Periyar University
Department of Environmental Science

M.Sc. Environmental Science

Syllabus

PERIYAR UNIVERSITY
M.Sc. ENVIRONMENTAL SCIENCE
CHOICE BASED CREDIT SYSTEM
REGULATIONS (w.e.f. 2011-2012)

1. CONDITIONS FOR ADMISSION

A. ELIGIBILITY CONDITIONS FOR ADMISSION

Candidate who has passed the B.Sc. degree in any Life Sciences [Environmental Science/ Microbiology / Applied Microbiology/ Industrial Microbiology/ Botany/ Plant Sciences and Plant Biotechnology/ Zoology/ Animal Science/ Applied Animal Science and Animal Biotechnology/ Biochemistry/ Bioinformatics/ Biology/ Life Sciences/ Home Science/ Food Science & Nutrition/ BSMS/BAMS/BUMS/Chemistry with Botany / Zoology as Allied Subjects of this University or an Examination of any other University accepted by the Syndicate as equivalent thereto shall be eligible for admission to M.Sc. Degree Course in Environmental Sciences.

Candidate shall be admitted to the examination only if he/she has taken the qualifying degree in Science/ Medical subjects as mentioned after having completed the prescribed courses consisting of twelve years of study and has passed the qualifying examination.

B. METHOD OF SELECTION

Candidates have to appear for an **entrance examination** in the respective subjects to be conducted by the respective departments and thereafter an interview. The date, venue, and time of the entrance examination and interview will be notified to the applicants separately as soon as it is fixed.

2. ELIGIBILITY FOR THE AWARD OF DEGREE

A candidate shall be eligible for the award of the degree only if he/she has undergone the prescribed course of study in a college affiliated to the University for a period of not less than two academic years, passed the examination of all the four semesters prescribed earning 90 credits (plus 2 credits for Human Rights) and fulfilled such conditions as have been prescribed therefore.

3. DURATION OF THE COURSE

The duration of the course is for two academic years consisting of four semesters.

4. EXAMINATIONS

There shall be four semester examinations: first semester examinations at the middle of the first academic year and the second semester examination at the end of the first academic year. Similarly, the third and fourth semester examinations shall be held at the middle and the end of the second academic year, respectively.

5. COURSE OF STUDY AND SCHEME OF EXAMINATIONS

		NAME OF THE COURSES
Core papers		
Semester I	Core –I	Cell Biology
	Core – II	Environmental Science
	Core – III	Environmental Chemistry
	Core – IV	Biodiversity & Conservation
	Elective – I	Energy and Environment
	Core Practical – I	Environmental Chemistry
Semester II	Core – VI	Natural Resources & Management
	Core – VII	Environmental Microbiology
	Core – VIII	Environmental Impact Assessment & Disaster Management
	Elective – II	Air and Water Quality Management
	Supportive-I	Supportive-I
	Core Practical – II	Environmental Microbiology, Air & Water Quality Management
Semester III	Core – X	Solid Waste Management
	Core – XI	Environmental Toxicology
	Core – XII	Climate Change and Current issues
	Core– XIII	Environmental Biotechnology
	Supportive-II	Supportive-II
	Core Practical– III	Environmental Biotechnology, Environmental toxicology & Solid waste Management
Semester IV	Core – XV	Environmental Laws, Policy & Planning
	Core – XVI	Research Methodology & Instrumentation
	Core Project-I	Project Work

Elective Courses - Major

1. Energy & Environment
2. Air and Water Quality Management
3. Energy & Green technology
4. Water and Waste water management
5. Eco-Tourism & Wild Life Management
6. Radiation Pollution, GIS & Remote Sensing

Supportive Courses for other Departments

1. Environment and Ecology
2. Global Warming and its impact
3. Environmental Planning & Sustainable development
4. Environmental Impact Assessment and Environmental Audit

SCHEME OF EXAMINATIONS

The scheme of examinations for different semesters shall be as follows:

Theory: Maximum marks – 75 Marks:
Part A – 25 Marks (5 Questions) and
Part B – 50 Marks (5 Questions)
Internal marks – 25
Total marks – 100
Time - 3 hrs.

The following procedure will be followed for Internal Marks:

Theory Papers:	**Internal Marks**
Best Two tests out of 3	10 marks
Attendance	5 marks
Seminar	5 marks
Assignment	5 marks
	25 marks

Practical:	**Internal Marks**	**40**
Attendance		5 marks
Practical Test Best 2 out of 3		30 marks
Record		5 marks

Project:

Internal Marks presentations	40 marks
Viva	10 marks
Project Report	50 marks

Break-up Details for Attendance

Below 60%	- No marks
60% to 75%	- 3 marks
76% to 90%	- 4 marks
91% to 100%	- 5 marks

6. REQUIREMENTS FOR PROCEEDING TO SUBSEQUENT SEMESTERS:

(i) Candidates shall register their names for the First semester examination after the admission in the PG courses.

(ii) Candidates shall be permitted to proceed from the First Semester upto the Final Semester irrespective of their failure in any of the Semester Examination subject to the condition that the candidates should register for all the arrear subjects of earlier semesters along with current (subject) Semester subjects.

(iii) Candidates shall be eligible to proceed to the subsequent semester, only if they earn sufficient attendance as prescribed therefore by the Syndicate from time to time.

Provided in case of candidate earning less than 50% of attendance in any one of the semester due to any extraordinary circumstance such as medical grounds, such candidates who shall produce Medical Certificate issued by the Authorized Medical Attendant (AMA), duly certified by the Principal of the College, shall be permitted to proceed to the next semester and to complete the course of study. Such candidate shall have to repeat the missed semester by rejoining after completion of final semester of the course, after paying the fee for the break of study as prescribed by the University from time to time.

7. PASSING MINIMUM:

a) There shall be no Passing Minimum for Internal.
b) For External Examination, Passing Minimum shall be of 50% (Fifty Percentage) of the maximum marks prescribed for the paper.
c) In the aggregate (External + Internal) the passing minimum shall be of 50% for each Paper/Practical/Project and Viva-voce.
d) Grading shall be based on overall marks obtained (internal + external).

8. CLASSIFICATION OF SUCCESSFUL CANDIDATES:

Candidates who secured not less than 60% of aggregate marks (Internal + External) in the whole examination shall be declared to have passed the examination in the First Class. All other successful candidates shall be declared to have passed in Second Class. Candidates who obtain 75% of the marks in the aggregate (Internal + External) shall be deemed to have passed the examination in First Class with Distinction, provided they pass all the examinations (theory papers, practicals, project and viva-voce) prescribed for the course in the First appearance.

9. GRADING SYSTEM:

The term grading system indicates a Seven (7) Point Scale of evaluation of the performances of students in terms of marks obtained in the Internal and External Examination, grade points and letter grade.

SEVEN POINT SCALE (As per UGC notification 1998)

GRADE	GRADE POINT	PERCENTAGE EQUIVALENT
`O' = Outstanding	5.50 – 6.00	75 – 100
`A' = Very Good	4.50 – 5.49	65 – 74
`B' = Good	3.50 – 4.49	55 – 64
`C' = Average	3.00 – 3.49	50 – 54
`D' = Below Average	1.50 – 2.99	35 – 49
`E' = Poor	0.50 – 1.49	25 – 34
`F' = Fail	0.00 – 0.49	0 - 24

10. RANKING:

Candidates who pass all the examinations prescribed for the course in the first appearance itself alone are eligible for Ranking / Distinction. Provided in the case of candidates who pass all the examinations prescribed for the course with a break in the First Appearance due to the reasons as furnished in the Regulations under "Requirements for Proceeding to subsequent Semester" are only eligible for Classification.

11. PATTERN OF QUESTION PAPER:

PART –A (200 words): All 5 Questions either or type 5 x 5 = **25** marks
PART –B (500 words): All 5 Questions either or type 5 x 10 = **50** marks

12. APPEARANCE FOR IMPROVEMENT:

Candidates who have passed in a theory paper / papers are allowed to appear again for theory paper / papers only once in order to improve his/her marks, by paying the fee prescribed from time to time. Such candidates are allowed to improve within a maximum period of 10 semesters counting from his/her first semester of his/her admission. If candidate improve his marks, then his improved marks will be taken into consideration for the award of Classification only. Such improved marks will not be counted for the award of Prizes / Medals, Rank and Distinction. If the candidate does not show improvement in the marks, his previous marks will be taken into consideration. Candidate will be allowed to improve marks in the Practical's, Project, Viva-voce, Field work.

M.Sc. DEGREE COURSE IN ENVIRONMENTAL SCIENCE

Semester	Core	Subject Code	Subject	Hrs/W	Credit	CIA	EA	Total
I	I	11UPEVS1C01	Cell Biology	5	4	25	75	100
	II	11UPEVS1C02	Environmental Science	5	4	25	75	100
	III	11UPEVS1C03	Environmental Chemistry	5	4	25	75	100
	IV	11UPEVS1C04	Biodiversity & Conservation	5	4	25	75	100
	E-I	11UPEVS1E01	Elective-I Energy & Environment	4	4	25	75	100
	V	11UPEVS1P01	**Practical-I** Environmental Chemistry	5	5	40	60	100
II	VI	11UPEVS1C05	Natural Resources & Management	4	4	25	75	100
	VII	11UPEVS1C06	Environmental Microbiology	4	4	25	75	100
	VIII	11UPEVS1C07	Environmental Impact Assessment & Disaster Management	4	4	25	75	100
	E-II	11UPEVS1E02	Elective-Air and Water Quality Management	4	4	25	75	100
	S-I	11UPEVS1S01	Supportive-I	4	4	25	75	100
	IX	11UPEVS1P02	**Practical-II** Environmental Microbiology, Air & Water Quality Management	5	5	40	60	100
III	X	11UPEVS1C08	Solid Waste Management	4	4	25	75	100
	XI	11UPEVS1C09	Environmental toxicology	4	4	25	75	100
	XII	11UPEVS1C10	Climate Change and Current issues	4	4	25	75	100
	XIII	11UPEVS1C11	Environmental Biotechnology	4	4	25	75	100
	S-II	11UPEVS1S02	Supportive-II	4	4	25	75	100
	XIV	11UPEVS1P03	**Practical-III** Environmental Biotechnology, Environmental toxicology & Solid waste Management	5	5	40	60	100

IV	XV	11UPEVS1C12	Environmental Laws, Policy & Planning	5	4	25	75	100
	XVI	11UPEVS1C13	Research Methodology & Instrumentation	5	4	25	75	100
	XVII	11UPEVSQ01	Project work	15	7	25	75	100
				Total	**90**			**2100**

SEMESTER I

CORE I: 11UPEVS1C01

CELL BIOLOGY

UNIT I

The Cell

Origin of Cell - Cell theory - Cell membrane – Physicochemical properties and Molecular Organisation – Asymmetric organization of lipids, proteins and carbohydrates - Biogenesis and Functions - Transport of small molecules across cell membranes – Types and mechanisms. Active transport by ATP powered pumps – Types, properties and mechanisms. Transport of proteins into Mitochondria and Chloroplast.

UNIT II

Structure and Organelles

Prokaryotic and Eukaryotic cell structure and intracellular organelles – Cell wall, membranes, nucleolus, endosomes, peroxisomes, endoplasmic reticulum, plant vacuoles, plastids, microbodies and chloroplast – Structure and functions. Chromosomes structure, Morphology and Functional elements of eukaryotic chromosomes – Lampbrush chromosomes, Polytene chromosome and Giant chromosome – Bar bodies – DNA banding patterns – Karyotyping – Idiogram.

UNIT III

Intracellular Digestion

Ultra structure and function of lysosomes – Cytoskeleton structure – Types – Function and role in motility. Transport of protein into and out of nucleus - Transport of protein into endoplasmic reticulum - Transport by vesicle formation: Endocytosis and Exocytosis – Moleclular mechanism of vesicular transport.

UNIT IV

Cellular Communication through Cell Junction

Occluding junctions, Anchoring junctions and Communicating junction - *Molecular mechanism of cell-cell adhesion*: Ca^{++} dependent cell-cell adhesions, Ca^{++} independent cell-cell adhesions - *Extracellular matrix of animals*: Organisation and functions - Extracellular matrix receptors on animal cells: Integrins.

UNIT V

Cell Signalling

Signalling via G-protein and enzyme linked cell surface receptors, MAP kinase pathways, Interaction and regulation of signaling pathways - *Eukaryotic Cell Division Cycle*: Different phases and molecular events - Control of cell division cycle in yeast and mammalian cells - *Overview of Apoptosis*: Phases and significance, morphological and biochemical changes associated with apoptotic cells - Apoptotic pathways and regulators.

References

1. Alberts *et al.* (1998) Essential Cell Biology
2. Alberts *et al.* (2002) Molecular Biology of the Cell
3. Becker *et al.* (1996) The World of Cell
4. Buchanan *et al.* (2000) Biochemistry and Molecular Biology of Plants
5. G.M. Cooper. The Cell: A Molecular Approach
6. Gerald Karp (2002) Cell and Molecular Biology: Concepts and Experiments (3rd Ed.)
7. Hughes and Mehnet (2003) Cell Proliferation and Apoptosis
8. Lodish *et al.* (2004) Molecular Cell Biology
9. Murray *et al.* Harper's Biochemistry
10. Stories *et al.* (2000) Working with Molecular Cell Biology : A study companion

Web References

1. www.cellsalive.com
2. www.cytochemistry.net/cell-biology/lysosome.htm
3. www.cellsignal.com
4. www.cellsignallingbiology.org
5. www.biochemweb.org

CORE II: 11UPEVS1C02

ENVIRONMENTAL SCIENCE

UNIT I

Ecology

Basic ecological concepts and Principles of our environment – *Geological consideration*: Atmosphere, Hydrosphere, Lithosphere – Scope of Ecology – Development and evolution of ecosystem – Principles and Concepts of ecosystem – Structure of ecosystem, Strata of an ecosystem, Types of ecosystem, Cybernatics and Homeostasis – Biological control of chemical environment – Energy transfer in an ecosystem – Ecological efficiencies – Trophic structure and Energy pyramids – Ecological energetics – Principles pertaining to limiting factors – Biogeochemical cycles (N, C, P cycles) – Overview of freshwater ecology – Marine ecology – Estuarine ecosystem – Terrestrial ecosystem

UNIT II

Pollution

Concepts of Environmental Pollution – Origin of Pollution – Classification and nature of pollutants – Major sources – Impacts of environmental pollution at local region and global level – *Air Pollution*: Formation of Fog and Photochemical Smog and Acid Rain – Industrial Pollution – Overview of Noise Pollution – *Radiation Pollution*: Types and possible hazards of radioactive substances – *Soil Pollution*: Waste land formation, Abandoned mine lands, Ravines, Deforestation, Shifting cultivation – Impact of Dams, Loss of soil fertility – *Global environmental changes*: Global warming, Greenhouse effect of climatic changes, Acid rain and Ozone depletion – *Overview of water pollution*: Oil spills

UNIT III

Effluent Treatment

Microbiology of wastewater treatment: *Aerobic Process*: Activated sludge, Oxidation ponds, Trickling filter, Towers, Rotating discs, Rotating drums, Oxidation ditch – *Anaerobic Process*: Anaerobic digestion, Anaerobic filters, Upflow anaerobic sludge blanket reactors (UASB) – Biotechnology in tannery, dairy, distillery, textiles, pulp, paper and antibiotic industries effluent treatment

UNIT IV

Application and Technology

Remote sensing and its application in resource management and pollution monitoring – IRS satellites and their sensors – Biosensors – Bioremediation (Mycorrhizae in restoration of soil fertility) and pollution abatement – *Biotechnological applications for xenobiotics degradation*: Hydrocarbons, Oil pollutants, Surfactants and Pesticides – Bioleaching – Phytoremediation – Recycling of metabolic wastes, Disposal of Plastic and Radioactive wastes – *Biotechnology in wasteland development*: Restoration of degraded lands – Biopesticides in Intergrated Pest Management – *Bioenergy from wastes*: Biomass, SCP, Biofertilizer, Biogas Production

UNIT V

Environmental Quality Assessment and Monitoring

Quality of environment for life on earth and man – Deterioration of environmental quality with reference to anthropogenic impact – Methods of assessment of Environmental quality – Short term studies/surveys – *Environmental Impact Assessment (EIA)*: Need of EIA – Scope and objectives – Types of environmental impacts – Steps involved in conducting the EIA studies – Merits and Demerits – The Environmental Protection Act, 1986 – Green piece friendly concept

References

1. Agarwal KC (2001) Environmental Pollution: Causes, Effects and Control. Nidhi Publishers (India), Bikanir.
2. Allsopp D and Seal KJ. ELBS/Edward Arnold. Introduction to Biodeterioration. Selected papers from Applied Environmental Microbiology.
3. De AK (2010) Environmental Chemistry. Wiley Eastern Ltd.,
4. Harvinder Sohal and Srivastava AK (1982) Environment and Biotechnology. Blackwell Publishers, New Delhi.
5. Jogdand SN (1995) Environmental Biotechnology. Himalaya Publishing House.
6. Kudesia VP and Kudesia R (1979) Environmental Health and Technology. McGraw Hill Publications Co. Ltd., New Delhi.
7. Kumar HD (1982) Modern Concepts of Ecology. Vikas Publishing House Private Ltd.
8. Kumaraswamy K, Alagappa Moses A and Vasanthi M. Environmental Studies. Bharathidasan University Publications, Trichy.
9. Metcalf and Eddy (2004) Wastewater Engineering: Treatment and Reuse. 4th Edition, (Eds.) George Tchobanoglous, F.L. Burton, H.D. Stensel, Tata McGraw Hill, New Delhi, India.
10. Olguin EJ, Sanchez G and Hetatdez (2003) Environmental Biotechnology and Clean Air Process. Taylor and Francis.
11. Rana SVS (2005) Essentials of Ecology and Environmental Sciences, Prentice-Hall of India Private Limited, New Delhi, India.

Web References

1. www.britannica.com/EBchecked/topic/65875/biogeochemical-cycle
2. library.thinkquest.org/CR0215471/oil_spills.htm
3. ccir.ciesin.columbia.edu/nyc/ccir-ny_q1.html
4. moef.nic.in/modules/divisions/eia
5. www.cpeo.org-techtree/ptdescript/phytrem.htm

CORE III: 11UPEVS1C03

ENVIRONMENTAL CHEMISTRY

UNIT I

Concepts of Environmental Chemistry

Concept and scope of Environmental Chemistry: Definition an explanation of various terms, segments of environment. Principles and cyclic pathways in the environments. Staoichiometry, Gibb's Energy, chemical potential, chemical equlibria, acid base reactions, solubility product, solubility of gases in water, the carbonate system, radionucliotides.

UNIT II

Molecular Environmental Chemistry

Chemistry of biologically important molecules: *Chemistry of water*: Unusual physical properties, hydrogen bonding in biological system, unusual solvent properties, changes in water properties by addition of solute. Protein structure and biological functions, enzymes, enzyme metabolism, biosynthesis of DNA and RNA, Mutations and gene control during embryogenesis.

UNIT III

Pollutant Chemistry

Chemistry of various organic and inorganic compounds: *Hydrocarbons*: Chemistry of hydrocarbon decay, environmental effects, effects on macro and microorganisms - *Surfactants*: Cationic, anionic and non-ionic detergents, modified detergents. *Pesticides*: Classification, degradation, analysis, pollution due to pesticides and DDT problems. *Synthetic polymers*: Microbial decomposition, polymer decay, ecological and consideration, Photosensitize additives. *Lead and its compounds*: Physical and chemical properties, behavior, human exposure, absorption, influence.

UNIT IV

Effects of Pollutants

Carcinogenic compound and their effects: Aflotoxin occurrence, chemical composition and properties, metabolism, acute toxicity, carcinogenicity. *Destruction of some hazardous substances*: Acid halides and anhydrides, alkali metals, cyanides and cyanogens, bromides, chromium, halogenated compounds.

UNIT V

Instrumentation

Principle, merits and demerits of the techniques: Neutron activation analysis, Isotope dilution analysis, Calorimetric, Colorimetry, Atomic Absorption Spectroscopy, Gas Chromatography, HPLC, Ion Exchange Chromatography, and Polarography, XRF, XRD etc.,

References

1. Arnikar HJ. Essential of Nuclear Chemistry
2. Banerjee SK. Environmental Chemistry
3. Chatwal and Anand. Instrumental Methods of Analysis
4. Dara SS. A Text Book of Environmental Chemistry and Pollution Control
5. De AK. Environmental Chemistry
6. Ewing GW. Instrumental Methods of Analysis
7. Jadhav HV. Elements of Environmental Chemistry
8. Khopkar. Environmental Pollution Analysis
9. Lehninger. Principals of Biochemistry
10. Lenihan J and Fletcher WW. Environment and Man: The Chemical Environment
11. Lunn G and Sansone EB. Destruction of Hazards Chemicals in the Laboratory
12. Moore JW and Moore EA. Environmental Chemistry
13. Satake M, Do S, Sethi S, Eqbal SA. Environmental Chemistry
14. Sharma BK and Kaur H. Environmental Chemistry
15. Well JH. General Biochemistry

Web References

1. www.gibbsenergy.com
2. www.chem.unep.ch/pops/pdf/lead/leadexp.pdf
3. www.icrisat.org/aflatoxin/aflatoxin.asp
4. bioenergy.asu.edu/photosyn/courses/bio_343/lecture/dna-rna.html
5. www.cem.msu.edu/cem333/Week09.pdf

CORE IV: 11UPEVS1C04

BIODIVERSITY AND CONSERVATION

UNIT I

Introduction to Biodiversity: Species, Genetic, Community and Ecosystem diversity – *Biodiversity magnitude and distribution*: Speciation and buil-up, Diversity gradients and related hypotheses – Biodiversity and ecosystem function – Methods for Biodiversity Monitoring

UNIT II

Ecosystem and Biodiversity

Biodiversity and Ecosystem Services: Provisioning, Regulating, Cultural and Supporting – *Threats to Biodiversity*: Natural and anthropogenic, Species extinctions – IUCN Threat Categories – Red Data Book – *Invasions*: Causes and Impacts, Over-harvesting and Climate change

UNIT III

Conservation Biology

Biodiversity Conservation: Principles and Strategies – In-situ and Ex-situ Conservation – Ecological Principles, Population Recovery, Conservation Management, and Design of Nature Reserves – Discuss the status and protection of species nationally and internationally including the Endangered Species Act – CITES and IUCN – Protected Area Network – Convention on Biological Diversity (CBD) – Biodiversity Act 2002 – NBSAP – Megadiversity zones and Hot Spots: Concepts, Distribution and Importance – *Use of Biodiversity*: Source of food, medicine, raw material, aesthetic and cultural – Biodiversity Prospecting

UNIT IV

Conservation and Sustainable Management

Conservation and sustainable management of biodiversity and bioresources – National Policies and Instruments relating the protection of the wild/domesticated flora and fauna as well as habitats – International Policies and Instruments – A general account on multilateral treaties – The role of CBD, IUCN, WIIF, IBPGR, NBPGR, WWF, FAO, UNESCO and CITES – Bioresources, Biotechnology and Intellectual Property: An elementary account on WTO, GAAT and TRIPS – Bioprospecting and IKS – Biopiracy rights of farmers, breeders and indigenous people – An elementary account on biodiversity/bioresources data base

UNIT V

Conservation Genetics

Conservation of biodiversity: Current practices in conservation – Habitat or Ecosystem Approaches, Species based Approaches, Social Approaches – Chipko Movement –In-situ (Afforestation, Social Forestry, Agro-forestry, Botanical gardens, Zoos, Biosphere Reserves, National Parks, Sanctuaries, Sacred Groves and Sthalavrikshas) and Ex-situ (Cryopreservation, Gene Banks, Seed Banks, Pollen Banks, Sperm Banks, DNA Banks,

Tissue Culture and Biotechnological Strategies) – Ecorestoration – Environmental and Biodiversity Laws – Environmental Education

References

1. Agrawal KC (1996) Environmental Science. Agrobotanical Publishers, India.
2. Chaudhuri AB and Sarkar DD (2003) Megadiversity Conservation, Flora, Fauna and Medicinal Plants of India's Hot Spots. Daya Publishing House, New Delhi.
3. Dadhich LK and Sharma AP (2002) Biodiversity –Strategies for Conservation, APH Publishing Corporation, New Delhi.
4. Garg MR Bansal VK and Tiwana NS (1997) Environmental Pollution and Protection. Deep and Deep Publications, New Delhi.
5. Gary K Meffe and Ronald Carroll C (1994) Principles of Conservation Biology. Sinauer Associates Inc., Massachusetts.
6. Groombridge B (Ed.) (1992) Global Biodiversity Status of the Earths Living Resources. Chapman & Hall, London.
7. IUCN (1992) Global Biodiversity and Strategy.
8. Khan TI and Dhari N Al Ajmi (1999) Global Biodiversity – Conservation Measure, Pointer Publishers, Jaipur.
9. Krishnamurthy KV (2003) An Advanced Textbook on Biodiversity – Principles and Practice, Oxford and IBH Publishing, New Delhi.
10. Krishnan Kannan (1997) Fundamental of Environmental Pollution. S. Chand & Company Ltd., Ram Nagar, New Delhi.
11. Kumar HD (1997) General Ecology. Vikas Publishing House (P) Ltd., New Delhi.
12. Ramade F (1991) Ecology of Natural Resources. John-Wiley.
13. Ronald M. Atlas (1997) Principles of Microbiology. 2nd edition, W.M.C.Brown Publishers, London.
14. Sharma PD (2000) Ecology and Environment. Rastogi Publications, Meerut, India.
15. Shukla RS and Chandel PS (2000) Plant Ecology and Soil Science. S.Chand & Company Ltd., Ram Nagar, New Delhi.
16. Singh MP, Singh BS and Soma S. Dey (2004) Conservation of Biodiversity and Natural Resources. Daya Publishing House, New Delhi.
17. Virchow D (1998) Conservation and Genetic Resources, Springer-Verlag, Berlin.

Web References

1. www.iucn.org
2. www.cites.org
3. www.cbd.int
4. www.fao.org/Ag/agp/agpc/doc/Publicat/TAPAFON/TAP_7.pdf
5. www.wri.org/biodiv/bp-home.html
6. www.jamaicachm.org.jm/DHS/conservation.htm

SEMESTER II

CORE VI: 11UPEVS1C05

NATURAL RESOURCES AND MANAGEMENT

UNIT I

Introduction

Natural resources – Classification, Concepts and approaches of natural resource conservation - Natural resources of India

UNIT II

Soil Resources Management

Distribution of Soil resources – Role of agricultural practices in soil degradation - Soil erosion – *Soil Fertility and Nutrient Management*: Role of organic matter and its significance in soil quality – Diagnosis of soil nutrient deficiencies – *Organic Farming*: Principles, Benefits to Soils - *Methods of organic farming*: Green manuring, Animal manures and Composting - Wasteland development strategies

UNIT III

Mineral Resources Management

Resources and reserves – Origin, distribution and uses of economic minerals - Exploration of mineral resources from oceans – Steps in mineral exploitation - Impact of exploitation of economic minerals on environment – Conservation of economic mineral resources

UNIT IV

Water Resources Management

Integrated water resource management - Watershed management – Rain water harvesting – Interlinking of rivers and river basin management - Wetland conservation – Coastal zone management strategies - Ecological significance of mangroves and coral reefs and its conservation

UNIT V

Forest Resources Management

Significance for the conservation of forest resources – Distribution of forests – Wood production - Forest-land use changes in India – Future demand of forest land – Carbon sequestration - *Forest management tools*: Social forestry, Agro-forestry and Urban forestry – Eco-development committees – Ecotourism – Climate change reduction – Carbon trading - Management of grasslands

References

1. Agarwal VG (1985) Forests in India. Oxford and IBH, New Delhi, India.
2. Dutta A (2001) Biodiversity and Ecosystem Conservation. Kalyani Publisher, Kolkata.
3. Jha LK (1997) Natural Resource Management. APH Publishing Corporation, New Delhi.
4. Kumar HD (1995) Modern Concepts of Ecology. Vikas Publishing House (P) Ltd., New Delhi.
5. MaDicken KG and Vergora NT (1990) Agroforestry: Classification & Management. John Wiley & Sons, New York.
6. Nalini KS (1993) Environmental Resources and Management, Anmol Publishers.
7. Nautiyal S and Kaul AK (1999) Forest Biodiversity & its Conservation Practices in India. Oriental Enterprises, Dehradun, India.
8. Negi SS (1993) Biodiversity and its Conservation in India. Indus Publications, New Delhi.
9. Owen OS & Chiras DD (1995) Natural Resources Conservation. Prentice Hall India.
10. Rana SVS (2003) Essentials of Ecology & Environmental Sciences. Prentice Hall of India.
11. Raymond F and Dasmann (1984) Environmental Conservation. 5th edition, John Wiley & Sons.
12. Sapru RK (1987) Environmental Management in India. Vol I & II. Ashish Pub. House.
13. Sharma VK (1985) Water Resources Planning and Management. Himalaya Pub. House.
14. Tewari DN (1994) Tropical Forestry in India. Int. Book Distributor, Dehra Dun.

Web References

1. www.onlinecarbonfinance.com/india-and-carbon-credits.htm
2. mines.nic.in/imsector.html
3. www.rainwaterharvesting.org/happenings/wetland_conservation.htm
4. www.ecoworld.com/atmosphere/effects/organic-farming-in-india.html
5. www.agroforestry.net
6. ecotourisminindia.com

CORE VII: 11UPEVS1C06

ENVIRONMENTAL MICROBIOLOGY

UNIT I

General Microbiology

History and scope of microbiology, Ultrastructure of Prokaryotic and Eukaryotic cell, Sterilization techniques used in microbiology, Preparation of media for isolation and culture of microorganisms - Microbial growth and multiplication of bacteria, virus and fungi - MPN, total cell count - Nature of virulence, toxins, extra cellular enzymes of pathogenic bacteria

UNIT II

Microbes and Environment

Classification and characteristics of Microorganisms, Microbial interactions-Entophytes-. *Microbial diversity of environment***:** Microbes in air, water, waste water and soil; Introduction, distribution, sampling techniques and identification. Microbes of extreme environment. Microorganisms as bio-indicators in the environment, Role of microorganisms in element cycles – different cycles. Ecological impacts of microbes - Symbiosis (Nitrogen fixation and ruminant symbiosis) - Microbes and Nutrient cycles - Microbial communication system - Quorum sensing – Microbial fuel cells - Prebiotics and Probiotics – Vaccines

UNIT III

Microbial Interactions

Microbes in the degradation of wastes, Bioremediation-Its role in Environmental management, advantages and disadvantages. Control of pests and diseases by microorganisms, Treatment of solid and liquid industrial wastes, Microbial degradation of pesticides. Microbes in metal extraction, mineral leaching and mining, copper extraction by leaching and microbes in petroleum product formation.

UNIT IV

Aquatic Microbiology

Methods of water sampling for pollution analysis - *Biofilms in treatment of waste water*: Biofilm development and biofilm kinetics, aerobic biofilms. *Bioreactors for waste water treatments*: Reactor types and design, Reactors in series - Different types of water sampling tools and it uses - Geomicrobial transformations – Biomobilization of silicon, phosphate, nitrogen - Geomicrobiology of fossil fuel, methane, peat, coal and petroleum

UNIT V

Microbial techniques

Molecular methods such as Denaturing Gradient Gel Electrophoresis (DGGE) - Temperature Gradient Gel Electrophoresis (TGGE) - Amplified rDNA Restriction Analysis and Terminal Restriction Fragment Length Polymorphism (T-RFLP) in assessing microbial diversity - 16S rDNA sequencing and Ribosomal Database Project

References

1. Patrick K. Jemba. Environmental Microbiology Principles and Applications.
2. P D Sharma- Environmental Microbiology.
3. Brock TD, Madigan MT, Martinko JM and Parker J (1994) Biology of Microorganisms, VII Ed., Prentice Hall, New Jercy, USA.
4. Shree N. Singh, Rudra D. Tripathi Environmental bioremediation technologies. Introduction to Microbiology. A. S. Rao
5. Maria Csuros, Csaba Csuros. Microbiological examination of water and wastewater,
6. Raina M. Maier, Ian L. Pepper, Charles P. Gerba - Science. Environmental Microbiology
7. Ehrlich HL (1996) Geomicrobiology, Marcel Dekker Inc., New York.
8. Eweis JB, Ergas SJ, Change DPY and Schroeder ED (1998) Bioremediation – Principles, McGraw-Hill Inc., New York.
9. Joseph C Daniel (1999) Environment Aspects of Microbiology. 1st Edition, Bright Sun Publications, Chennai.
10. Pelczar MJ Jr., Chan ECS and Kreig NR (1993) Microbiology, Tata McGraw Hill, Delhi.
11. Reed G, Prescott and Dunn's (1987) Industrial Microbiology, 4th Edition, CBS Publishers.
12. Subba Rao NS (2004) Soil Microbiology. 4th Edition, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

Web References

1. www.wastewatertreatment.co.in/index.php
2. www.microbialfuelcell.org
3. www.pollutionissues.com/A-Bo/Bioremediation.html
4. www.bioreactors.net
5. http://www.cpeo.org/techtree/ttdescript/biorec.htm
6. http://www.personal.psu.edu/jel5/biofilms/
7. www.rdp.cme.msu.edu

CORE VIII: 11UPEVS1C07

ENVIRONMENTAL IMPACT ASSESSMENT AND DISASTER MANAGEMENT

UNIT I

Introduction

Definition – Basic concepts and principles of EIA – Origin and development of EIA - Short-term and Long-term objectives – EIA guidelines 2006 (Notification of Government of India) – Environmental Management Plan ISO 14000 - Basis for Environment Impact Assessment – Types of impacts (Negative & Positive, Primary & Secondary, Reversible and Irreversible Tangible and Intangible) – Merits and Demerits of EIA

UNIT II

Components and Methodologies of EIA

Components: Screening of Projects - Notification – Public Participation - Preparing environmental impact statements – Review of EIA analysis – Decision methods for evaluation of alternatives - *EIA Methodologies*: Adhoc Method – Checklist Approach – Matrix Methods – Network Methods

UNIT III

EIA of major development projects & Environmental auditing

Transportation - River valley Projects – Irrigation and dams - Mining and quarrying - Oil refinery - Thermal Power Project - Cement Industries – *Environmental Auditing*: Scope, Objectives and Procedures for environmental auditing

UNIT IV

Environmental Hazards

Natural and Man-made hazards – Environmental security and hazard zoning – *Catastrophic geological hazards*: Earthquakes, Tsunami's, Volcanic eruptions, Snow avalanches, Landslides, Cyclones, Floods, Droughts, Heat and cold waves, Desertification, and Forest fires – *Man made hazards*: Improper irrigation and deforestation – *Industrial hazards*: Fire, Explosion, Toxic release and dispersion - Effects, Predictions, Forecasting and Mitigation measures of environmental hazards

UNIT V

Disaster Management

Disaster management Plans: Components of disaster management plan on-site and off-site emergency plans - Pre disaster phase, Actual disaster phase and Post disaster phase - *Disaster assistance*: Technological assistance, Relief camp Organization, Camp layout, Food requirement, Water needs, Sanitation, Security, Information administration, Fire fighting camping and Tent pitching, Rope, Knots and their use - Emergency rescue -

Disaster education: Alternatives and new directions - Conceptualizing disaster recovery, Mitigation and preparedness, Programme planning and management

References

1. Bregman JI (1999) Environmental Impact Statements. Lewis Publishers, London.
2. Canter LW (1996) Environmental Impact Assessment. Mc Graw Hill, New York.
3. Cuttler SI (1994) Environmental Risk and Hazards, Prentice Hall of India, New Delhi.
4. Eccleston CH (2000) Environmental Impact Assessment- A Comprehensive Guide to Project and Strategic Planning, John Wiley and Sons.
5. Harold D. Foster (1980) Disaster Planning. The Preservation of Life and Property, Springer-Verlag, New York.
6. Jensen ME and Bourgeron PS (2001) A Guide Book for Integrated Ecological Assessments, Springer-Verlag, New York, Inc.
7. Joseph Cascio. The ISO 14000 Handbook
8. Natural Disasters – A Guide for relief workers – JAC Adhyatme Sadhma Kendra, Mehrauli, New Delhi.
9. Parasuraman S and Unnikrishnan PV (2000) Indian Disasters – Report towards a policy initiative, Oxford University Press.
10. Petalc WJ and Allissoon AA (1982) Natural Hazards Risk Assessment and Public Policy – Anticipating Unexpected, Springer-Verlag, New York.
11. Shailendra K. Singh, Subash C, Kundu and Shobu Singh (1998) Disaster Management, Mittal Publications.
12. Singleton R, Castle, P and Sort, D (1999) Environmental Assessment, Thomas Telford Publishing, London.

Web References

1. www.14000.org
2. www.iso.org
3. www.fao.org/docrep/V8350E/v8350e06.htm
4. http://ismenvis.nic.in/My_Webs/Digital_Library/gs10.htm
5. http://www.ncbi.nlm.nih.gov/pubmed/9299766
6. www.xstrata.com/sustainability/ourapproach/standards/06/
7. www.disasterassistance.gov
8. www.disastereducation.org

SEMESTER III

CORE X: 11UPEVS1C08

SOLID WASTE MANAGEMENT

UNIT I

Waste Management

Waste – Introduction, sources, characteristics, composition, classification, waste generated per capita- Global scenario. Solid Waste – collection, Storage, segregation-transportation and disposal methods-sanitary land fills and types, composting, aerobic digestion, incineration, types of incineration, pyrolysis and medical waste, technology options for biomedical waste treatment

UNIT II

Hazardous waste Management

Hazardous waste-Introduction, characteristics, resource conservation and recovery act, listed hazardous waste, listing criteria. Classification of hazardous waste and handling of hazardous solid wastes. Radio active wastes- sources, pollution, types of radioactive waste and its control and management.

UNIT III

Reuse and Recycling of waste

Waste management – waste minimization program, typical material recovery facility operation (TMRF), Reuse and recycling of paper, glass, rubber. Plastic waste status in India, effect of plastic wastes on environment, management of plastic waste.

UNIT IV

Reclamation of metal contaminated sites using Phytotechnologies

Development of eco-friendly processes such as integrated waste management: Plants used for dual benefits - Canola case studies for Se phytoremediation and biofortification in California – *Terrestrial Phytotechnology*: Phytoremediation, Phytovolatilization, Phytodegradation, Phytostabilization - *Aquatic Phytosystems*: Blastofiltration, Rhizoremediation, Constructed wetlands, Algal blooms

UNIT V

Chosen Treatment Designs

Compost pits - Mushroom sheds - Sewage farm designs - Filter systems - Flash mixers - Contact filters - Fabric filters - Trickling system - Settling tanks - Biogas plant - Incinerators

References:

1. Hazardous Wastes and Solid Wastes- Lie, D.H.F. and Liptak, B.G. (2000), Lewis publishers, New York.
2. Solid Waste management in Developing countries – Indian National Scientific documentation center- Bhide and Sundaresan, New Delhi. (2000)
3. Solid waste management- George Tehobanaglous- Milary Theiren and Samuel A vigil, Integrated, Mc Graw Hill Inc, (1993).
4. WHO Manual on solid waste management
5. CPHEEO Manual on solid waste management
6. Hazardous Waste Management, II Ed, La Grega, M.D., Buckingham, P.L. and Evans J.C., Mc Graw Hill Inc., (2001)
7. Bioremediation, Baker, K.M. and Herson, B.S, Mc. Grqw-Hill Inc., (1994)
8. Bioremediation- Principles, Eweis, J.B.Ergas S.J.Change, D.P.Y and Schroeder, E.D. Mc Graw Hill Inc., (1998)
9. Bhide AD and Sunderson BB (1983) Solid Waste Management in Developed Countries, INSDOC, New Delhi.
10. John Pitchel (2005) Waste Management Practices, Municipal, Hazardous, and Industrial. Taylor & Francis Group, LLC.
11. Lagrega MD, Buckingham PL and Evans JV (2001) Hazardous Waste Management, McGraw Hill Int. Ed. New York.
12. Tchobanglous G, Thesien GH, Eliassen R (1977) Solid wastes: Engineering Principles & Management Issues, Mc Graw Hill Int. ED, Singapore.

Web References

1. http://www.cpeo.org/techtree/ttdescript/pyrols.htm
2. www.satavic.org/vermicomposting.htm
3. http://web.mit.edu/urbanupgrading/urbanenvironment/sectors/solid-waste-landfills.html
4. www.cement.org/waste/wt_apps_radioactive.asp
5. www.ipma.co.in/recycle.asp
6. linkinghub.elsevier.com/retrieve/pii/S026974910600042X
7. www.algae.info
8. www.biotech-india.org/

CORE XI: 11UPEVS1C09

ENVIRONMENTAL BIOTECHNOLOGY

UNIT I

Molecular Biology

Basic concepts of molecular biology - DNA structure and organization into chromosomes - DNA replication - Repetitive DNA - Coding and non-coding sequences in genomes - Gene structure and expression - Mechanics of transcription, translation and their regulation in both prokaryotes and eukaryotes

UNIT II

Genetic Engineering

Basic techniques in genetic engineering - Genetic manipulation - Restriction Endonucleases - Introduction of cloned genes into new hosts using plasmid and phage vector systems – Expression cloning - Affinity purification of expressed proteins - Nucleic acid hybridization and polymerase chain reaction - DNA sequencing

UNIT III

Biotechniques

Buffers - Methods of cell disintegration - Enzyme assays and controls - Detergents and membrane proteins – Dialysis - Ultrafiltration and other membrane techniques - *Spectroscopy Techniques*: Raman Spectroscopy, Fluorescence, MS, NMR, PMR, ESR, API-electrospray, MALDI-TOF - Mass spectrometry and Plasma Emission spectroscopy - Chromatography Techniques- Chromatographic methods for macromolecule separation - Gel permeation, FPLC - *Electrophoretic techniques*: Theory and application of Polyacrylamide and Agarose Gel Electrophoresis, Capillary electrophoresis, 2D Electrophoresis, Gradient electrophoresis, Pulsed field gel electrophoresis

UNIT IV

Applied Biotechnology

Practical aspects of genetic engineering with microorganisms from extreme environment: Use of extremophilic microorganisms in waste treatment and methane production from agro industrial wastes - Production of enzymes like cellulase, proteases, amylases - Alcohol and acetic acid production – Biocomposting and Biomining - *Alternate fuels*: Source and mechanism of various biofuel production

UNIT V

Bioremediation and Metagenomics

Bioremediation: Concept and role of bioremediation in controlling various pollution problems e.g. solid water, sewage water, industrial effluents, heavy metals, radioactive substances and oil spillage - *Metagenomics*: Environmental Genomics, ecogenomics or

community genomics, the study of genetic material recovered directly from environmental samples and future applications in bioremediation - Genetically modified organisms and Biosafety- a general account

References

1. Agarwal SK. Environmental Biotechnology, APH Publishing Corp., New Delhi.
2. Brown TA (2000) Essential Molecular Biology. Practical Approach. Vol 1, 2nd edition, Oxford University Press, UK.
3. Brown TA (2006) Gene Cloning and DNA Analysis: An Introduction. John Wiley & Sons.
4. Chatterji AK. Introduction to Environmental Biotechnology, Prentice Hall of India Pvt. Ltd, New Delhi.
5. Dubey RC. A Text Book of Biotechnogy, S. Chand & Company Ltd., New Delhi.
6. Glick and Pasternak. Molecular Buiotechnology - Principles and Applications of Recombinant DNA,. Panima Publishing Corporation, New Delhi.
7. Gupta PK. Elements of Biotechnology, Rastogi Publishing House, New Delhi.
8. Indu Shekhar Thakur I.K. Environmetal Biotechnology-Basic Concepts and Applications International Pvt. Ltd. New Delhi.
9. Jogdand SN. Environmental Biotechnology, Himalaya Publishing House, New Delhi.
10. Singh BD. Biotechnology, Kalyani Publishers , New Delhi.

Web References

1. isebindia.com/05_08/06-04-2.html
2. www.bio.sci.osaka-u.ac.jp/initiative2006/pdf/TsaiLectSum.pdf
3. www.rsc.org/ebooks/archive/free/.../BK9780854046065-00001.pdf
4. www.globalmethane.org/.../events_ag_20090127_techtrans_roos.pdf
5. www.alternative-energy-news.info/technology/biofuels/
6. http://www.mnre.gov.in/policy/biofuel-policy.pdf

CORE XII: 11UPEVS1C10

CLIMATE CHANGE AND CURRENT ISSUES

UNIT I

Elements of climate, climate controls - Earth's radiation balance, Latitudinal and seasonal variation of insulation, temperature, pressure, wind belts, humidity, cloud formation and precipitation - Water balance, spatial and temporal patterns of climate parameters - Air masses and fronts - SW and NE monsoon - Jet stream, tropical and extra-tropical cyclone - ENSO, QBO - Classification of climate - Koppen's and Thornthwaite' scheme

UNIT II

Global Environmental problems - Ozone depletion, causes and effects. Acid Rain – How acid rain is formed, adverse effects of acid rain. Photochemical smog, Factors responsible for photochemical smog.

UNIT III

Green house gases – green house effect and climate change Global warming facts – Effects of Global warming – control and remedial measures of green house effect, global warming and climate change, impacts of sea level rise

UNIT IV

Man and Ecodegradation of Natural Environment, Present status of wasteland in India. Problems and prospects of wasteland development. Wasteland reclamation through Social Forestry, Bioaesthetic planting for pollution abatement.

UNIT V

Eutrophication and restoration of Lakes. Drug abuse and alcoholism as a threat to environment. Environmental ethics - stewardship ethics and lifeboat ethics of Garret Hardin. Fly ash utilization, wet land conservation, environmental disaster (man made) episodes; Mina mata, itai itai, London smog, Los Angeles smog, Bhopal gas tragedy.

References-

1. Environmental Education – Nanda. A.N. (1996)
2. A text book of Environment – Agarwal. K. M. Sikdar. P. K. and Deb. S. C, MacMiller India Ltd., Calcutta (2002)
3. Living in the Environment – Principles, Connections and Solutions – Tyler Miller Jr. G, Wadsworth Publishing Co. New York (1996).
4. Botkin, D.B.Changing the Global Environment, Academic Press, San Diago (1989)

Web References

1. http://www.nationalaglawcenter.org/assets/crs/RL34513.pdf
2. http://www.oecd.org/dataoecd/22/16/1934784.pdf

CORE XIII: 11UPEVS1C11

ENVIRONMENTAL TOXICOLOGY

UNIT I

Introduction to toxicology, scope of toxicology subspecialties of toxicology, description and terminology of toxic effects, factors influencing toxicity, drug toxicity, biochemical basis toxicity – mechanism of toxicity and receptor mediated events, acute and chronic toxicity. Selective toxicity. Dose response relationship-graded response time action curves, threshold limit value, LC_{50} LD_{50}, Margin of safety and toxicity curves.

UNIT II

Bioaccumulation and Biomagnifications of toxic materials in food chain, Toxicology of major pesticides-Environmental impacts of pesticides, biotransformation, biomonitoring, programs and parameters of biomonitoring, concept of bioindictor, bioindicator groups and examples. Basic concepts of Environmental forensics.

UNIT III

Concepts of Bioassay- types, characteristics. Importance and significance of bioassay, Field based microbial bioassay for toxicity testing, Bioassay test models and classification. Immunotoxicity, histotoxicity, cell toxicity.

UNIT IV

Sampling of air and water pollutants - *Monitoring techniques and methodology*: pH, Dissolved Oxygen (DO), Chemical Oxygen demand (COD), Biological Oxygen Demand (BOD), Speciation of metals - Monitoring and Analysis of CO, NO_2, CO_2, SO_2, pesticide residues, phenols and petrochemicals.

UNIT V

Introduction to Separation techniques - Flame photometry, Inductively Couple Plasma Emission Spectroscopy (ICP-ES), ICP-MS, X-ray Fluorescence - Non-dispersive IR Spectroscopy (NDIR) - Electro analytical methods - NMR and Mass Spectroscopy.

Reference:

1. Environmental biology and Toxicology, by Sharma P.D. Rastogi and Lamporary., 1994.
2. Environmental pollution and Toxicology by Meera Asthana and Astana D.K., Alka printers, 1990.
3. Toxicology, by A.Sood, Sarup and sons New Delhi, 1999
4. Text book of Preventive and Social Medicine, by Park J.E. and Park K., Banosidas Bharat Publishers, Jabalpur, 1985
5. Environmental Epidemiology, by Anisa Basheer, Rawat Publication Jaipur, New Delhi 1995.

6. Toxicology, Biochemistry and Pathology of Mycotoxins, by Kenji Uroguchi a mikio, Yamazadi Kodanshoa Ltd., Tokyo, 1978.

Web References

1. www.epa.gov/kidshometour/toxic.htm
2. www.marietta.edu/~biol/102/2bioma95.html
3. ilocis.org/documents/chpt33e.htm
4. www.uji.es/bin/ocit/grups/00503001.pdf
5. www.cis.rit.edu/htbooks/nmr/

SEMESTER IV

CORE XV: 11UPEVS1C12

ENVIRONMENTAL LAWS, PLANNING AND POLICY

UNIT I

Duties and responsibilities of citizens for environmental protection – Subjects related to environment in the seventh schedule of the Constitution: Union list, State list and Common or Concurrent list - Central and State Pollution Control Boards: Powers and functions of pollution control boards - Penalties and procedure - Scheme of lebelling of environmentally friendly products (ecomark) Major International conventions for sustainable environment: Kyoto Protocol 1997 - Earth Summit 2002 – Bali Summit 2007 – Nagoya Protocol 2010

UNIT II

Legal control of Environmental pollution in India with special

reference to :

i. The Wildlife protection Act – 1972
ii. The Water prevention and control of pollution Act, 1974, amended 1988: CESS Act 1977, amended in 1991.
iii. The Forest Conservation Act, 1980, amended in1988.
iv. The Air prevention and control of pollution Act, 1981, amended in 1990.
v. The Environment protection Act. 1986.
vi. The Motor Vehicle Act, amended in 1988
vii. The National Environment Tribunal Bill 1992, Stockholm conference-1972, UNEP- 1982
viii. Hazardous waste management rules-1989 & amendment rules
ix Municipal waste management rules 2000

UNIT III

Environment (Protection) Act, 1986 - Powers of Central Government under EPA - Salient features of Water ((Prevention & Control of Pollution) Act, 1974 - Air (Prevention & Control of Pollution) Act, 1981 - Powers and Functions of CPCB & SPCB under Water and Air Acts - The Factories Act of 1948

UNIT IV

(i) Planning: Importance of planning, local, regional, state and national planning. Site and location with reference to Environmental Pollution, Zoning-Physical planning. **(ii)** Economics of pollution control, cost-benefit ratios. Reliability and Risk analysis.

UNIT V

National policy, sectorial – integration, state level policy and implementation. Environmental protection in India – Organizational structure at state and central governmental levels.

References

1. Defense preparedness in India – Jain N.K.,Joint assistance center, Adhyatma Sadhana Kendra Mehrauli, New Delhi
2. Environmental Law and Policy in India, Divan.S and Rosencranz. A, Oxford University Press, 2nd edition (2001)
3. Pollution control Legislation, Vol. I and II, Tamilnadu Pollution Control Board, Chennai (1999)
4. Divan S and Roscencranj A (2001) Environmental Law & Policy in India. Oxford Publishers, New Delhi.
5. Diwan P (1997) Environmental Administration - Law & Judicial Attitude, Vol. I, II. Deep & Deep Publishers, New Delhi.
6. Gurudeep Singh (2005) Environmental Law in India, Mc Millan, New Delhi.
7. Jariwala CM (2000) Complex Enviro-Technoscience Issues. 42 (1), Journal of Indian Law Institute. 29.
8. Leelakrishnan P (1999) Environmental Law in India. Butterworths Publications, New Delhi.
9. Shyam Diwan and Armin Rosencrany (2001) Environmental Law and Policy in India, Oxford University Press, New Delhi.
10. Singh G (1995) Environmental Law: International & National Perspectives.
11. Tamil Nadu Pollution Control Board (1999) Pollution Control Legislations, Vol. I and II, Chennai.

Web References

1. cpcb.nic.in/
2. www.tnpcb.gov.in/
3. www.thesummitbali.com/
4. envfor.nic.in/legis/legis.html
5. edugreen.teri.res.in/explore/laws.htm
6. envfor.nic.in/legis/crz/crznew.html
7. rti.gov.in/
8. www.ngosindia.com/resources/pil.php

CORE XVI: 11UPEVS1C13

RESEARCH METHODOLOGY AND INSTRUMENTATION

UNIT I

Overview of Moral and Ethical questions in Scientific writing - Overall outline and structure of the article/manuscript - Description, value, and development of points/outlines before writing

UNIT II

Screening of material for inclusion within the structure of the manuscript - Importance of Authors and their sequence - Importance of clear title, abstract or summary - Introduction, Methods, Results and Discussion - Numbers and Statistics, Tables and Figures - Discussion.

UNIT III

Optical methods: Various ranges of electromagnetic radiation, interaction of electromagnetic radiation with matter, UV-Visible spectroscopy: Theory, instrumentation and applications to environmental samples, optical fibers in spectroscopy. X-ray spectroscopy.

UNIT III

IR and NDIR spectroscopy: Molecular vibrations and vibration frequencies, special features of IR and NDIR instruments. Applications for the environmental samples. Continuous monitoring of CO using NDIR spectroscopy, Atomic Absorption Spectroscopy, principles, instrumentation and applications in environmental sample analysis. Atomic Emission Spectroscopy-Principle, instrumentation and applications of flame emission spectroscopy.

UNIT IV

Nephelometry and turbidometry: Principles and applications in the determination of turbidity of water.Radio analytical methods: Radiochemical techniques- Principles and applications of neutron activation analysis and isotope dilution analysis. Polarography: Principles, instrumentation and applications of polarography in the environmental sample analysis. Solvent extraction, thin layer chromatography, gas chromatography, HPLC and Ion exchange chromatography.

References:

1. Basic concepts of Analytical Chemistry – S.M.Khopkar, 2nd edition New Age International Pub (1998)
2. Environmental Pollution analysis, S.M.Khopkar, Wiley Eastern Ltd. (1993)
3. Analytical Chemistry – G.D.Christian, 5th edition, John Wiley and sons Inc., India (2001)
4. Principles of Instrumental analysis – D.A.Skoog, F.J.Holler and T.A.Nieman 5th edition Thomson Asia Pvt., Singapore, (1980)

5. Quantitative analysis, - A.I. Vogel, 6th edition, Prentice Hall Inc., (1998)
6. Introduction to Chemical Instrumentation – Bour.E.J. Wiley and sons 4th edition (1982)
7. Instrumental Methods of Analysis – Willard.H.H., Merrit.L.L. and Dean.J.A – Van Nostrand Reinhold, 5th edition (1976)
8. Environmental Chemistry – Manahan.S.E.7th edition Lewis Publications, Florida, USA
9. Manly (2001) Statistics for Environmental Science and Management, Chapman and Hall / CRC Press, Boca Raton, FL, USA.

Web References

1. www.sportsci.org/jour/9901/wghstyle.html
2. www.computerhope.com/os.htm
3. www.perl.org/
4. blastalgorithm.com/
5. www.fao.org/docrep/W7295E/w7295e08.htm
6. itl.nist.gov/div898/handbook/eda/section3/eda35b.htm

ELECTIVE PAPERS

ELECTIVE I: 11UPEVS1E01

ENERGY AND ENVIRONMENT

UNIT I

Thermodynamics and Energy

Energy- the first and second laws of thermodynamics - Free energy - Converting heat in to work - Reversible process - Conversion of matter in to more useful forms - Storage distribution and conversion of energy - Synthetic chemical fuels - The electrochemical energy conversion - Conservation of the energy - The energy balance of earth - *Non renewable energy*: Fossil fuels - Classification of fossil fuels, composition, physico-chemical characteristics and energy content of coal, petroleum, and natural gas - Origin and use of coal, coal –power plant - Cleaner coal combustion - Origin and uses of petroleum and natural gas - Composition and classification of petroleum and natural gas - Petroleum refinery - Gas hydrates.

UNIT II

New Developing Energy Sources

Nuclear fission reactors - Fission power and environment - *Fuel cells*: Hydrogen fuel cell, metal hydrate fuel cell, microbial fuel cell. *Renewable energy sources*: Solar energy, geothermal, tidal, wind energy - Principals of generation of hydro electric power - Ocean thermal energy conversion - Energy use pattern in different parts of the world - Management of renewable energy - Present scenario in India.

UNIT III

Bioenergy resources

Biomass and its uses - Classification of biomass - *Biomass as a source of energy*: Biodiesel from *Jatropha* Sp., - Biogas as a rural energy source - Biogas production mechanism - Gasification and combustion of biomass.

UNIT IV

Introduction to Environment

Environmental ethics - Environmental policy - *Global environmental issues*: Ozone layer depletion- Climate changes - Acid rain - Sea level raises - Nature and man-made disasters - National environmental problems - *Environmental Quality*: Objectives and standards - Environmental legislation in India.

UNIT V

Environmental Impact Assessment

Introduction to Environmental Impact Assessment (EIA) - Frame work of environmental assessment - Description of environmental setting - Prediction and assessment of impact on air, water, biological and socio-economic environment - Methods of impacts analysis -

Public participation in decision making - Future Environmental Impact Assessment - Environmental Management System (EMS) - Tools for environment management - Cleaner production technology - Waste minimization techniques - Polluters pay principles - Guidelines for the preparation of environmental management planning strategies.

References

1. Boyle GF (2004) Renewable Enegy - Power for a Sustainable Future, Second edition, Oxford University Press.
2. Glyll Henry and Gary W. Heinke (1996) Environmental Science and Engineering Pearson Education, New Delhi.
3. John Andrews and Nick Jelly (2007) Energy Science: Principle, Technologies, and Impacts - Oxford University Press.
4. Kurian Joseph and Nagendra R (2004) Essential of Environmental Studies, Pearson Education, New Delhi.
5. Sharma BK and Kaur SH (1992) Environmental Chemistry. Goel Publising House, Meerut.
6. Taylor and Miller (2008) Environmental Science -10th Edition, Thomson Asia Pvt. Ltd. Publications, Singapore.
7. Viswanathan B (2006) An Introduction to Energy Sources- Indian Institute of Technology.

Web References

1. www.physicalgeography.net/fundamentals/6e.html
2. www.conserve-energy-future.com/
3. www.jatrophabiodiesel.org/
4. www.gasification.org/
5. www.corecentre.co.in/Database/Docs/DocFiles/ems.pdf

ELECTIVE II: 11UPEVS1E02

AIR AND WATER QUALITY MANAGEMENT

UNIT I

Air Pollution Control Technologies

Concept of air pollution - Natural and anthropogenic sources - Major air pollutants - Meteorology and Plume Dispersion - Thermodynamics of major air pollutants - *Particulate matter control equipments*: Settling chamber, cyclones, fabric filter, electrostatic precipitator, wet scrubber, control of gaseous pollutants.

UNIT II

Air Quality Management

Chemical compositions of Air: Classification of elements - Chemical speciation, Particles, Ions and radicals in atmosphere - Chemical processes for formation of inorganic and organic particulate matter – Thermo-chemical and photochemical reaction in atmosphere - Oxygen and Ozone chemistry - Chemistry of air pollutants - Photochemical smog - Methods of monitoring and control of air pollution.

UNIT III

Water Pollution

Principal forms of water pollution - Sources of water pollution - Phenomenon of Eutrophication - Water quality parameters - Water quality standards – Sources, effects and control measures of Ocean, Oil and Ground water pollution

UNIT IV

Reuse and Recycle of Water & Wastewater

Primary, secondary and tertiary treatments - Sludge dewatering and its disposal - Water reclamation and reuse, removal of impurities, removal of residual impurities - Effluent recycle and disposal - *Designs and functioning of ETP*: Concept of ETP, Need of ETP in industry, Concept of CETP, Major units in ETP and their functions - Design aspects of major ETP units - MIS system related to ETP in industry.

UNIT V

Water Treatment Methods

Methods of water treatment - Optimized design, plant control and operational variables - Preliminary treatment process - *Waste water Treatments*: *Physical treatments*: Principles, flow measurement, screening, grit removal - *Chemical treatments*: Principles of chemical treatment, coagulation, flocculation, and sedimentation - *Biological treatments*: Principle of biological treatment, microbial growth and their kinetics for substrate removal, technical considerations in biological treatment.

References

1. Khopkar. Environmental Pollution Analysis
2. Miller TG Jr. Environmental Geography.
3. Rao CS (1993) Environmental Pollution Control, Wiley Eastern Ltd.,
4. Sharma PD (1985) Environmental Biology and Toxicology. Rastogi Publications, Meerut.
5. Sharma PD (1994) Ecology & Environment. Ashish Publications.
6. Todd DK. Ground Water Hydrology. John Wiley & Sons.
7. Valdia KS (1987) Environmental Geography.

Web References

1. www.epa.gov/eogapti1/bces/module6/matter/character/character.htm
2. www.ausetute.com.au/photsmog.html
3. www.water-pollution.org.uk/eutrophication.html
4. www.environengg.com/
5. www.wastewatertreatment.co.in/

ELECTIVE III: 11UPEVS1E03

ECOTOURISM AND WILD LIFE MANAGEMENT

UNIT I

Introduction to Eco-Tourism

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

UNIT II

Interesting Eco-tourism

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.

UNIT III

Impact of Eco-tourism

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.

UNIT IV

Wildlife Conservation

Wildlife conservation - Protected Areas Network in India - Goals of management, Strategies for planning. Factors influencing wildlife management such as habitats, population, behavior, food-habits, health, etc. - Tools for data collection and analysis.

UNIT V

Wildlife Management

Human land-use and wildlife management units - Important projects for the conservation of wildlife in India - Role of local communities in wildlife management – Man-wildlife conflicts - Poaching of wildlife - Wild life conservation laws - The Wildlife (Protection) Act, 1972 (2002 amendment).

References

1. Dasman RF (1968) Environmental Conservation: John Wiley and Sons, New York.
2. Jadhav and Bhosale. Environmental Protection and Laws, , V.M. Himalaya publishing House.
3. Mukherjee N (2008) Ecotourim and sustainable Development. Cybetech Publications, NewDelhi.
4. Prabhas Chandra (2003) Global Ecotourism, Kaniskha Publishers, New Delhi.
5. Sinha, P.C (2003) Encyclopedia of Ecotourism, Volume I, II and III, Anmol Publications Pvt. Ltd., New Delhi.
6. Weaver DB (2001) The Encyclopedia of Ecotourism, CABI Publishing, U.K.

Web References

1. www.incredibleindia.org/newsite/cms_page.asp?pageid=994
2. www.nativescience.org/html/eco-tourism.html
3. www.wcsindia.org/
4. envfor.nic.in/divisions/9-10.pdf
5. http://www.ceeraindia.org/documents/lib_tabofcon_160300.htm

ELECTIVE IV: 11UPEVS1E04

ENERGY AND GREEN TECHNOLOGIES

UNIT I

Introduction – renewable energy sources, non-renewable energy sources, non-conventional and inexhaustible energy resources. Geothermal energy, wind driven power station, Tidal power plants, Glacier power plants, solar energy, nuclear energy, natural radio activity, nuclear power plant, fast breeder reactors, nuclear fusion, gober gas

UNIT II

Energy management – solar energy input conventional fuels – oil, coal, natural gas, uranium, risk of nuclear accidents, bio energy – biomass and biofuels, biogas- biogas technology, petroplants energy plantations and crops.

UNIT III

Waste as renewable sources of energy- types of waste, classification based on chemical nature and physical state, composition of the waste, conversion of methane in to synthetic gas, factors effecting methane formation.

UNIT IV

Green Technology: Phytoremidiation- Hyperaccumulators- biotic interactions, biofilm, Green chemistry- introduction- inception and evolution- importance of solvents- types of catalysts and their role- Biological alternatives- applications. Principles of green chemistry, advances in green chemistry

References:

1. Rashmi Sanghi and Srivasta M.M., Green Chemistry, Narosa (2006)
2. Stanley E Manahan, Environmental Chemistry, Lewis Publications (2001)
3. Sharma, B.K. Kaur H., Environmental Chemsitry, Goel, publishing House (1995)
4. Tyagi O.D and Mehra M, Text book of Environmental Chemistry, Anmol publications (1990)

Web References

1. www.pipeflow.co.uk/
2. cpcb.nic.in/upload/.../NewItem_103_statusof**water**qualitypackage.pdf
3. www.epa.gov/nrmrl/pubs/625179011/625179011prel.pdf
4. www.wapc.com/PDF/ESP_04.pdf

ELECTIVE IV: 11UPEVS1E05

RADIATION POLLUTION, GIS AND REMOTE SENSING

UNIT I

Radioactivity: Laws of radioactivity, successive disintegration types of radioactive equilibrium. Natural radioactive series of elements. Units of radioactivity, Interaction of radiation with matter, ionization, types of exposure, units of exposure and dose.

UNIT II

Detection and Measurement of Radiation: scintillation, ionization, solid state nuclear track detectors, instrumentation. Dosimeters. Biological Effects of Radiation: Stochastic and Deterministic effects, Radiation Protection: System of Dose Limitation, types of exposure, protection methodology.

UNIT III

Fundamentals of remote sensing: Background of Remote sensing, Electro-magnetic radiation, Interactions between matter and Electro-Magnetic radiation, Reflectance, Spectral reflectance and their characteristics Sensors: Types of sensors, Characteristics of optical detectors, Types of scanners, Atmospheric sensors, Microwave sensors produces used in remote sensing, Remote sensing application in mapping vegetation, water, waste land.

UNIT IV

Products used in Remote Sensing, images, scale, mosaics, time and Seasons orbital cycles, GIS and their use for environmental monitoring, Data modals GIS and spatial distribution of environmental data, Data integration and analysis, GIS and natural resources and disaster management.

Reference-

1. Environmental Radioactivity from Natural, Industrial and Miltry sources, Merril Eisenbud and Thomas Gessell Academic Press, London
2. Radiation and Man – Jain.H.C, National Book trust, New Delhi
3. Remote Sensing a better view – Rudd.R.D. (1974)
4. Remote sensing techniques for Environmental Analysis, Estes. J.E. and Senger.L.W
5. Remote sensing of Environment – Lintz.J and Simonnet.D.S (1976)
6. Remote Sensing and GIS for Environmental Planning – Murli Krishna.I.V. (1995).
7. Essential of Remote Sensing – (S.Srikantaswamy 2008)

SUPPORTIVE PAPERS

SUPPORTIVE I: 11UPEVS1S01

ECOLOGY AND ENVIRONMENT

UNIT I

Fundamentals of Ecology- Definition, principles, and scope of ecology, objectives and sub-divisions. Concept of levels of organization, Ecological Dominance, Population ecology. Characteristics, population density, natality, mortality, age distribution, population growth, causes for population explosion, population control.

UNIT II

Ecosystems- Structure, functions, biotic and a biotic component, food chain, food web, Homeostasis, Ecological Niche, Ecological Dominance. Types of ecosystems : aquatic and terrestrial ecosystem.

UNIT III

Resources of environment – Habitat- classification – reasons for depletion of natural resources – conservation of natural resources ; air, water, soil, minerals, forests & wildlife.

UNIT IV

Ecological Adaptation ; ecological adaptation of hydrophytes, ecological adaptation of mesophytes, ecological adaptation of xeropytes, ecological adaptation of halophytes. Deep sea adaptation, osmoregulatory adaptation

References :

1. Fundamentals of Ecology 3rd Ed. W.B.Saunders & Co.Philadelphia
2. Systems Analysis & Simulation in Ecology Patten B.C. (Ed) 1971 Academic press London
3. An Introduction to Cybemetics Chapman & Hall Ltd. Ashby W.R. 1956
4. Ecology & Environment seventh edition P.D.Sharma Rastogi publication Rajsons Printers, New Delhi (2004)
5. Plants and the Eco-system Macmilian & Co.Laondon Billings W.D 1964
6. Population Ecology A Unified study of Animals & Plants Blackwell Oxford, Begon M and Mortimer. M 1981
7. Environmental Concerns and strategies Indian Environmental Society Khoshoo T.N. 1984
8. Ecology with special Reference to Animals and Man Prentice- Hall New Jersey, Kendeigh S.C. 1974

SUPPORTIVE II: 11UPEVS1S02

GLOBAL WARMING AND ITS IMPACT

UNIT I

The Universe, Solar System and Origin of Earth
Elements of climate, climate controls - Earth's radiation balance - Latitudinal and seasonal variation of insulation - Temperature, pressure, wind belts, humidity, cloud formation and precipitation - Water balance, spatial and temporal patterns of climate parameters - Air masses and fronts

UNIT II

Atmosphere, Structure, Composition and Dynamics
Brief introduction to universe - Sun - its structure and atmosphere physical characteristics of planets - Brief description of comets, asteroid, meteors - Origin of earth - Origin and evolution of biosphere - Origin and evolution of life - Spontaneous generation of the life.

UNIT III

Earth System Engineering and Management
Biochars for energy production and as mitigation measures for global warming and soil rejuvenation - Concept, Examples of ESEM - Implemented and Proposed – Brownfield Restoration - Dredging the waters - Restoring Regional Scale Wetlands - Combating Global Warming - *The Principles of ESEM:* Theoretical, Governance principles of ESEM, Design and Engineering Principles of ESEM

UNIT IV

Climate Change
Climate change - Case Studies - Kyoto protocol - Photo chemical smog - Automobile pollution in India - Zero emission standards - Gaseous pollution control measures - Nuclear accidents and holocaust

UNIT V

Global Environmental Issues
Global environmental issues and International laws: Global warming, Ozone depletion, Acid rain - Role of UN authorities in protection of Global Environment - Multinational authorities and agreements, Future of International laws.

References

1. Andy D Ward and William J Elliot. Environmental Hydrology. Lewis Publishers.
2. Dara SS (1998) A Text Book of Environmental Chemistry and Pollution Control. S. Chand & Company Ltd, New Delhi.
3. Lal DS. Climatology. Parag Pustak Bhavan, Allahabad.
4. Philp Bedient. Ground Water Contamination (Transport and Remediation), Hanadi.
5. Roy I Donalue, Raymond W Miller and John C Shiekluna (1987) An Introduction to Soils and Plant Growth, 5th Ed, Prentice Hall of India.
6. Sawyer CN, McCarty PL and Parkin GF (2003) Chemistry for Environmental Engineering and Science, Tata McGraw-Hill Publishing Company Ltd., New Delhi.
7. Sharma PD (1994) Ecology & Environment, Ashish Publications.
8. Strahler S. Physical Geography. John Wiley & Sons.
9. Todd DK. Ground water Hydrology. John Wiley & Sons.
10. Trewartha. Introduction to Weather and Cclimate.

Web References

1. www.globalwarming.org.in/
2. www.acidrain.org/
3. unfccc.int/kyoto_protocol/items/2830.php
4. cpcbenvis.nic.in/airpollution/finding.htm
5. envfor.nic.in/legis/legis.html
6. epa.gov/brownfields/
7. www.moorlandschool.co.uk/earth/earthorigin.htm

SUPPORTIVE III: 11UPEVS1S03

ENVIRONMENTAL PLANNING AND SUSTAINABLE DEVELOPMENT

UNIT I

Sustainable Development – scope & definition, parameters of sustainability, Population stabilization, integrated land use planning, Healthy cropland and grassland, wood land revegetation, conservation of biological diversity, control of pollution, development of non-polluting renewable energy systems.

UNIT II

Recycling of wastes/residues, ecologicaly compatible human settlement and slum improvement, environmental education and awarness, updating environmental law.

UNIT III

Agriculture – sustainable agricultural rotation of crops, organic farming. Environmental degradation due to pesticides and chemical fertilizers- Sustainable Management.

UNIT IV

Environmental movements and role of NGO's in sustainable development. Global policy for sustainable development – world summits.

UNIT V

Urbanization and its impact on Environment. Rural and Urban planning for sustainable development.

References:

1. Eco-Efficiency: The Business link to Sustainable Development by Livio Desimone.
2. Planning Sustainability by Michael Kenny.
3. Environmentally Sustainable Economic Development by Asayehgn Desta

SUPPORTIVE IV: 11UPEVS1S04

ENVIRONMENTAL IMPACT ASSESSMENT AND ENVIRONMENTAL AUDIT

UNIT I

Origin and development of EIA, Framework of Environmental Impact assessment (EIA), simple methods of identification of impacts, matrices network, checklists. Assessment and Prediction of impact on Air water, noise and biological environment.

UNIT II

Methods of impact analysis, public participation in Environmental decision making, EIA in project planning and implementation section. Risk Assessment, mitigation measures.

UNIT III

Environmental Audit**:** Introduction, General approach Environmental Auditing, Programme Planning, Environmental Audit methods, benefits of environmental auditing.

UNIT IV

On-site Audit, Post – Audit activities, statutory Environmental statements. Requirements of rule 14 for Environmental Audit under Environmental protection Act 1986.

References:

1. Environmental Impact Assessment, by Larry W. Canter, Mc Graw- Hill International Editions, civil Engineering series
2. Environmental Impact Assessment for Developing countries. Biswas A.K. and Agarawal SBC. Butterworth-Heinemann Ltd. Reed International
3. Environmental Impact Assessment-Theory and practice, by Wathern P Routledge, Unwin Hyman London
4. Methods of Environmental Impact Assessment by Morris P and Theirvel R UCL press Ltd., London
5. UNEP, 1996, Environmental Impact Assessment: Issues, Trends and Practice, United National Environmental Programme Nairobi.
6. Environmental Impact Analysis by Jain et al.

PRACTICALS

SEMESTER I

PRACTICAL I: 11UPEVS1CP01

ENVIRONMENTAL CHEMISTRY

UNIT I

1. Neutralization titration

(a) Determination of Acidity
(b) Determination of alkalinity
(d) Determination of Salinity

2. Physio-chemical analysis of water

(a) Determination of total dissolved and total suspended solids.
(b) Determination of pH.

UNIT II

1. Measurement of pollutant in the water

(a) Determination of Dissolved Oxygen (DO).
(b) Determination of Biological Oxygen Demand (BOD).
(c) Determination of Chemical Oxygen Demand (COD).

2. Complexometric titration

(a) Determination of calcium and magnesium hardness.
(b) Determination of Total organic carbon

UNIT III

1. Precipitation titration

(a) Determination of Chloride and Phosphate
(b) Determination of Sodium and Potassium
(c) Determination of Turbidity by Nephelometer

2. Complexometric titration

(a) Determination of Nitrate nitrogen
(b) Determination of Total Kjeldahl nitrogen

UNIT IV

1. Redox titration

(a) Determination of ferrous iron.
(b) Determination of copper.

2. Soil physical properties

(a) Particle size distribution analysis (sand, silt and clay)
(b) Determination of specific gravity and water holding capacity

UNIT V

1. Spectrophotometric/ Colorimetric determination

(a) Determination of nickel.

(b) Determination of hexavalent chromium.

2. Precipitation titration

(a) Determination of Nitrogen

(b) Determination of Phosphorus

References

1. Jackson ML (1973) Soil chemical analysis. Prentice Hall, New Delhi.
2. Olsen SR, Cole CV, Watanabe FS and Dean LA (1954) Estimation of available phosphorus in soils by extraction with sodium bicarbonate. US Dep. Agric. Circ. 939, 90.
3. Walkley A and Black IA (1934) An estimation of the Degtjareff method for determining soil organic matter and proposed modification of the chromic titration method. *Soil Sci.* 37:29-38.
4. Hydrology – Principles, Analysis and Design: H. M. Raghunath
5. Instrumental Methods of Analysis : G. W. Ewing.
6. Dudley H.Williams and Ian Fleming, Spectroscopic Methods in Organic Chemistry, 4th ed., Tata Mc- Graw Hill Book Company (1998).
7. R.M.Silverstein, G.Clayton Bassler and Terence C. Morrill, Spectroscopic Identification of Organic compounds, 6th ed, John Wiley & Sons (1998).
8. D.A. Skoog, F.J. Holler and Nieman, Principles of Instrumental Methods, 5th ed.,Thomson Asia Pvt.Ltd., Singapore (2003).
9. G.D. Christian., Analytical Chemistry, 6th ed, John Wiley & Sons (2000)

Web References

9. http://www.dtsc.ca.gov/AssessingRisk/ECL/hml_users_manual.cfm
10. http://www.epa.gov/owow/monitoring/wsa/WRS_lab_manual.pdf

SEMESTER II

PRACTICAL II: 11UPEVS1CP02

ENVIRONMENTAL MICROBIOLOGY, AIR & WATER QUALITY MANAGEMENT

Unit I

Apparatus used for a microbiological laboratory; Sterilization and Disinfections; Media preparation: semi-synthetic, synthetic media and semisolid; culture media – Nutrient agar; Enrichment media preparation; Gram staining. Safety in microbiological laboratory.

Unit-II

Bacteriology of drinking water and domestic sewage -MPN techniques for total coliform; Faecal coliform (thermotolarent coliform) MPN test; Faecal Streptococci (FS) MPN test; Membrane filtration techniques for faecal coliform and total coliform; P-A coliform test; Seven hour – coliform test.

Unit-III

Enumeration of microorganisms form polluted environment water/ soil and air. Microbial Assay – Disc diffusion method, Minimum Inhibitory Concentrations.

Unit IV

Bioremediation using microorganisms from industrial effluent: Isolation and screening of industrially important microorganisms. *Microbiology of Air*: by exposure plate method; Air sampler techniques (Passive and Active) Impinge method, settle plate method and Impactors.

Unit V

Determination of SO_2, NO_x and CO in ambient air; Preparation of Wind Rose Diagram; 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 matte, An air quality survey report of an area, Detection and estimation of noise pollution. A visit to aquatic ecosystem and methods for water and plankton collection, Plankton identification and quantification from river / lake water samples.

References

1.Moo-Young, M., Anderson, W.A. and Chakrabarty, A.M. 1996. Environmental biotechnology: Principles and applications. Boston, Mass.: Kluwer Academic Publishers.
2. Wainwright, M. 1999. An introduction to environmental biotechnology. Boston, Mass. Klumer Academic Publishers.
3. Wrigglesworth, J.M. 1984, Biochemical research technique - a practical introduction. John Wiley, New York.
4. Patki, L.R., Bhalchandra, L. and Jeevaji, I.H., 1989, An introduction to microtechniques, S. Chand and Company Ltd., New Delhi.

5. Keith Wilson and John Walker, 1994. Practical Biochemistry - principles and techniques, Cambridge Press, New York.
6. Keith Wilson and Goulding, K.H. 1986, a biologists guide to principles and techniques of practical biochemistry, ELBS, London.
7. Kothari, C.R., 1988. Research methodology, Wiley Eastern Ltd., New Delhi.
8. Irfan A. Khan and Atiya Khanum, 1994. Fundamental of Biostatistics, Ukaaz publishers, India.
9. Anderson, J., Durosn, B.H. and Poole, M. 1986. Thesis and assignment writing, Wiley Eastern Ltd., New Delhi

Web References

1. http://microbiology.mtsinai.on.ca/manual/default.asp
2. http://www.microbiologyprocedure.com

SEMESTER III

PRACTICAL III: 11UPEVS1CP03

ENVIRONMENTAL BIOTECHNOOLOGY AND ENVIRONMENTAL TOXICOLOGY

Unit I

Environmental Biotechnology
Plasmid DNA isolation and DNA quantitation: Plasmid minipreparations Agarose gel Electrophoresis - Microorganisms from polluted environment/Soil /Water/Air - Microbial degradation of textile dyes/pesticides/hydrocarbons and oils.

Unit II

Environmental Management
Techniques for collection, Cultivation and analysis of protein present in Azolla and Spirulina - Vermicomposting: Collection, preparation and analysis of composted material for NPK, moisture holding and microbial load

Unit III

Industrial Biotechnology
Techniques for Cultivation and commercialization edible Mushroom and Sericulture - Techniques for the production and commercialization of biofertilizer and related byproduct for various industrial applications.

Unit IV

Environmental Toxicology – Plant Bioassays
Estimation of protein content of biological samples – Pesticides and Metal Tolerance-microbes and Plant Bioassays - Estimation of heavy metals in soil, plant and animal materials

Unit V

Environmental Toxicology – Animal Bioassays
In-vitro and *In-vivo* Cell toxicity Assays- Cell viability and Cytotoxicity - Toxicity assays – Nematodes / Earthworms - Animal Bioassays – Fish LC_{50}, Micronucleus assay, Comet assay, Melanophore Index - Determination of Animal LD_{50}, Probit Analysis and Graphical method.

References

1. Sahoo L, Plant Biotechnology Lab Manual, Department of Biotechnology, Indian Institute of Technology, Guwahati.
2. Nickrent DL (2006) Molecular Methods in Plant Biology, 4th edition, Department of Plant Biology, South Illinois University, Carbondale, IL, USA.
3. Techniques in Molecular Biology, Laboratory Exercises (2011) University of Lethbridge, Canada.
4. Edwards CA, Arancon NQ, Sherman RL (2010) Vermiculture Technology: Earthworms, Organic Wastes, and Environmental Management, CRC Press, Boca Raton, FL, USA.
5. Vazquez MZ (2010) Combining the in vivo comet and micronucleus assays: a practical approach to genotoxicity testing and data interpretation. Mutagenesis 25(2): 187-199.
6. Finney DJ (2009) Probit Analysis.

Web References

1. facultad.bayamon.inter.edu
2. www.promega.com
3. www.pjoes.com/pdf/9.6/511-515.pdf
4. www.cometassayindia.org/introduction.htm
5. www.iasri.res.in
6. lakewatch.ifas.ufl.edu/circpdffolder/Morph2ndEdApx.pdf
7. libraries.mit.edu/gis/data/themes/lulc.html
8. www.jatit.org/volumes/research-papers/Vol23No2/3Vol23No2.pdf
9. gis-lab.info/docs/books/aerial-mapping/cr1557_16.pdf

SCHEME OF EXAMINATION

Scheme of Examination

I/II/III/IV Semester M. Sc. Examination, ..MONTH …YEAR

Environmental Science
Paper title

Duration: 3 Hrs **Max Marks:75**

Instruction: ***Answer all the three Parts.***

PART – A

Answer all the questions: **5 X 5 = 25**

1.
2.
3.
4.
5.

PART – B

Answer any FIVE questions of the following: **5 X 10 = 50**

6.
7.
8.
9.
10.

PERIYAR UNIVERSITY
DEPARTMENT OF ENVIRONMENTAL SCIENCE
Periyar palkali Nagar, Salem-11.

Scheme of Examination

I/II/III Semester M. Sc. Examination, ..MONTH …YEAR

Environmental Science
Practical Exmaination

Duration : 6 Hrs **Max. Marks : 60**

Q.1. Conduct given Experiment, Write a procedure and calculate the results. – Major Practical — 20 Marks

Q.2. Minor Practical — 15 marks

Q. 3 Identify and Critical comment on. (Specimens / Spotters) — 3 X 5 = 15

A.

B.

C.

. Viva-Voce — 5 Marks

Q.4. Class records — 05 Marks

IV Semester

M.Sc. Examination Project work (Dissertation)

Dissertation Thesis – 50 Marks
Viva-Voce - 10 Marks