BHARATHIAR UNIVERSITY, COIMBATORE.
M.Sc. Environmental Sciences (UD)
(From the academic year 2015-16 onwards)

SCHEME OF EXAMINATION

			Durn	Int.	Ext.	Total	Credit
SEMESTER I							
CORE 1	15ENVA13A	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	15ENVA13C	Statistics and Research Methods in Environmental Management	3	25	75	100	4
CORE 4	15ENVA13D	Instrumental Methods of Analysis	3	25	75	100	4
Elective I	15ENVA1EA/ 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	15ENVA23A	Environmental Impact Assessment	3	25	75	100	4
CORE 6	15ENVA23B	Waste Management and Bioremediation	3	25	75	100	4
CORE 7	15ENVA23C	Biodiversity and Conservation	3	25	75	100	4
CORE 8	14ENVA23D	Green Products	3	25	75	100	4
Elective II	14ENVA2EB/ 15ENVA2EB	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	15ENVA33C	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	15ENVGS01	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.

Note: The revised syllabus for the following papers furnished below be followed and there is no change in the existing syllabi of remaining papers.

SEMESTER I CORE I 15ENVA 13A
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.

Unit II

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. Laws of thermodynamics, reversible and irreversible processes, thermodynamic functions, exothermic and endothermic reactions, spontaneous and nonspontaneous reactions.

Unit III

Faraday's law of electrolysis-conductance (equivalent and molar conductance). Laws of mass action and Applications, Le-Chatlier Braun principle. Principles of photochemistry, fluorescence, phosphorescence, photochemical and photosensitized reactions, energy transfer – examples. 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, 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, Cryopreservation.

UNIT V

Introduction to Animals, Importance of systematics, Using Taxonomic Keys, Identification Procedure. Theories of animal classifications and their history; Procedure in classifying; Phylogeny; Zoological Nomenclature, ICZN; Animal diversity; Animal systems: skeletons and mussels, circulatory and respiratory systems. Botanical nomenclature: Need for scientific names,
history of botanical nomenclature, principles of ICBN, the type method, author citation, publication of names, Process of Identification: Specimen preparation, herbarium methods, and identification methods; Botanical gardens.

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. Modern Inorganic Chemistry, R. D. Madan (2010), S. Chand & Company Ltd, New Delhi, India.
7. Atkins' Physical Chemistry, P. W. Atkins and Julio de Paula (2006), Oxford University Press, NY, USA.
8. Environmental Chemistry, S. E. Manahan (2000), CRC Press, USA.
9. Surface Chemistry, A. Singh and R. Singh (2005), Campus Book International, New Delhi, India.
10. Cell Biology, Genetics, Molecular Biology, Physiology, Evolution and Ecology, Verma, P. S., Agarwal, V. K. (2010), 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. (2010), Tata McGraw Hill Publishing Company Ltd., New Delhi.
22. Plant Taxonomy and Biosystematics, Stace, C.A. (1989), 2nd E,. Edward Arnold, London.

CORE 3: 15ENVA13C STATISTICS AND RESEARCH METHODS IN ENVIRONMENT AL 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 – Moments, Skewness and Kurtosis – Normal, Poisson and Binomial Distributions.

UNIT – II Sampling Methods: Probability sampling, random sampling, systematic sampling, stratified sampling, cluster sampling and multistage sampling. Non-probability sampling: convenience sampling, judgement sampling, quota sampling.

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

UNIT - V Scientific documentation: Methods of literature collection, design, planning and execution of investigation, 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.

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: 15ENVA13D 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, Infrared spectroscopy, FT-IR, Flame Spectrometry; Atomic Absorption spectroscopy (AAS) – Inductively Coupled Plasma Emission Mass Spectroscopy, Mass spectrometry, Nuclear magnetic resonance 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 – H_2S, CO_2, SO_2, O_3, 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 15ENVA1EA : 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, Major classes of environmental toxicants, Origin and 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 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 of xenobiotics – Molecular mode of action – 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.
13. Casarettand Doull's Essentials of Toxicology. Second Edn. (2010). Curtis Klaassen and John B. Watkins III. Mc Graw Hill.
14. Environmental Toxicology-Biological and Health effects of Pollutants. Ming Ho Yu, Humio Tsunado and Masashi Tsunoda. CRC press. 3rd Edn. (2011).

15ENVA23A 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. Environmental Auditing, Energy Auditing, Environmental Management Systems

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. Environmental Management, N.K. Uberoi (2009), Excel Books, New Delhi, India.
7. ISO 14000 Environemntal Management, David L Goetsch and Stanley B David (2001), Prentice hall Inc., New Jersey, USA.
8. Terms of Reference for EIA report for activities/ Projects requiring Environmental Clearance (2009), Administrative Staff College of India, Hyderabad.
9. Environmental Impact Assessment for Science, Art, Management and other Post graduate courses(2007), Manual Pubilished by Indian Institute of Technology, Roorkee, India
10. Guidlines to project proponents for preparation of EIA report (2010), Manual Pubilished by State Level Expert Appraisal Committee, Gujarat, India.
11. Environmental Life Cycle Analysis, David F Ciambrone (1997), Lewis Publishers, New York, USA.
12. Environmental Management an Indian Perspective, S.N. Chary and Vinod Vyasulu (2000), Macmillan India Limited, New Delhi, India.
13. Energy technology and Directions for the Future, John R Fanchi (2004), Elsevier Academic Press, Burlington, MA, USA.
14. Environmental Politics and Policy, Walter A Rosenbaum (1991), Affliated East West Press Pvt. Ltd., New Delhi, India.
15. Environmental Impact Assessment for Science, Art, Management and other Post graduate Courses (2007), Manual Pubilished by Indian Institute of Technology, Roorkee, India.

CORE 6: 15ENVA23B

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

1. Microbial Ecology, IV Ed., Atlast, R.M and Bartha,R.,(2000) Addison Wesley Longman Inc.
2. Bioremediation, Baker,K.H. and Herson,D.S., (1994) Mc Graw–Hill Inc, New York.
3. Biology of Microorganisms, VII Ed., Brock,T.D., Madigan,M.T. Martinko,J.M. and Parker, J (1994) Prentice Hall, New Jercy.
4. Geomicrobiology, Ehrlich,H.L (1996) Marcel Dekker Inc., New York.
5. Bioremediation – Principles, Eweis,J.B., Ergas,S.J, Change,D.P.Y and Schroeder, E.D (1998). Mc Graw-Hill Inc.
6. Environmental Engineering, Kiely, G (1998) Irwin/Mc Graw Hill International, U.K.
7. Hazardous Waste Management, II Ed, LaGrega,M.D.,Buckingham,P.L., and Evans, J.C (2001) Mc Graw Hill Inc.
8. Microbial Degradation of Xenobiotics and Recalcitrant Compounds, Leisinger, T,

Cook,A.M., Hutter,R and Nuesch,J (1981) Academic Press, London.
9. 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: 15ENVA23C 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, Description 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 indicatorspecies 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 – Habitat restoration, 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 Act 2002 – Patent Act – Agenda 21 – Forest protection Act-Forest conservation Act 1980-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 – Project elephant – Project tiger.

REFERENCES

1. Ecology of Natural Resources, FerancoisRamade (1991), John Wiley.
2. Global Biodiversity and Strategy, IUCN (1992)

3. Biodiversity, Science and Development, Francesco di castri (1996), Backhuys Publishers, The Netherlands.
4. Global Biodiversity, Sinha, R. K(1997), INA Shree Publishers, Jaipur.
5. The Biology of Biodiversity, Kato, M (1999), Springer Verlag, Tokyo
6. Global Biodiversity – Conservation Measure, Khan, T. I and Dhari N Al Ajmi (1999), Pointer Publishers, Jaipur.
7. BIODIVERSITY, 1998 E.O.Wilson,FrancesM.Peter, NATIONAL ACADEMY PRESS
   Washington, D.C.
8. Biodiversity –Strategies for Conservation, Dadhich L. K. and A.P. Sharma (2002), APH Publishing Corporation, New Delhi.
9. Biodiversity Conservation – In Managed forest and Protected areas, Kotwal, P.C. and S. Banerjee (2002). Agrobios, India.
10. Biodiversity: An Introduction, 2nd Edition, 2003, Kevin J. Gaston and John I. Spicer, Wiley-Blackwell publications.
11. Textbook of Biodiversity, K. V. Krishnamurthy, 2003, CRC Press.
12. An Advanced Textbook on Biodiversity – Principles and Practice, Krishnamurthy, K.V (2003). Oxford and IBH Publishing, New Delhi.
13. 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.
14. Conservation of Biodiversity and Natural Resources. Singh, M.P., B.S. Singh and Soma S. Dey (2004), Daya Publishing House, Delhi.
15. Fundamentals of ecology, 2006, Odum Eugene, Cengage Learning.
16. Biodiversity Ecosystem Functioning and Human Wellbeing: An Ecological and Economic Perspective, 2009, ShahidNaeem, Daniel E. Bunker, Andy Hector, Oxford University Press.
17. The Diversity of Life – Edward O. Wilson, 2010, Belknap Press, Harvard University Press.
18. Biodiversity Economics - Principles, Methods and Applications, 2010, Andreas Kontoleon, UnaiPascual, Timothy Swanson, Cambridge University Press.
19. Biodiversity Hotspots, 2011, Zachos, Frank E., Habel, Jan Christian, Springer Publications.
20. Ecosystems Biodiversity, Oscar Grillo and Gianfranco Venora, 2011 Publisher: InTech.
21. Biodiversity in Dead Wood, 2012,Jogeir N. Stokland, JuhaSiitonen, Bengt Gunnar Jonsson, Cambridge University Press.
22. Breakfast Of Biodiversity: The Political Ecology of rain forest destruction, 2013, John Vandermeer, Ivette Perfecto, Library of congress.
23. Encyclopedia of Biodiversity, 2nd Edition, 2013, S Levin, Academic Press.

ELECTIVE II 15ENVA2EB

2. NATURAL HAZARDS AND DISASTER MANAGEMENT

UNIT - I

Natural Disasters –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 – Nature and characteristics Cyclone – Tornadoes – Avalanches – Flood –Drought – Volcanic – Earthquakes – Fire – Landslides – Causes and effects - Impact on Environment Forecasting and Warning System – Disaster Profile of India.

UNIT - III

Disaster Management. Predisaster Planning-Toning of Disaster – prone areas – prioritization –regulations – protection measures during disaster and Post disaster. Relief Camp Organization –Survey and Assessment. Disaster Management Cycle – Vulnerability Analysis – Disaster Training – Legal Aspects – case studies for disasters and management. Technology for Disaster Management – Role of Information and communication technology, GPS, Remote sensing and Geographic Information system in Disaster Management.

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.

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. Natural Hazards and Disaster management ; Vulnerability and Mitigation. R.B. Singh. Rawat Publications. 2006
10. Early warning Systems for Natural Disaster Reduction. Jochen Zschau, Andreas n. Kuppers. (2003). Springer-verlag, Berlin Heidelberg.
11. A Manual on Disaster Management. Dr. Parag Diwan. (2010). Pentagon Earth.

CORE 11: 15ENVA33C 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, e-waste (Management and Handling rules) 2011, amendments 2015. 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).
7. Environmental Legislation in India. K.R. Gupta. Volume 4. Nice Printing Press. New Delhi. (2006).

SUPPORTIVE PAPER I: 15 ENVGS01 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

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