for Technologists”, Engineers and Managers”, Prentice Hall.
2. Della D.E., and Giustina, (1996), “Safety and Environmental Management”, Van Nostrand Reinhold International Thomson Publishing Inc.
3. Environmental Strategies–Hand Book, Kolluru R. V, (1994) Mc Graw Hill Inc., New York.
4. A B C of Industrial Safety, Walsh, W and Russell, L, (1984), Pitma Publishing United kingdom
5. Environmental and Industrial Safety, Hommadi, A. H. (1989), I.B.B Publication, New Delhi.

CORE 5 14ENVA23A ENVIRONMENTAL IMPACT ASSESSMENT

Objectives: To expose the students to the recent methods, programmes and projects, preparation of EA and EIA reports and institutional requirements of assessment of environmental impacts of policies and plans.

UNIT - I

Objectives – Basis for Environment Impact Assessment, Screening of Projects – Environmental Assessment Procedures – Writing the Environmental Assessment and Checklists, Concept and Significant Impact – Case Studies - Project Alternatives.

UNIT - II

The Environmental Impact Statement Process. EIA Methodologies – Adhoc Method – Checklist Methods – Matrix Methods – Network Methods – Preparing EIS.

UNIT - III

Prediction and Assessment of Impacts on natural Resources – Biota, Surface Waters, Ground Water, Air, Noise, Hazards, Historic and Cultural Resources, Transportation, Socio-economic relationships. Interlinking of rivers and River Basin Management.

UNIT - IV

Notification 1994 and 2006 – Public Participation, Regional and Sectoral Impact Assessment, Major limitations of Environmental Impact Assessment.

UNIT - V

Case studies - Land Clearing Projects – Dam sites – EIA for Aquaculture, Steel, Mines, Hydel, Thermal, Nuclear, Oil and Gas based Power Plants – Highways projects – Industrial Projects.

REFERENCES

1. Environmental Impact Assessment, Canter, L.W., (1996) Mc Graw Hill, New York.
2. Environmental Impact Statements, Bregman, J. I., (1999) Lewis Publishers, London.
3. Environmental Assessment, Singleton R, Castle, P and Sort, D (1999), Thomas Telford Publishing, London.
4. Effective Environmental Assessment, Eccleston, C. H., (2000) Lewis Publishers, London.
5. Environmental Impact Assessment- A Comprehensive Guide to Project and Strategic Planning, Eccleston, C.H., (2000) John Wiley and Sons.
6. A guide book for Integrated Ecological Assessments, M. E. Jensen and P. S. Bourgeron (2001) Springer-Verlag, New York, Inc.

CORE 6: 14ENVA23B 2014-15 onwards

WASTE MANAGEMENT AND BIOREMEDIATION

Objectives: To impart knowledge on the management of solid and liquid wastes from municipal and industrial sources and principles of remedial measures of recycling, reuse and recover from the wastes.

UNIT - I

Wastes– Classification and Quantification – Solid Waste Management and Disposal: Sources and Generation of Solid Waste – characterization, composition and classification. Hazardous Waste Management: Cyanides, Dioxins, Detergents, Plastics, Nylon and Paper. Waste Minimization approaches – Monitoring and Management strategies. Radioactive Waste: Sources, half life of radioactive elements, modes of decay. Effects on Plants, Animal and Man. Low and High-level Radioactive Waste Management – Waste Minimization and Treatment, Radiation standards.

UNIT - II

Recycling of Wastes – Types – sources – composition of waste – recycling of waste for Industrial, Agricultural and Domestic Purposes; Recycling of Metals, Reuse, recovery and reduction of paper and plastics; Recycling in Food Manufacturing, Beverages, Apparel, Leather, Paper, Pulp, Chemical and other industries; Fly Ash utilization. Waste Disposal Methods – composting, incineration, pyrolysis, medical waste disposal strategies.

UNIT - III

Microbial Activity in Soil and Ground Water, Lithosphere as Microbial habitat, Microorganisms in rock and minerals, Mineral soil and Organic soil. Physiological groups of prokaryotes, Geomicrobial transformations – Biodegradation of carbonates – Biomobilization of silicon, phosphate, nitrogen. Geomicrobiology of fossil fuel, methane, peat, coal and petroleum.

UNIT – IV

Principles of Bioremediation – Rapid growth and Metabolism- Genetic plasticity – Metabolic pathways for the degradation of xenobiotics, hydrocarbons – Microbial site characterization – Biodegradation potential – Bioprocess design, optimization – Microbial removal rates – inherent problems associated with biotreatment studies. Microbiological methodologies – Standard biotreatability protocols – Quantification of biodegradation; Biocleaning -Chernobyl radioactive contaminated area - Phytoremediation.

UNIT - V

Aerobic Bioremediation: Bioremediation of Surface Soils: Fate and transport of contaminants in the Vadose zone – Biodegradation in soil ecosystems – Types of soil treatment systems – Bioreactors. Subsurface Aerobic Bioremedidation: *in situ* Bioremediation – *in situ* Bioventing – *in situ* treatments of Harbour Sediments and Lagoons. Bioremediation in fresh water and marine systems: Bench and Pilot Scale studies – *in situ* Bioreactor treatment of sediments – *in situ* treatment in marine ecosystem. Anoxic/Anaerobic Bioremediation: Anoxic/Anaerobic Processes – Fermentation, Degradation of xenobiotics – Anoxic/Anaerobic bioremediation of

hydrocarbons, Phenols, Chlorophenolic compounds, Polycyclic Aromatic Hydrocarbons (PAH), Heterocyclic Compounds, Cyanide, dyes, Radioactive wastes.

REFERENCES

01. Microbial Ecology, IV Ed., Atlast, R.M and Bartha,R.,(2000) Addison Wesley Longman Inc.
02. Bioremediation, Baker,K.H. and Herson,D.S., (1994) Mc Graw–Hill Inc, New York.
03. Biology of Microorganisms, VII Ed., Brock,T.D., Madigan,M.T. Martinko,J.M. and Parker,J (1994) Prentice Hall, New Jercy.
04. Geomicrobiology, Ehrlich,H.L (1996) Marcel Dekker Inc., New York.
05. Bioremediation – Principles, Eweis,J.B., Ergas,S.J, Change,D.P.Y and Schroeder, E.D (1998). Mc Graw-Hill Inc.
06. Environmental Engineering, Kiely, G (1998) Irwin/Mc Graw Hill International, U.K.
07. Hazardous Waste Management, II Ed, LaGrega,M.D.,Buckingham,P.L., and Evans,J.C (2001) Mc Graw Hill Inc.
08. Microbial Degradation of Xenobiotics and Recalcitrant Compounds, Leisinger, T, Cook,A.M., Hutter,R and Nuesch,J (1981) Academic Press, London.
09. Hazardous Wastes and Solid Wastes, Liu, D.H.F and Liptak,B.G (2000), Lewis Publishers, New York.
10. Microbiology, Pelezar, M.J.Jr., Chan, E.C.S and Kreig,N.R (1993) Tata Mc Graw Hill, Delhi.
11. Remediation of Petroleum Contaminated Soils – Biological, Physical and Chemical processes, Riser-Roberts, E., (1998) Lewis Publisher, New York.
12. Vadose-Zone and Ground Water Contamination – Assessment, Prevention and Remediation, Russel Boulding, J (1995), Lewis Publishers, Tokyo.
13. Recycling of Crop, Animal and Human Waste in Agriculture, Tandon (1995), Mc Graw Hill Publishing Co.

CORE 7: 14ENVA23C BIODIVERSITY AND CONSERVATION

Objectives: To impart understanding on the occurrence and distribution of various flora and fauna, their existence and conservation

UNIT - I

Biological Diversity: Species – Origin of new species, Community and ecosystem diversity, Genetic diversity, Systematics in Diversity – Environment and Genetic Variations – Biological Classification – Phylogenetic Relationship – Ecological Biodiversity –Species Concept – Biological and Phylogenic Concepts; Species Inventory – Biodiversity hot spots. IUCN categories– Red data book.

UNIT II

Species Diversity – Global Distribution of Species - Tropical species diversity – Diversity in terrestrial, marine and freshwater –Micro-organisms-lower and higher plants – lower and higher invertebrates and vertebrates; Species extinction and Endangered species; Monitoring indicator

species and habitats; Threats to biodiversity: Extinction – Past rate of Extinction – Human Caused Extinctions – Endemic species - Extinction rates - Man and animal conflicts.

UNIT III

Habitats and Ecosystem – Classification – Ecosystem mapping, tropical forests, grasslands, wetlands, coral reefs, mangroves; Habitat lass: Habitat destruction – Fragmentation and degradation – desertification, Economics of Ecosystem, Green Revolution, Food Plants, medicinal and ornamental plants, animal uses – livestock and fisheries;

UNIT - IV

Conservation and Management – National Legislation – Protection of Wild flora and Fauna - Protection of National Habitats - National and International Protected Areas – Current Practices in Conservation - in *situ* Conservation and *ex situ* Conservation of Threatened Species – Biodiversity Bill 2002 – Patent Act – Agenda 21 – Multilateral Treaties – Biodiversity Conventions.

UNIT – V

Species Diversity – Case Studies – Deciduous Forests - Desert Lizard communities – Coral Reef - Fish Communities -Island species – Environmental ethics – Biodiversity – a Socio – Political Perspective – Western and Eastern Ghats - Himalayas.

REFERENCES

1. Global Biodiversity – Status of the Earths Living Resources, Brian Groombridge (1992) Chapman & Hall, London.
2. Ecology of Natural Resources, Ferancois Ramade (1991), John Wiley.
3. Global Biodiversity and Strategy, IUCN (1992).
4. Biodiversity, Science and Development, Francesco di castri (1996), Backhuys Publishers, The Netherlands.
5. The Biology of Biodiversity, Kato, M (1999), Springer Verlag, Tokyo
6. Biodiversity Conservation – In Managed forest and Protected areas, Kotwal, P.C. and S. Banerjee (2002). Agrobios, India.
7. Global Biodiversity, Sinha, R. K(1997), INA Shree Publishers, Jaipur.
8. Mega diversity Conservation, flora, Fauna and Medicinal Plants of India's hot spots, Chaudhuri, A. B. and D. D. Sarkar (2003), Daya Publishing House, Delhi.
9. Conservation of Biodiversity and Natural Resources. Singh, M.P., B.S. Singh and Soma S. Dey (2004), Daya Publishing House, Delhi.
10. Biodiversity –Strategies for Conservation, Dadhich L. K. and A.P. Sharma (2002), APH Publishing Corporation, New Delhi.
11. Global Biodiversity – Conservation Measure, Khan, T. I and Dhari N Al Ajmi (1999), Pointer Publishers, Jaipur.
12. An Advanced Textbook on Biodiversity – Principles and Practice, Krishnamurthy, K.V (2003). Oxford and IBH Publishing, New Delhi.

CORE 8: 14ENVA23D GREEN PRODUCTS

Objectives: To educate students about how the industrial ecology can be exploited to create zero emission

Unit I

Industrial Ecology and Waste Minimization Waste Management for Resource Recovery, Recycling, Waste Oil Utilization and Recovery, Recovery of solutes from Wastewater, Recovery of Water from Wastewater, Solvent Recovery

Unit II

Industrial Ecology and Waste Treatment Physical methods of waste Treatment, Chemical Treatment of Wastes, Acid/Base Neutralization, Chemical Precipitation, Chemical Flocculation, Oxidation/Reduction, Electrolysis, Chemical Extraction, Chemical Destruction of PCBs, Biological Destruction of PCBs, Photolytic reaction, Thermal Treatment

Unit III

Industrial Ecology of Waste Disposal Immobilization, Chemical Fixation, Physical Fixation, Ultimate Disposal, *In Situ* Treatment

Unit IV

Earth System Engineering and Management[ESEM] Concept, Examples of ESEM, Implemented and Proposed – Brownfield Restoration, Dredging the waters, Restoring Regional Scale Wetlands, Combacting Global Warming, The Principles of ESEM –Theoretical, Governance principles of ESEM, Design and Engineering Principles of ESEM

Unit V

Future of Industrial Ecology Industrial Ecology in the Midst of Change, The Industrial Ecology Hardware Store – Tools for Product and Process, Service Provider, Systematist and Policy Maker, Industrial Ecology as an Emerging Science, An Industrial Ecology Research Roadmap

REFERENCES

1. Industrial Ecology: Environmental Chemistry and Hazardous Wastes, Stanley E Manahan, (1999). Lewis, New York, USA.
2. Industrial Ecology. T. E. Graedel and B. R. Allenby, (2003). Printice Hall, New Jersey, USA.

ELECTIVE II: 14ENVA2EB CONCEPTS OF INDUSTRIAL ECOLOGY

Objectives: To educate students about the new concepts of treating industrial systems analogues to forest ecology to achieve zero pollution status

Unit I

Principles of Industrial Metabolism The astrosphere and industrial ecology, Industrial metabolism and biological analogies, material and energy flow in industrial metabolism, industrial metabolism, internalization of materials cycle, system integration and industrial metabolism, Eco-efficiency.

Unit II

Industrial Ecosystems Components of the industrial ecosystem, overview of an integrated industrial ecosystem or symbiosis, examples of symbiotic industrial ecosystems, designing and developing symbiotic industrial ecosystem.

Unit III

Life Cycles: Products, Processes and Facilities Life Cycles: Expanding and Closing the Materials Loop, Life Cycle Assessment, Materials and Product Budgets, Consumable, Recyclable and Service Products, Design for Environment, Design for Recycling, Kinds of Materials Recycled, Efficient use of materials through Industrial Ecology

Unit IV

Status of Resources Depletion Times, Under abundant Resources, Hitchhiker Resources, Energy Resources, Energetically Limited Mineral Resources, Geographically Influenced Resource Availability, Environmentally Limited Resources, Cumulative Supply Curves, Water Resources.

Unit V

Industrial Product and Process Design The Product and Process Challenge, Conceptual Tools for Product Designers, Design of X, Product Design Teams, The Product Realization Process, The Process Life Cycle, Approach to Process Analysis, Guidelines for Process Design and Operation, Implications for Corporation.

REFERENCES

1. Industrial Ecology: Environmental Chemistry and Hazardous Wastes, Stanley E Manahan, (1999). Lewis, New York, USA.
2. Industrial Ecology. T. E. Graedel and B. R. Allenby, (2003). Printice Hall, New Jersey, USA.

ELECTIVE II -2 14ENVA2EB
NATURAL DISASTER MANAGEMENT

UNIT - I

Natural Disasters – Nature and Extent and Educative – trends in climatology, meteorology and hydrology. Seismic activities. Changes in Coastal zone, coastal erosion, beach protection. Coastal erosion due to natural and manmade structures.

UNIT II

Disasters - Cyclone – Tornadoes – Avalanches – Flood –Drought – Valconic – Earthquakes – Fire – Landslides. Forecasting and Warning System: Cyclone Disaster Education - Cyclone Safety – Earthquake – Avalanche – Safety and Flood Safety – Impact on Environment

UNIT - III

Disaster Management. Predisaster Planning-Toning of Disaster – prone areas – prioritization – regulations – protection measures during disaster - Post disaster. Relief Camp Organization – Survey and Assessment. Disaster Management Cycle – Vulnerability Analysis – Warning system – Disaster Training – Legal Aspects – case studies for disasters and management, Safety Measures – a general account, Disaster Management plans

UNIT - IV

Disaster Preparedness and Training. Community Preparedness in Natural Disasters- Role of information, education, communication and training- Roles and responsibilities of different national and international agencies and government - NGO, Armed forces, Paramilitary forces, Community based organizations (CBO) - Army Training for Disaster Reduction –Role of team and co-ordination -Training needs – Target Groups – Local Condition.

UNIT V

Mitigation Strategies : Disaster Mitigation – emerging trends in disaster management - UN draft resolution on Strengthening of Coordination of Humanitarian Emergency Assistance, International Decade for Natural Disaster Reduction (IDNDR), Policy for disaster reduction, problems of financing and insurance. Training for emergency. Regulation/guidelines for disaster tolerance building structures.

REFERENCES

1. Bryant Edwards (2005): Natural Hazards, Cambridge University Press, U.K.
2. Roy, P.S. (2000): Space Technology for Disaster management: A Remote Sensing & GIS Perspective, Indian Institute of Remote Sensing (NRSA), Dehradun.
3. Sharma, R.K. & Sharma, G. (2005) (ed) Natural Disaster, APH Publishing Corporation, New Delhi
4. www.GIS. Development.net
5. www.iirs.nrsa.org
6. http://quake.usgs.gov
7. Carter, N W. Disaster Management : A disaster Manager's Handbook, Asian Development Bank, Manila. (1992).
8. Gautam Ashutosh. Earthquake : A Natural Disaster. Ashok Publishing House. New Delhi. 1994.

9. Singh T. Disaster Management approaches and strategies, Akansha Publishing House, New Delhi. 2006.
10. Singh D K. Towards Basics of Natural Disaster Reduction, Research book Centre, New Delhi, 2006.
11. Natural Disasters – A Guide for Relief Workers, (1980), JAC Adhyatma Sadhna Kendra-Mehrauli, New Delhi.
12. Disaster Planning: The Preservation of Life and Property, Harold D. Foster (1980), Springer Verlay, New York.
13. Disaster Management, Shailendra K Singh, Subash C. Kundu and Shobu Singh (1998), Mittal Publications, New Delhi.
14. India Disasters Report: Towards a Policy Initiative, Parasuram, S and Unnikrishnan, P.V (2000), Oxford University Press.
15. Disaster Management, Indu Prakash (1994), Rashtra Prahari Prakasan, Gaziabad.
16. At Risk: Earthquakes and People's Vulnerability, Shudhirendar Sharma Energy and Environment Group, New Delhi.
17. Natural Disaster Reduction, Girish K Misra ad Mathur, G.C (1993), Reliance Publishing House, New Delhi.

CORE 9: 14ENVA33A REMOTE SENSING AND GIS

Objective: To teach the principles and applications of spatial information technologies viz RS, GPS and GIS about the distribution of resources. To give hands-on training on the uses of GIS software in environmental studies

UNIT - I

Elements of photographic systems and computer applications. Land stat. IRS and other satellite systems- satellite data. Principles involved in thermal IR image and microwave image interpretation. Applications of different types of images in earth Sciences, Environmental Sciences, Archeology, Marine studies, Forestry, Soils, Hazard management etc.

UNIT - II

Concepts and foundations of remote sensing - History of remote sensing - Electro-magnetic energy – Properties and interaction with the earth. Atmospheric windows. Black, white and grey bodies, sources of EMR. Image interpretations. Aerial photo-classification based on attitude of camera lens, distortions caused due to flight irregularities, overlaps, scale, relief displacement and its effects. Photo recognition elements. Different types of photographs.

UNIT - III

Introduction to Geographical Information Systems and GIS software, Fundamentals of GIS: Layers and features, Raster/Vector- Georeferencing and projection, Spatial data and GIS basics; Data attributes and spatial topology, Projection / Image registration, Digitization and data attributes -map data representation, GPS.

UNIT - IV

GIS Applications: Resources mapping, Inventory and monitoring natural resources, Land cover mapping, Wetland mapping – Applications to Agriculture - Water Management, Specific Applications - Infrastructure – Ground Water. GPS applications – Principles of Accuracy – Database Creation – Networking of Data.

UNIT - V

Environmental Applications of GIS – Impact Assessment – Pollution Monitoring – Water – Air – Ocean Pollution – Land Degradation – Desertification – Industry – Mining – Ground Water Modeling – Damage Assessment – Coastal and Marine applications – Future Sensors – Satellite System – ENVISAT – Megha Tropiques – TRMM – EOS Missions – Integral Earth Observation Studies – Global Change-Case studies.

REFERENCE

1. Remote Sensing and image interpretation, Lilles and Keifer (2004), John wiley and sons, New York.
2. Remote Sensing Techniques for Environmental Analysis, Estes J. E., and Senger, L.W. (1973), John Wiley and Sons New York.
3. Remote Sensing of Environment, Lintz, J and Simonett, D. S (1976) Addition - Wesley.
4. Geographic Information Systems – Spatial Modeling and Policy Evaluation, Fischer, M.M and Nijkamp, P (1993). Springer – Verlag.
5. Remote Sensing and GIS for Environmental Planning, Muralikrishna, I.V (1995). Tata-McGraw Hill.
6. Environmental Monitoring: Applications of Remote Sensing and GIS, Singh, R.B (1992), Geocartho International Centre, Honk Hong.
7. Environmental Remote Sensing from Regional and Global Scales, Roody, G.M and Curran, P.J. (1994).
8. Advances in Environmental Remote Sensing, Danson, F.M and Plummer, S.E (1995).
9. Space Remote Sensing Systems – An Introduction, Chen, H.S (1985).
10. Introduction to Environmental Remote Sensing, Barrett, E.C and Curtis, L.F (1982).
11. Digital Image Processing, William K Pratt (2001), John Wiley & Sons.
12. Observation of Earth and its Environment – Survey of Missions and Sensors, Kramer J. Herbert (2002), Springer-Verlag.
13. Fundamentals of Remote Sensing, George Joseph (2003), Universities Press (India) Ltd., Hyderguda, Hydrabad.

CORE 10: 14ENVA33B ENVIRONMENTAL ENGINEERING

Objectives: To educate the students about concepts of designs of water distribution systems, sewer networks, working principles and design of various physical, chemical and biological treatment systems of water and waste water.

UNIT - I

Hydraulics – Pressure- Hydrostatic Pressure, Pressure Head, Measurement of Pressure, Flow, Design of Pressure Pipes – Darcy – Weisbach Formula, Manning's Formula, Hazen – William's Formula – limiting velocities, Minimum and Maximum Test Pressure and Working Pressure in pipes – selection of pipe material – Pump types, Characteristic Curves – selection and determination of capacity.

UNIT - II

General layout of Water Treatment Plant. Flash Mixer – Design – Clariflocculator – parameters for design – Filtration - Rapid sand filter and Pressure filter and Disinfection -calculation of chlorine dosage, chlorine demand, and residual chlorine.

UNIT - III

Physical and Chemical Unit Operations and Applications – Design Parameters and Design of Primary and Secondary Settling Tanks – Activated Sludge Process – types and modifications – Design of Aeration Tanks– Diffusers and Mechanical Aerators. Trickling Filters and Design. Oxidation Ditch and Duncan Mara Systems (Waste Stabilization Ponds).

UNIT - IV

Sludge Processing and Disposal Methods – Design of Anaerobic Digester and Sludge Drying Bed – Reverse Osmosis – Ion Exchange – Incinerators and Multiple Evaporators.

UNIT - V

Air Pollution – Minimum Stack Height – Plume Rise, Ground Level Concentration of Pollutants. Design of Settling Chamber, Cyclones, Fabric filters and Electrostatic Precipitators. Wet Scrubber. Case studies: Distillery, Dyeing, Electroplating, Paper and Pulp, Steel, Tannery - Industrial Effluent Treatments.

REFERENCES

1. Introduction to Environmental Engineering and Science, Gilbert M. Masters (2004), Prentice-Hall of lndia Pvt. Ltd., New Delhi.
2. Water and Wastewater Technology, Hammer M.J. and Hammer Jr M. J. (2001), Prentice Hall of lndia Pvt. Ltd., New Delhi.
3. Wastewater Engineering: Treatment and Reuse, Metcalf and Eddy (2003), Tata Mc Graw Hill Publishing Company Ltd., New Delhi.
4. Handbook of Water and Wastewater Treatment Plant Operations, Frank R. Spellman, (2003), Lewis Publishers, London.
5. Environmental Engineering, Howard S Peavy (2003), Tata Mc Graw Hill Publishing Company Ltd., New Delhi.
6. Environmental Engineering: A Design Approach, Sincero A. P and Sincero G. A. (1999), Prentice-Hall of India Pvt. Ltd., New Delhi.

CORE 11: 14ENVA33C ENVIRONMENTAL LAW AND POLICY

Objectives: To impart knowledge about environmental laws, regulations and policies of India and international environmental laws

UNIT I

Environmental policy in Ancient India, Medieval India, British India, during post independent era, the seventies, eighties and nineties. International environmental policy – environmental problems and their impact on international system, the instruments of international environmental policy – international law, soft law, scientific cooperation - fund support, sanction, dispute settlement procedures, non state actors and international environmental policy - Transnational environmental policies – the Indus river basin, the Ganga – Brahmaputra river basin system

UNIT II

Environmental planning, trends in planning, concepts and approaches and strategic environmental planning and management. International Environmental laws - hazardous wastes- Basal convention – Necessity for International Environmental Court. United Nations Environment Programme [UNEP] role on international environment laws. Case studies for International environmental disputes.

UNIT III

Constitutional and legislative provisions : constitutional provisions and the environment, environmental protection and fundamental rights, judicial remedies and procedures – Tort law, public nuisance, the writ jurisdiction, statutory remedies, public interest litigation, class action, freedom of information and the right to know.

UNIT IV

Indian legislation to protect the environment: The water act of 1974, the water cess act of 1977, The wildlife Act of 1972, the air act of 1981, The public Liability insurance act of 1991, the natural environmental tribunal act of 1995, the national environment appellate authority act of 1997, the mines and minerals act of 1957. Case studies one each in the protection of forests, rivers and wild life.

UNIT V

The Indian forest act of 1927, the forest (conservation) act of 1968, The atomic energy act of 1962, The factories act of 1948. The environmental protection act of 1986, The national environment appellate authority act of 1997. The forest conservation act 1980, The wildlife protection act 1972 (2002 amendment), Biodiversity act 2002.

REFERENCES

1. Environmental law in India – Gurudeep Singh (2005) Mc Millan, New Delhi.
2. Environmental law and policy in India, Shyam Diwan and Armin Rosencrany, 2001, Oxford University Press, New Delhi.

3. Pollution Control Legislations, Vol. I and II, 1999, Tamilnadu Pollution Control Board, Chennai.
4. Environmental Management in Practice, Vol I, Nath B., Hens, L., Compton, P and D. Devuyst (1998), Routledge, London and New York.
5. The ISO 14000 Handbook: Joseph Cascio. ISO 14004 – Environmental management systems: General guidelines on principles, systems and supporting techniques (ISO 14004: 1996 (E).
6. ISO 14001: Environmental management systems: Specification with guidance for use (ISO 14001: 1996b (E)). (International organization for standardization – Switzerland).

CORE 12: 14ENVA33D NATURAL RESOURCES MANAGEMENT

Objectives : To enrich the knowledge on natural resources and their significance and to know the strategies for sustainable management

Unit I

Natural resources: Concept and types of natural resources, classification of natural resources. Factors influencing resource availability, distribution and uses. Interrelationships among different types of natural resources. Concern on Productivity issues - ecological, social and economic dimension of resource management.

Unit II

Land and Water Resource: soil types, profile and composition, degradation of land and soil-agricultural lands - Land use and land cover, impacts of land use on environment – man-induced landslides; wetland ecology & management.

Major water resources- surface and ground water - distribution and supply- hydrological cycle, Causes of water resource depletion - Use and over use of water resources, water resource management - Ground water recharging, rain water harvesting; Watershed management Concept, and objectives, flood control-Dams; Wetlands: definition, importance and classification.

Unit III

Mineral and Energy Resources: Types, distribution and reserves of mineral resources, - use and exploitation - environmental effects of mining – case studies - Resource extraction, access and control system – Ecological, economic, and ethnological approach and their implications; integrated resource management strategies.

Unit IV

Forest and Energy resource: Types and extent of forests in India - deforestation and conservation strategies; Importance of natural areas - carbon sequestration; forest fragmentation, national forest policy; Biodiversity- conservation strategies, global biodiversity hotspots; threatened and endemic species-Developing and developed world strategies for forestry.

World energy demand – renewable, non-conventional, nuclear energy, tidal energy- alternate energy sources- solar and wind energy- Oil and natural gas, coal, biomass energy, geothermal energy, hydropower; Environmental implication of energy use.

UNIT V

Management of Common International Resources: Ocean, climate, International fisheries and management commissions; Antarctica: the evolution of an international resource management regime – case studies – Resource management in mountain ecosystem – management of marine and coastal ecosystem .

REFERENCES

1. Global Biodiversity : Status of the Earth's Living Resources, World conservation Monitoring Centre. Ed. Brian Groombridge, 2010, UNEP, Cambridge.
2. The Environment. P.H. Raven, L.R. Berg. 2011. The Environment, 8th edition. Wiley, UK.
3. S. K. Agarwal. Resource Ecology. 1993. Himanshu Publications. Delhi.
4. Francois Ramade 1984. Ecology of Natural Resources. John Wiley & Sons Ltd.
5. Odum, E.P. 1971. Fundamentals of Ecology. W.B. Saunders Co. USA, 574p
6. Ramachandran, N. 2000. Monitoring Sustainability: Indices and Techniques of Analysis. Concept Publishing Company, New Delhi.
7. Coastal Ecology & Management, Mann, K.H. 2000. Ecology of Coastal Waters with implications for Management (2nd Edition).Chap. 2-5, pp.18-78 & Chap. 16, pp.280-303.
8. Global Change and Natural Resource Management, Vitousek, P.M. 1994. Beyond global warming: Ecology and global change. Ecology 75, 1861-1876.
9. Agarwal, K.C., 2001. Environmental Biology, Nidhi Publication Ltd. Bikaner.
10. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publishing House.
11. Heywood, V.H. & Watson, R.T. 1995. Global Biodiversity Assessment. Cambridge Univ. Press.
12. Y. Anjaneyulu. Introduction to Environmental Science, B.S. Publications, Hyderabad (2004)
13. Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co. (TB)
14. Townsend C., Harper J, and Michael Begon. Essentials of Ecology, Blackwell Science.

ELECTIVE III 14ENVA3EC 1. Environmental Biotechnology

Objectives : To impart knowledge in molecular biotechnology and its applications in Environmental management

UNIT-I

Technology for Bioremediation: Recombinant DNA Technology, development of genetically engineered microorganisms (GEMs), Polymerase Chain Reaction (PCR) and development of gene probes for environmental remediation*:* Role of plants,microbes and GEMs in *In-situ* and *Ex-situ* bioremediation Airborne microbes, Suicide genes. Micro-electromechanical systems (MEMS), Genosensor technology, Gene probes Nah Operon.

UNIT-II

Xenobiotics and Biodegradation: Xenobiotics, Integrated treatment system for biodegradation of Polychlorinated biphenyls (PCBs) PCB treatment process and design, Enzymes contributing to industrial sustainable development. Starch processing, detergents, textile, leather, pulp and paper manufacture, Industrial ecology, Biochemical measures of Stress, Mixed Function Oxidases (MFOs), Fermentation Technology, Absorption, distribution and elimination of toxic agents, Biodegradation of halogenated hydrocarbons; polycyclic aromatic hydrogen; Pesticides and Detergents.

UNIT-III

Biotechnology for Resource Management : Bio-transformation of heavy metals ; Oil field microbiology; Improved oil recovery; Role of environmental biotechnology in resource management – Bioremediation – energy production - mineral and energy recovery, Nanotechnology for control of pollution - Planning and management of bioremediation and environmental biotechnology processes

UNIT-IV

Forestry and Biotechnology: Forestry and Biotechnology:- Reforestation through micro-propagation; Somaclonal variations; Induction of genetic variability and heriditability; Conservation of endangered species; Biotechnology in preservation of bio-diversity; In situ and ex situ conservation through gene banks. Phytoremediation - xenobiotics and bioaccumulation of metals using plants.

UNIT-V

Bioethics and Biosafety

Bioethics– stem cell research-Genetically modified crops and organisms- Human genome project - ICMR Ethical Guidelines for Biomedical Research on Human Subjects. Biosaftey guidelines and regulations - Potential effect on Environment and Human health by transgenic plants-Risk assessment, regulation and containment - Intellectual Property Rights - Plant variety protection.

Reference Books

1. Evano, G.H. and Furlong, J.C. *Environmental Biotechnology – Theory and Application.* John Wiley and Sons, USA. 2004.
2. Jjemba, P.K. *Environmental Microbiology – Theory and Application.* Science Pub. Inc., USA. 2004.
3. Olguin, C. J., Sanchez, G., Hernandez. E. *Environmental Biotechnology and Cleaner Bioprocesses.* Taylor & Francis.2000.
4. Pepper, I.L. and Gerba, C.P. *Environmental Microbiology - Laboratory Manaul*. Elsevier, USA. 2005.
5. Ratledge, C. and Kristiansen, B. *Basic Biotechnology*. 2nd ed. Cambridge University.

ELECTIVE III – B 14ENVA3EC
2. ENVIRONMENTAL MANAGEMENT AND SUSTAINABLE DEVELOPMENT

Objectives: To impart an understanding of system approaches, tools of environmental management, management of ecosystem and; local and global environmental **issues**

UNIT - I

Concept and scope of Environmental Management, Environmental Management of Resources -- Water, forest, biological, mineral and agricultural; Environmental management of chemical, mining and manufacturing industries –petroleum, coal, cement, paper, fertilizer. Analysis and prediction of Environmental issues: Environmental Planning, Establishment of Health and Environmental standards, measuring Sustainable Development, Life Cycle Assessment, Material Flow Analysis, Environmental Auditing and Environmental Management Systems and Accounting for Eco-efficiency.

UNI T - II

Principles of Risk Assessment: Human Health Risk Assessments, Ecological Risk Assessment, Probabilistic Risk Assessments, Determination of acceptable risk based limits for Environmental chemicals and development of risk based remediation goals.

UNIT - III

The role of Risk Assessment in Environmental Management decisions: Evaluation of Human Health Risks Associated with airborne exposures to asbestos, a diagnostic human health risk assessment for a contaminated site problem and a risk based strategy for developing a corrective action, Response plan for petroleum – contaminated sites, Risk Management and Risk Communication.

UNIT - IV

Basic concepts of Environmental Economics, International Trade and its Environmental Integrity, Ecolabelling, responsible care, design for the Environment and full-cost accounting for municipal solid waste management, Waste lands and their reclamation, Desertification and its control. Soil erosion, Formation and reclamation of user, alkaline and saline soil, Terra Preta [black carbon] soil in Amazon forests for sustainability in soil; Biochars for energy production and as mitigation measures for global warming and soil rejuvenation.

UNIT - V

Environmental Education and Communication, Environmental Conflict Management, Sustainable development – concept, and growth of the idea, indicators of sustainability, Sustainability of Water Resources, Sustainable Management of Forests, Sustainability in Industry, Ecosystem Management: Coastal Environments, River and Inland Water Environments, Wetlands, Desert margins, Rural and Urban Environments. Current environmental issues in India – Case studies: Narmada Dam, There Dam, Almetti Dam.

REFERENCES

1. A Practical Guide to Understanding Management and Reviewing Environmental Risk Assessment Reports, Sally L. Benjamin and David, A. Bullock, (2001) Lewis Publishers, Washington D.C

2. Hand Book of Environmental Risk Assessment and Management, Peter Calow (1998), Blackwell-Synergy, London.
3. Environmental Management in Pactice,Volume – I to III Instruments for Environmental Management, Nath, B., Hens,L., Compton, P and D. Devuyst (1998), Routledge, London and New York.
4. Risk based analysis for Environmental Managers, Kart A, Frantzen, (2001) Lewis Publishers Washington D.C.
5. Risk Assessment in Environmental Management, D.Kofi Asante – Duah, John Willey and Sons, New York.

PRACTICAL : BIODIVERSITY AND CONSERVATION

Biodiversity assessment

1. Plankton diversity : Phytoplankton - Zooplankton – Biomass estimation – Primary productivity
2. Aquatic insect community study: Species identification - Diversity – density – abundance – distribution
3. Fish community study: Species identification - Diversity – density – abundance – distribution
4. Amphibians community study: Species identification - Diversity – density – abundance – distribution
5. Reptiles community study: Species identification - Diversity – density – abundance – distribution
6. Bird community study: Species identification - Diversity – density – abundance – distribution
7. Mammals community study: Species identification - Diversity – density – abundance – distribution
8. Vegetation studies by line, quadrates and belt transect methods and their analysis – Species identification - Diversity – density – abundance – distribution
9. Grassland community study: Species identification - Diversity – density – abundance – distribution
10. Taxonomic identification of plants and animals

PRACTICAL

INSTRUMENTAL METHODS OF ANALYSIS & ENVIRONMENTAL POLLUTION

1. Spectrophotometric Methods of Estimation: Fluoride, Nitrate, Phosphate, Chromate [Cr 6+], Hg, Pb, Cd, three pesticides, phenol
2. Flame photometric analysis of Na, K, Ca
3. Sampling and analysis of SO2, CO2, NOX, HC
4. Determination of
   (i) SPM in ambient air by high volume sampler (ii) water soluble suspended matter
   (iii) Water insoluble suspended matter and (iv) organic suspended matter
5. Study on the effect of selected air pollutants on some plants
6. An air quality survey report of an area
7. Detection and estimation of noise pollution.

8. Water quality analysis: Determinations of DO, BOD, COD, TKN, TDS, TSS, turbidity, conductivity, alkalinity, acidity, nitrate, chloride, total hardness - Instrumental and wet chemical methods of analysis
9. Estimation of sulphate by turbidimetry.
10. Physical, Chemical and Biological properties of soil: Collection, particle size analysis (silt and clay), Soil profile, water holding capacity, density, porosity, pH, conductivity, NPK, TOC

PRACTICAL
ENVIRONMENTAL TOXICOLOGY

1. Microbial Assays – Disc Diffusion method, Minimal Inhibition Concentration
2. Pesticides and Metal Tolerance- Plant Bioassays
3. *In vitro* Cell toxicity Assays
4. *In vivo* Cell toxicity Assays- Cell viability, cytotoxicity
5. Toxicity assays – Nematodes / Earthworms
6. Animal Bioassays – Fish LC_{50}, Micronucleus assay,
7. Comet assay, Melanophore Index
8. Determination of Animal LD_{50}, Probit Analysis and Graphical method

PRACTICAL
ENVIRONMENTAL MANAGEMENT AND SUSTAINABLE DEVELOPMENT

1. Calculation of carrying capacity based on different assumptions
2. River ecosystem management (Estimation of Riparian land, Bank stability and water quality)
3. Health assessment of traffic police
4. Estimation of soil organic carbon/matter
5. Evaluation of soil fertility using Neubauer technique (analysis of K & P)
6. Enrichment of Azotobacter and Rhizobium, Preparation of biofertilizers and testing its Efficacy
7. Estimation of soil enzymes-urease and phosphatase
8. Estimation of leg-haemoglobin from root nodules
9. Production of biogas from organic waste

PRACTICAL : STATISTICS AND RESEARCH METHODS IN ENVIRONMENT MANAGEMENT

1. Collection of Data: Primary data – Secondary data – Classification and Tabulation – Diagrammatic Representation
2. Data Analysis using software: SPSS and Excel stat: Editing, Data Tabulation,
3. Analysis: Descriptive statistics – Correlation – Regression – Factor analysis – Cluster analysis – Principal Component Analysis (PCA), Graph Plotting - One way ANOVA – Two way ANOVA

PRACTICAL : WASTE MANAGEMENT AND BIOREMEDIATION

1. Basic Microbiology: Aseptic techniques - Sterilization, Media Preparation and Isolation of pure culture
2. Growth curve, measure of bacterial population by turbidometry and studying the effect of temperature and pH.
3. Determination of thermal death point and thermal death time of Microorganisms
4. Metal resistant Bacteria and effect of heavy metals on microbial growth
5. Production of biogas from different organic waste materials
6. Mushroom Cultivation
7. Study of the impact of the chosen waste materials on seed germination and radical elongation
8. Composting and vermicomposting techniques
9. Exercises on estimation, composition and segregation of solid waste
10. Landfill designs & design criteria

PRACTICAL : GREEN PRODUCTS

Recycling of agricultural and industrial solid wastes [non-toxic] for treatments of water and wastewater:
Students are given option to choose <u>either</u> an agricultural solid waste <u>or</u> an industrial solid waste [non-toxic]

A. Agricultural solid waste[non-toxic]

1. Development of activated carbons using any locally available agricultural solid waste [Different students will use different solid wastes to develop different types of activated carbons using different methods] [one student – one carbon]

2. Characterization of activated carbons [any 5 parameters] –
pH (1% solution) , Conductivity (1% solution) (mS/cm), Bulk density (g/ cm^3), Mechanical moisture content (%), Ash content (%), Specific gravity, Porosity (%) , Decolorizing power (mg/ g), Iodine number (mg/g), Ion exchange capacity (meq/ g), Ash analysis - Sodium (%) , Potassium (%), Calcium (%), Phosphorous (%)

3. Treatment studies using the activated carbon for the removal of phenol / dye / metal ion / anion / pesticide / microbe and evaluation of the adsorption capacity using an isotherm – Langmuir or Freundlich

B. Industrial solid waste[non-toxic]

1. Development of activated adsorbents using any locally available non-toxic industrial solid waste [Different students will use different solid wastes to develop different types of activated adsorbents using different methods] [one student - one adsorbent]
2. Characterization of activated adsorbent – [any 5 parameters]

Apparent density (g/ ml), Acid (HNO3) soluble matter(%), Acid (HNO3) insoluble matter (%), Water soluble matter(pH range 3.5–10.0)(%), Water insoluble matter(%), Mechanical moisture content (%) , Loss on ignition (%),pH of 0.2% solution, Conductivity of 0.2% solution (µS/ cm), Particle size (µm), pHzpc, Decolorizing power (mg/ g), Iodine number (mg/g), Ion exchange capacity (meq/ g), Porosity (%).

3. Treatment studies using the activated adsorbent for the removal of phenol / dye / metal ion /anion / pesticide / microbe and evaluation of the adsorption capacity using an isotherm – Langmuir or Freundlich.

PRACTICAL : ENVIRONMENTAL ENGINEERING

1. Calculation and designing of Sedimentation Tank, Clariflocculator
2. Calculation and designing of Aeration Tank
3. Calculation and designing of Activated Sludge Processes
4. Calculation and designing of Trickling Filter
5. Calculation and designing of Disinfection Process
6. Calculation and Designing of Sanitary Landfills
7. Calculation and Designing of Settling chambers
8. Calculation and Designing of Cyclones
9. Calculation and Designing of Electrostatic Precipitator

PRACTICAL : REMOTE SENSING & GEOGRAPHICAL INFORMATION SYSTEM

REMOTE SENSING

1. Importing Aerial/ Satellite image in ERDAS
2. Georeferencing and Image/Map Projection in ERDAS
3. Supervised and Unsupervised classification

GEOGRAPHICAL INFORMATION SYSTEM I. Visual Interpretation

1. Map reading (survey of India Topo sheet)
2. Marginal Information and Extra Marginal Information
3. Relief and Cultural Features

II. Digital Interpretation

1. Importing Aerial/Satellite Imagery and Scanned Raster Image
2. Georeferencing and Co-Ordinate System
3. Map Projection (Type of Map Projection)
4. Digitization and Editing
5. Topology Creation
6. Proximity Analysis (Buffer, Distance Measures)
7. Interpolation Analysis (Kriging, Idw Etc)
8. Density Analysis (Point, Line Etc.)
9. Surface analysis: Tin Creation – Aspect – Slope - Hill Shade - View Shed - Cut and Till

SUPPORTIVE PAPER I: 14ENVGS01 ECOTOURISM

Objectives: To teach the students the importance of tourism and ecotourism activities

UNIT - I

Concepts of Tourism - Classification – Religious Tourism – Cultural Tourism – Heritage Tourism – Monumental Tourism – Adventure Tourism – Mass Tourism – Sustainable Tourism – Consumptive and Non-Consumptive Tourism. Principles of Ecotourism – Types of Ecotourism – Concepts of Ecotourism – Origin of Ecotourism – Objectives of Ecotourism – Benefits of Ecotourism – Trends affecting Ecotourism.

UNIT - II

Places of interests of Ecotourism – Ecocircuit of the Western Ghats – Infrastructural Facilities for Ecotourism – Maintenance of Ecological Centers – Important Biosphere Reserves. Target group of Ecotourism – Ecotourism and Conservation – Study of different Ecosystem – Rain forest Ecotourism – Mountain Ecotourism – Polar, Islands and Coasts Ecotourism – Wilderness – Marine Ecosystem- Sanctuaries and National Parks - TQM of Ecotourism Resorts.

UNIT - III

Impact of Ecotourism – Economic Impacts (Fiscal Impacts, Concept and Methods) – Types and Degree of Impacts from Ecotourism activities – Socio-cultural Impacts – Ecotourism related organization – Ecotourism Research-Disasters and Ecotourism-Role of ethics in ecotourism - Advantages and Disadvantages of Ecotourism- Eco-branding and Eco-labeling of Ecotourism Products - Marketing of Ecotourism, Ecotourism and Sustainable Development - Management Issues in Ecotourism.

REFERENCES

01. The Encyclopedia of Ecotourism, Weaver, D. B. (2001), CABI Publishing, U.K.
02. Encyclopedia of Ecotourism, Volume I, II and III, Sinha, P.C (2003), Anmol Publications Pvt. Ltd., New Delhi.
03. Ecotourism and sustainable Development, N. Mukherjee (2008). Cybetech Publications, New Delhi.
04. Global Ecotourism, Prabhas Chandra (2003), Kaniskha Publishers, New Delhi.

SUPPORTIVE II : 14ENVGS02
NATURAL DISASTER MANAGEMENT

UNIT - I

Natural Disasters – Nature and Extent and Educative – Disasters - Cyclone – Tornadoes – Avalanches – Flood –Drought – Volcanic – Earthquakes – Fire – Landslides. Forecasting and Warning System: Cyclone Disaster Education - Cyclone Safety – Earthquake – Avalanche – Safety and Flood Safety – Impact on Environment.

UNIT - II

Disaster Management. Predisaster Planning-Toning of Disaster – prone areas – prioritization – regulations – protection measures during disaster - Post disaster. Relief Camp Organization – Survey and Assessment. Disaster Management Cycle – Vulnerability Analysis – Warning system –Legal Aspects – case studies for disasters and management, Safety Measures – Disaster Management plans.

UNIT - III

Disaster Preparedness and Training. Community Preparedness in Natural Disasters- Roles and responsibilities of different national and international agencies and government - NGO, Armed forces, Paramilitary forces, Community based organizations (CBO) - Army Training for Disaster Reduction –Role of team and co-ordination -Training needs – Target Groups – Local Condition. Mitigation Strategies : Disaster Mitigation –Training for emergency.

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1. Sharma, R.K. & Sharma, G. (2005) (ed) Natural Disaster, APH Publishing Corporation, New Delhi
2. www.GIS. Development.net
3. www.iirs.nrsa.org
4. http://quake.usgs.gov
5. Carter, N W. Disaster Management : A disaster Manager's Handbook, Asian Development Bank, Manila. (1992).
6. Gautam Ashutosh. Earthquake : A Natural Disaster. Ashok Publishing House. New Delhi. 1994.
7. Singh T. Disaster Management approaches and strategies, Akansha Publishing House, New Delhi. 2006.
8. Singh D K. Towards Basics of Natural Disaster Reduction, Research book Centre, New Delhi, 2006.
9. Disaster Planning: The Preservation of Life and Property, Harold D. Foster (1980), Springer Verlay, New York.
10. Disaster Management, Shailendra K Singh, Subash C. Kundu and Shobu Singh (1998), Mittal Publications, New Delhi.
11. Disaster Management, Indu Prakash (1994), Rashtra Prahari Prakasan, Gaziabad.
12. Natural Disaster Reduction, Girish K Misra ad Mathur, G.C (1993), Reliance Publishing House, New Delhi.

SUPPORTIVE III -14ENVGS03
ENVIRONMENTAL EDUCATION AND AWARENESS

UNIT-I

Environmental Education:

Concept, scope and importance of Environmental Education - Objectives of Environmental Education at secondary school level. Values and ethics related to environment - Approaches of Environmental Education - Salient features of environmental awareness through education: programs of environmental education for secondary school children - Programs of environmental education for attitude changes among the children.

UNIT II

Environmental Hazards:

Causes and effects of environmental hazards, effect of human activities on environment - environmental pollution - global and local (Soil pollution, water pollution, air pollution, noise pollution) - Green House effect –Ozone layer depletion –acid rain, pillar melting, rise of sea level and their implications - Mitigation efforts.

UNIT III

Sustainable Development and Environmental Awareness - Learning to live in harmony with nature - environmental education for development, conservation of soil, water, forests, wild life, energy resources, movement to save environment, eco-friendly technology - Alternate sources of energy - Waste management - Population and environment -

Suggested Text Books

1. Gupta, V.K. (1998) : Environmental Education, New Academic Publishing House, Mail Hiran Gate, Jallandhar.
2. Palmer J. & N. Philips : The Handbook of Environmental Education, Routledge, London

References

11. Canter, E.W. (1977) : Environmental Impact Assessment. McGraw Hill Co., New York

12. Fedron, E. (1980) : Man and Nature, Progress Publishers, Moscow
13. Kormondy, E. (1991): Concept of Ecology, Prentice Hall of India, New Delhi.
14. Odem, E.P. (1975): Ecology, Oxford and IBH Publishing Co., New Delhi.
15. Purdom, P.W. & Anderson, : Environmental Science, Charles E. Merril Publishing Co.,
16. Saxena, A.B. (1996) : Education for the Environmental Concerns, Implications and Practices, Radha Publication, New Delhi.
17. Sharma, P.D. (1993) : Environmental Biology, Rastogi & Co., Meerut.