Periyar University

Periyar Palkalai Nagar, Salem – 636 011

Department of Environmental Science

M.Sc. Environmental Science

Syllabus

(w.e.f. 2014-2015 onwards)

PERIYAR UNIVERSITY
M.Sc. ENVIRONMENTAL SCIENCE
CHOICE BASED CREDIT SYSTEM
REGULATIONS (w.e.f. 2014-2015 onwards)

1. CONDITIONS FOR ADMISSION

A. ELIGIBILITY CONDITIONS FOR ADMISSION

Candidate who has passed the B.Sc. degree in any Life Sciences including 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 and Biochemistry
	Core – II	Fundamentals of Environmental Sciences
	Core – III	Environmental Chemistry
	Core – IV	Biodiversity and Conservation
	Elective – I	Energy and Environment
	Core Practical – I	Cell Biology and Biochemistry, Fundamentals of Environmental Sciences and Environmental Chemistry
Semester II	Core – V	Natural Resources and Management
	Core – VI	Environmental Microbiology
	Core – VII	Environmental Impact Assessment & Disaster Management
	Elective – II	Environmental Pollution and Management
	Supportive-I	Supportive-I
	Core Practical – II	Environmental Microbiology, Environmental Impact Assessment and Environmental Pollution and Management
Semester III	Core – VIII	Waste Management
	Core – IX	Environmental Toxicology
	Core – X	Climate Change and Current issues
	Core– XI	Environmental Biotechnology
	Supportive-II	Supportive-II
	Core Practical– III	Waste Management, Environmental Toxicology and Environmental Biotechnology
Semester IV	Core – XII	Environmental Laws, Planning and Policy
	Core – XIII	Research Methodology and Instrumentation
	Core Project-I	Project Work

Elective Courses – Major

1. Energy and Environment
2. Environmental Pollution Management
3. Eco-Tourism and Wild Life Management
4. Energy and Green Technologies
5. Radiation Pollution, GIS and Remote Sensing
6. Environmental Engineering

Supportive Courses for other Departments

1. Ecology and Environment
2. Environmental Quality Management
3. Environmental Pollution
4. Global Environmental Issues and Management

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	14UPEVS1C01	Cell Biology and Biochemistry	5	4	25	75	100
	II	14UPEVS1C02	Fundamentals of Environmental Sciences	5	4	25	75	100
	III	14UPEVS1C03	Environmental Chemistry	5	4	25	75	100
	IV	14UPEVS1C04	Biodiversity and Conservation	5	4	25	75	100
	E-I	14UPEVS1E01	Elective-I Energy and Environment	4	4	25	75	100
	P-I	14UPEVS1P01	**Practical-I** - Cell Biology and Biochemistry, Fundamentals of Environmental Sciences and Environmental Chemistry	5	5	40	60	100
II	V	14UPEVS1C05	Natural Resources and Management	4	4	25	75	100
	VI	14UPEVS1C06	Environmental Microbiology	4	4	25	75	100
	VII	14UPEVS1C07	Environmental Impact Assessment and Disaster Management	4	4	25	75	100
	E-II	14UPEVS1E02	Elective-II Environmental Pollution and Management	4	4	25	75	100
	S-I	14UPEVS1S01	Supportive-I	4	4	25	75	100
	P-II	14UPEVS1P02	**Practical-II -** Environmental Microbiology, Environmental Impact Assessment and Environmental Pollution and Management	5	5	40	60	100

III	VIII	14UPEVS1C08	Waste Management	4	4	25	75	100
	IX	14UPEVS1C09	Environmental Toxicology	4	4	25	75	100
	X	14UPEVS1C10	Climate Change and Current Issues	4	4	25	75	100
	XI	14UPEVS1C11	Environmental Biotechnology	4	4	25	75	100
	S-II	14UPEVS1S02	Supportive-II	4	4	25	75	100
	P-III	14UPEVS1P03	**Practical-III -** Waste Management, Environmental Toxicology and Environmental Biotechnology,	5	5	40	60	100
IV	XII	14UPEVS1C12	Environmental Laws, Planning and Policy	5	4	25	75	100
	XIII	14UPEVS1C13	Research Methodology and Instrumentation	5	4	25	75	100
	Q-I	14UPEVS1Q01	Project work	15	7	25	75	100
				Total	**90**			**2100**

SEMESTER I

CORE I: 14UPEVS1C01

CELL BIOLOGY AND BIOCHEMISTRY

UNIT I

The Cell

Origin of Cell - Cell theory - Cell membrane – Physicochemical properties and Molecular Organisation – Asymmetric organization of lipids, proteins and carbohydrates - Transport of small molecules across cell membranes – Types and mechanisms. Active transport by ATP powered pumps. 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, mitochondria, endoplasmic reticulum, plant vacuoles, plastids, microbodies and chloroplast – *Structure and functions of chromosomes*: Chromosome 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 – Molecular 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 and independent cell-cell adhesions, *Extracellular matrix of animals*: Organisation and functions and Integrins.

UNIT V

Cell Signalling

Signalling via G-coupled 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 in multiple cancers.

References

1. Alberts B, Bray D, Hopkin K *et al.* (2009) Essential Cell Biology, 3rd edition,

2. Alberts B, Johmson A, Lewis J, Raff M, Roberts K and Walter P (2002) Molecular Biology of the Cell, Garland Science, New York.
3. Buchanan BB, Gruissem W and Jones RL (2002) Biochemistry and Molecular Biology of Plants, ASPB, USA.
4. Cooper GM and Hausman RE (2013) The Cell: A Molecular Approach, 6th edition, Sinauer Associates, Sunderland, MA, USA.
5. David L. Nelson, Michael M. Cox (2004) Lehninger Principles of Biochemistry (1970) by Albert L. Lehninger Published April 23rd 2004 by W. H. Freeman (first published).
6. Gerald Karp (2002) Cell and Molecular Biology: Concepts and Experiments, 7th edition.
7. Hardin J, Bertoni G and Kleinsmith LJ (2011) Becker's World of the Cell, Pearson Education, NY.
8. Hughes and Mehnet (2003) Cell Proliferation and Apoptosis
9. Lodish H, Berk A, Kaiser CA, Krieger M, Scott MP, Bretscher A, Ploegh H and Matsudaira P (2007) Molecular Cell Biology, 6th edition.
10. Robert K. Murray *et al*. (2012) Harpers Illustrated Biochemistry (Lange Medical Book), 29th edition.

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2. www.cytochemistry.net/cell-biology/lysosome.htm
3. www.cellsignal.com
4. www.cellsignallingbiology.org
5. www.biochemweb.org
6. http://www.goodreads.com/book/show/198505.The_Demon_in_the_Freezer

CORE II: 14UPEVS1C02

FUNDAMENTALS OF ENVIRONMENTAL SCIENCES

UNIT- I

Ecology and Environment

Environmental Science - Definition, Scope and Importance. *Components of the environment*: Atmosphere, Hydrosphere, Lithosphere and Biosphere – Structure and composition. History and scope of Ecology - Terminologies in ecology - Abiotic and Biotic factors, Laws of limiting factors – Liebig's law of minimum, Shelford's law of tolerance.

UNIT – II

Ecosystems

Ecosystem: Types – Terrestrial and aquatic ecosystems, Structure and functional aspects of ecosystem - Food Chain, Food Web, Energy flows, Ecological pyramids, Productivity of an ecosystem and Biogeochemical cycling – Carbon and Nitrogen Ecological efficiency - Ecological succession - Major biomes of India and the world - Sampling methods in ecological studies - Introduction to ecological modeling.

UNIT – III

Population Ecology

Population ecology: Levels of Organization, population characteristics - Density, natality, mortality, survivorship curves, age distribution, growth curves. *Population interactions*: Co-evolution, Neutralism, symbiosis, commensalism, mutualism, antagonism, antibiosis, parasitism, predation; competition- inter and intra specific. Population regulation – biotic potential and environmental resistances (r and k selections); Factors of population regulation – density dependent and density independent and carrying capacity.

UNIT – IV

Remote Sensing and GIS

Principles of remote sensing (Optical/Microwave) – Concepts and principles. Imaging systems, satellites, sensors, data generation. Applications of remote sensing for land use/land cover, landscape mapping, vegetation analysis, climate change studies, flood, drought assessment desertification and water shed management. *GIS concepts:* Data structures - vector and raster data. Data inputting, Data storage, Data editing - Hardware and Software requirement - Application of GIS for environmental studies. *GPS*: Concepts, types of GPS machines and its applications for surveying and mapping

UNIT – V

Statistical Analyses

Statistical Analysis: Sampling, Data collection and recording. *Measures of central tendency*: Arithmetic mean, Geometric mean, mode, median (ungrouped and grouped data). *Measures of dispersion*: absolute and relative measures; range, standard deviation (grouped and ungrouped data), variance, quartile deviation, coefficient of variability. Skewness, Kurtosis; Probability - normal,

poisson and binomial. Statistical Methods - Hypothesis testing, significance and correlation. Correlation.models Linear models and regressions. Pearson and other correlation coefficients. Multiple Regressions, Distribution- Normal, t and chi square test, Difference among means – ANOVA.

References

1. Bailey NTJ (1994) *Statistical Methods in Biology*. 3rd ed. Cambridge University Press, Cambridge, UK.
2. Banerjee PK (2004) *Introduction to Biostatistics*. S. Chand and Co., New Delhi.
3. Cunningham WP and Cunningham MA (2004) Principles of Environment Science. Enquiry and Applications. 2nd ed. Tata McGraw Hill, New Delhi, India.
4. George Joseph (2003) *Fundamentals of remote sensing*, Universities press (India) Pvt Ltd., Hyderabad.
5. Jha LK (1997) Natural Resource Management. APHA Publishing Corporation, New Delhi.
6. Kemp MJ (1997) *Environmental Science.* Tata McGraw-Hill Company, New Delhi.
7. Michael N. Demers (2008) *Fundamentals of Geographical Information Systems.* John Wiley & Sons, Inc. Natraj Publishers, Dehradun, India.
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12. Sharma PD (2000) Ecology and Environment. Rastogi Publications, Meerut, India.

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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: 14UPEVS1C03

ENVIRONMENTAL CHEMISTRY

UNIT I

Fundamentals of Environmental Chemistry

Environmental Chemistry: Definition and explanation of various terms – Molarity, molality, normality and percent solutions, stock and standard solution preparation. Stoichiometry, Gibb's Energy, chemical potential, chemical equlibria, acid base reactions, solubility product, solubility of gases in water, the carbonate system, radionuclides.

UNIT II

Atmospheric Chemistry

Atmospheric layers - Classification of elements, chemical speciation, particles, ions and radicals in the atmosphere - Chemical processes for formation of inorganic and organic particulate matter. Thermochemical and photochemical reactions in the atmosphere - Oxygen and ozone chemistry, Chemistry of air pollutants, Photochemical Smog

UNIT III

Aquatic chemistry

Chemistry of water - Formation of water, unusual physical properties, hydrogen bonding in biological system, unusual solvent properties, changes in water properties by addition of solute - Chemical reactions in aquatic environment; Concept of oxygen demand - DO, BOD, COD; TDS, pH, conductivity – Colloids – Salinity - Chemical speciations in aquatic environment - Role of water in the environment – Hydrological cycle.

UNIT IV

Soil Chemistry

Chemical composition of earth, metals, minerals, fossil fuels and soils - Physico-chemical characteristics of soil, soil air, soil clays, organic carbon, soil humus and mineralization, cation exchange capacity, soil water solution, Nitrogen pathways, C/N ratio, soil acidity and salinity.

UNIT V

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 – DDT and Endosulphan *Heavy metals*: Toxic effects of Cd, Pb & Hg.

References

1. Banerjee SK (2005) Environmental Chemistry, 2nd edition, Prentice-Hall of India, New Delhi.
2. Balram Pani (2007) Text book of Environmental Chemistry, IK international Pvt. Ltd, New Delhi.
3. Dara SS (2005) A Text Book of Environmental Chemistry and Pollution Control, S. Chand & Company, New Delhi.
4. De AK (2003) Environmental Chemistry, 5th edition, New Age International (P) Ltd, New Delhi.
5. Jadhav HV (1992) Elements of Environmental Chemistry, APT Books Inc., SA.
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10. Sharma BK and Kaur H (2000) Environmental Chemistry, Goel Publishing, New Delhi.

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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_

CORE IV: 14UPEVS1C04

BIODIVERSITY AND CONSERVATION

UNIT I

Types, Functions and Benefits of Biodiversity

Types of Biodiversity: Species, Genetic and Ecosystem diversity – Alpha, beta, and gamma diversity – Biodiversity and ecosystem function – Megadiversity zones and Biodiversity Hot Spots in India – Ecologically Sensitive Areas (ESA) in India - *Use of Biodiversity*: Source of food, medicine, raw material, aesthetic and cultural uses – *Biodiversity Prospecting*: Significance of Indigenous Knowledge Systems

UNIT II

Threats to Biodiversity

Natural and anthropogenic threats to biodiversity – Human-Animal conflict with special reference to elephants and tigers - IUCN Threat Categories – Red Data Book – Wildlife exploitation - Species extinctions – Endangered and endemic species of flora and fauna in India - Over-harvesting and Climate change on biodiversity - Causes and Impacts of Invasive species to biodiversity

UNIT III

Conservation Strategies

Current practices in conservation: Habitat or Ecosystem Approaches - Species-based Approaches - *Social Approaches*: Chipko Movement – *In-situ conservation*: Afforestation, Social Forestry, Agro-forestry, Botanical gardens, Zoos, Biosphere Reserves, National Parks, Sanctuaries, Protected Area Network, Sacred Groves and Sthalavrikshas – *Ex-situ conservation*: Cryopreservation, Gene Banks, Seed Banks, Pollen Banks, Sperm Banks, DNA Banks, Tissue Culture and Biotechnological Strategies

UNIT IV

Sustainable Management of Bioresources

National Biodiversity Authority (NBA) – Functions of State Biodiversity Board (SBB) and Biodiversity Management Committee's (BMC) – The role of WWF, FAO, UNESCO, UNDP and UNEP for biodiversity conservation – An elementary account on WTO, GAAT and TRIPS – Biopiracy rights of farmers, breeders and indigenous people –Biodiversity informatics with special reference to plant genetic resources

UNIT V

Policies, Programmes and Acts for Conservation

Status and protection of species in National and International levels – Role of CITES and IUCN – Convention on Biological Diversity (CBD) – Nagoya Protocol – Man and Biosphere Programme (MAB) – Policies implemented by MoEF for biodiversity conservation – Salient features of Biological Diversity Act 2002 – Ecosystem restoration

References

1. Chaudhuri AB and Sarkar DD (2003) Megadiversity Conservation, Flora, Fauna and Medicinal Plants of India's Hot Spots. Daya Publishing House, New Delhi.
2. Dadhich LK and Sharma AP (2002) Biodiversity –Strategies for Conservation, APH Publishing Corporation, New Delhi.
3. Gary K Meffe and Ronald Carroll C (1994) Principles of Conservation Biology. Sinauer Associates Inc., Massachusetts.
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12. Sharma PD (2000) Ecology and Environment. Rastogi Publications, Meerut, India.
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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 V: 14UPEVS1C05

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 and 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, 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 and Management of grasslands.

References

1. Dutta A (2001) Biodiversity and Ecosystem Conservation. Kalyani Publisher, Kolkata.
2. Jha LK (1997) Natural Resource Management. APH Publishing Corporation, New Delhi.
3. Kumar HD (1995) Modern Concepts of Ecology. Vikas Publishing House (P) Ltd., New
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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

CORE V: 14UPEVS1C05

ENVIRONMENTAL MICROBIOLOGY

UNIT I

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 – Nature of virulence, toxins, extra cellular enzymes of pathogenic bacteria

Unit II

Geomicrobiology

Distribution of microorganisms in soil - Factors influencing the soil microflora – Role of microorganisms in soil fertility - *Interactions among microorganisms*: Mutualisms, comensalism, competition, amensalism, parasitism, predation - *Interactions between microbes and plants*: Rhizosphere, phyllosphere, mycorrhizae

Unit III

Biogeochemical Cycles

Biogeochemical cycles: Carbon cycle - Role of microbes in carbon cycle - Nitrogen cycle - Mechanism of biological nitrogen fixation – Ammonification, nitrification, denitrification and microorganisms involved in such processes - Phosphorous cycle and Sulphur cycle.

Unit IV

Air and Water-borne Diseases

Microbial air pollutants – Bioaerosols, Aero allergen - Airbone disesases, Symptoms and preventive measures - *Water pollution*: Sources and nature of pollutants in water – waterborne diseases. Assessment of microbiological quality of water - MPN technique and Biological Oxygen Demand. Domestic solid (compost) and liquid waste treatment – Eutrophication

Unit V

Applied Microbiology

Microbial conversion of solid waste to food (Mushroom, SCP), fuels (Biogas, Ethanol), Bioleaching of Ores, Biodegradation of Lignin – Pesticides – Recalcitrant – *Bioremediation*: Types and its application – Biodeterioration of paper, wood and paints - Metal corrosion

References

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CORE VII: 14UPEVS1C07

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) – 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 of EIA: 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 – *Catastrophic geological hazards*: Earthquakes, Tsunami's, Volcanic eruptions, Snow avalanches, Landslides, Cyclones, Floods, 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

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SEMESTER III

CORE VIII: 14UPEVS1C08

WASTE MANAGEMENT

UNIT I

Introduction to waste

Wastes – Introduction, sources, characteristics, composition, classification, waste generated per capita - Global scenario of wastes - Waste collection, Storage and segregation - Transportation and disposal methods - Sanitary land filling techniques

UNIT II

Municipal Solid Waste Management

Municipal solid waste – Sources, types, collection and transportation, Waste processing and resource recovery (typical material recovery facility operation (TMRF)) - Reuse and recycling of paper, glass and rubber - *Disposal methods:* Incineration, pyrolysis, composting, sanitary landfills and aerobic and anaerobic digestion.

UNIT III

Hazardous Waste Management

Hazardous waste - Introduction, characteristics - Classification of hazardous waste (Industrial, hospital and domestic) - Handling of hazardous solid wastes (segregation, recovery of hazardous waste substances) - Hazardous waste disposal techniques - *Radioactive wastes*: Sources, pollution, types of radioactive waste and its control and management.

UNIT IV

Biomedical, Plastic & e-waste management

Biomedical wastes: Sources, types of biomedical wastes – Impacts of biomedical wastes on environment - Control measures of biomedical wastes - *Plastic wastes*: Sources, Facts & figures of plastic waste scenarios in National & International - Effect of plastic wastes on environment – Control measures of plastic wastes. *E-wastes*: Sources, types of e-wastes – Impacts of e-wastes in environment - Control measures of e-wastes.

UNIT V

Energy Recovery from Wastes

Vermicomposting, mushroom sheds, fly ash bricks, biogas, and Bioelectro chemical systems – Microbial electrolysis cell – Microbial fuel cell - Production of methane, Hydrogen peroxide, ethanol, electricity.

References

1. Bhide AD and Sunderson BB (1983) Solid Waste Management in Developed Countries, INSDOC, New Delhi.
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CORE IX: 14UPEVS1C09

ENVIRONMENTAL TOXICOLOGY

UNIT I

Introduction

Toxicology - Introduction, scope and types - Classification of toxic agents, toxicity, hazard, risk, Routes of exposure, duration and frequency of exposure - Drug toxicity, biochemical basis of toxicity and mechanisms of toxicity, receptor mediated events - Acute and chronic toxicity, Dose response relationship and graded response time action curves, LC_{50} LD_{50}, Margin of safety levels.

UNIT II

Toxicity testing

Toxicity testing – (i) laboratory animals, (ii) toxicity testing in animals, (iii) toxicological field studies, Interpretation of laboratory data – (i) distinction between adverse and non-adverse effects. Human data – (i) ethical consideration, (ii) need for human investigation (iii) clinical toxicology.

UNIT III

Pesticide toxicology

Bioaccumulation and Biomagnifications of toxic materials in food chain, Types, mechanism and Toxicology of major pesticides - Environmental impacts of pesticides, biotransformation, biomonitoring, concept of bioindicator groups and examples.

UNIT IV

Bioassay

Concepts of Bioassay, Types and characteristics - Field based microbial bioassay, Test models and classification - Immunotoxicity, histotoxicity and cell toxicity. Basic concepts of Environmental forensics.

UNIT V

Xenobiotics

Xenobiotics, Interaction between xenobiotics, Combined effect of xenobiotics on physiology and biochemistry of aquatic organisms - Drug Development and safety, Drugs and chemicals induced hepatotoxicity, food toxicity, genotoxicity, Molecular neurotoxicity.

References

1. Anisa Basheer (1995) Environmental Epidemiology, Rawat Publications, New Delhi.
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CORE X: 14UPEVS1C10

CLIMATE CHANGE AND CURRENT ISSUES

UNIT I

Elements and Components of Climate Change

Elements of climate: Temperature, precipitation, atmospheric circulation and atmospheric chemistry – Components *of climate change processes*: Human activities (Fossil fuel burning, industrial processes, land use), Natural influences (Plate tectonics, orbital cycles, ocean circulation, solar variability), Natural aerosols (volcanoes, sea spray and dust) and Natural greenhouse gases - Radioactive forcing - *Classification of climate*: Koppen's and Thornthwaite' scheme

UNIT II

Surface and Atmospheric Climate Change

Air masses: Definition, Classification of air masses, Types of air masses – *Fronts*: Definition, Types of fronts - SW and NE monsoon - Jet stream, tropical and extra-tropical cyclone - *Extreme events of climate change*: Heat and cold waves, drought, floods, hurricanes – Recent extreme events in the world – El Nino, La Nina and ENSO - Global consequences of El Niño – Benefits of El Niño Prediction

UNIT III

Global Warming

Global warming and climate change: Green house gases – Green house effect and climate change – Facts and figures of current global warming scenarios in the world – Remedial measures to control/combat global warming – India's Forest and Tree cover contribution as a carbon sink

UNIT IV

Climate Change and its Impacts

Climate change on water and food security – Climate change on species extinction – Climate change on human health – Global Climate Risk Index 2014

UNIT V

Global/National Action Plans to Combat Climate Change Issues

Key steps taken by UNFCCC to combat climate change: Kyoto Protocol – Bali Action Plan 2007 – Cancun Agreements 2010 – Durban outcomes – Doha Climate Gateway 2012 – Warshaw outcomes 2013 – Green climate funds – Clean Development Mechanism (CDM) – Climate Change Information Network (CC:iNet) – National Action Plan on Climate Change – Recent Initiatives related to climate change in India 2010

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3. http://www.un-redd.org/
4. http://unfccc.int/
5. https://www.ipcc.ch

CORE XI: 14UPEVS1C11

ENVIRONMENTAL BIOTECHNOLOGY

UNIT-I

Introduction to Biotechnology - *Restriction enzymes*: Nomenclature - Classification - restriction and Methylation - Type II restriction endonuclease - Use of restriction endonucleases - Restriction mapping and its applications - DNA modifying enzymes - nucleases - polymerases - DNA ligases

Unit II

Gene Cloning – Over view, Cloning vectors - Plasmids, phages and cosmids, phagemids, Ti plasmids and viral vectors M13 - Cloning strategies, cloning and selection of individual genes - Working principle of PCR, Types of PCR and application of PCR.

Unit III

Introduction to the use of microbes in environmental applications - Bioremediation, bioaugmentation, Bioemulsifiers, biosurfactants, MEOR. Microbial fuels (Methane, Hydrogen)

Unit IV

Microbial biomass production, utilization of plant biomass by microorganisms (lignocellulose biodegradation), ethanol production, amino acids, antibiotics - Biotransformation of steroid and non-steroid compounds, metabolic engineering.

Unit V

Bioremediation - Biotechnology for clean environment - Bioindicators and biosensors for detection of pollution - Biotechnology for Hazardous Waste Management, Persistent organic pollutants, Xenobiotics, Biological Detoxification of PAH, Biotechniques for Air Pollution Control - Indian GMOs - Research Information System (IGMORIS) – *Status of GMOs and Products*: Healthcare applications and Agricultural applications - GMO and their impacts.

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4. http://igmoris.nic.in/

SEMESTER IV

CORE XII: 14UPEVS1C12

ENVIRONMENTAL LAWS, PLANNING AND POLICY

UNIT I

Environmental Protection

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 - Scheme of lebelling of environmentally friendly products (ecomark) – Significance of Environmental Education – Environmental Information Systems (ENVIS)

UNIT II

Environmental Laws in India

Legal control of Environmental pollution in India with special reference to:

Environment (Protection) Act, 1986 - Powers of Central Government under EPA - The Water (Prevention and Control of Pollution) Act 1974 - Air (Prevention and Control of Pollution) Act, 1981 – Forest Conservation Act, 1980 – Wildlife (Protection) Act, 1972 - Public Liability Insurance Act, 1991 - National Environment Appellate Authority Act, 1997 – The National Green Tribunal Act, 2010

UNIT III

Guidelines and Rules for Environmental Protection

Guidelines for Common Effluent Treatment Plants (CETPs) – Guidelines for environmentally sound management of e-waste 2008 - The Biomedical waste (Management and Handling) Rules 1998 - Hazardous Waste (Management and Handling) Rules, 1989 - The Municipal Solid Wastes (Management and Handling) Rules, 2000 - The Ozone Depleting Substances (Regulation and Control) Rules, 2000

UNIT IV

Environmental Planning

Importance of planning - Local, regional, state and national planning - Site and location with reference to Environmental Pollution, Zoning-Physical planning - Economics of pollution control - Cost-benefit ratios - Reliability and Risk analysis

UNIT V

Major Initiatives/Policies from MoEF

Central and State Pollution Control Boards: Powers and functions of pollution control boards - Penalties and procedure - *National Policies for Environmental Protection in India*: National River Conservation Plan (NRCP), National Ganga River Basin Authority (NGRBA), Ganga Action Plan Phase I and II, National Green Tribunal (NGT), Capacity Building for Industrial Pollution Management (CBIPM), National Environmental Protection Authority (NEPA), Green India Mission – *Environmental Clearances*: National Environmental Assessment and Monitoring Authority (NEAMA)

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8. rti.gov.in/
9. www.ngosindia.com/resources/pil.php

CORE XVI: 14UPEVS1C13

RESEARCH METHODOLOGY AND INSTRUMENTATION

UNIT I

Research Methods

Basic of Fundamental and Applied Research, Types, scope, hypothesis and design - Overview of Moral and Ethical questions in scientific writing - Outline and structure of the article/manuscript - Description, value, and development of points/outlines before writing - Impact factor, Entrez Pubmed, Science direct and Data mining - Plagiarism, Retraction and reproducibility.

UNIT II

Library, Field and Laboratory Research

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, Discussion and conclusion - Numbers and Statistics, Tables and Figures - Statistical methods and Citation index (h index and i-10 index) and SCI Impact factor for journals.

UNIT III

Basic analytical equipments

Principle, Working mechanism and environmental applications of pH Meter, Conductivity meter, Nephlometer - Basic principles and applications of light and electron microscopes – Types, function and applications of centrifuges - Principle, types and environmental application of elctrophoretic techniques and radio immune assay techniques.

UNIT IV

Spectroscopy

Various ranges of electromagnetic radiation - Interaction of electromagnetic radiation with matter, Spectrophotometry – Priciple and working mechanism, types and applications of colorimeter, UV – Visible spectrophotometer, fluorimeter, flame photometer, AAS, AES, ICP-MS, IR, NMR spectrophotometer and XRD spectrometer.

UNIT V

Chromatography

Principle and concept of Chromatography- stationary phase, mobile phase, partition and adsorption, coefficients. Working principle, Instrumentation and environmental applications of Paper, Thin layer, Ion exchange, Gas solid, Gas liquid, GC - MS and High Performance Liquid Chromatography.

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ELECTIVE PAPERS

ELECTIVE I: 14UPEVS1E01

ENERGY AND ENVIRONMENT

UNIT I

Thermodynamics and Non-renewable Energy Sources

Energy: First and second laws of thermodynamics – Energy conversion – Global Energy crisis - *Non-renewable energy sources*: Fossil fuels – Composition and Classification of coal, crude oil and natural gas – Consumption and demands of coal, crude oil and natural gas – Environmental impacts of fossil fuel consumption

UNIT II

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 of renewable energy sources in India

UNIT III

New Developing Energy Sources

Nuclear fission reactors - Fission power and environment - *Fuel cells*: Hydrogen fuel cells, metal hydrate fuel cells, microbial fuel cells

UNIT IV

Bioenergy Resources

Biomass as a source of energy: Biomass and its uses - Classification of biomass – Biomass feedstocks for fuel production - Gasification and combustion of biomass - Biogas production mechanism – *Biofuels*: Definition, Types of biofuels - Ethanol production from corn and sugarcane - Biodiesel from *Jatropha curcas* – Algal biofuels – Advantages and limitations of biofuels - National Biofuel Policy

UNIT V

Sustainable Environmental Management

Cleaner production technology – Phytomanagement strategies for biofuel production and remediation of contaminated lands - Waste minimization techniques - Polluters pay principles (PPP) – Mitigation of global warming by biomass – Clean Development Mechanism (CDM) –Recent initiatives of renewable energy by Government of India – India's Clean Energy goals 2012-2022 – Significance of energy audit

References

1. Boyle GF (2004) Renewable Enegy - Power for a Sustainable Future, Second edition, Oxford University Press, UK.
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3. John Andrews and Nick Jelly (2007) Energy Science: Principle, Technologies, and Impacts - Oxford University Press, UK.

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ELECTIVE II: 14UPEVS1E02

ENVIRONMENTAL POLLUTION AND MANAGEMENT

UNIT I

Air Pollution and Management

Air pollution - Natural and anthropogenic sources - Major air pollutants – Types and effects of air pollutants - Acid rain, Green house effect and global warming - Meteorology and Plume Dispersion – Sampling of air pollutants – SOx, NOx, ozone, methane, hydrocarbons and particulate matter. *Particulate matter control equipments*: Settling chamber, cyclones, fabric filter, electrostatic precipitator and wet scrubbers - Air quality and emission standards.

UNIT II

Water Pollution and Management

Water pollution - Sources of water pollution – Organic, inorganic and heavy metals - Phenomenon of Eutrophication – Transport of pollutants in the aquatic ecosystem - Water quality parameters - Water quality standards – Sources, effects and control measures of Ocean, Oil and Ground water pollution - Water sampling techniques - *Water remediation techniques*: Rhizofiltration, wetlands, lagoon, oxidation pond and oxidation ditch.

UNIT III

Water Treatment Methods & Management Strategies

Water treatment: Drinking water and wastewater treatment technologies – Physical, chemical and biological - Primary, secondary and tertiary treatments - Sludge dewatering and its disposal. *Designs and functioning of ETP*: Concept of ETP, Need of ETP in industry, Concept of CETP, Major units in ETP and their functions - *Water management strategies*: Rain water harvesting, Recharging of ground water, Use of domestic waste water, Recycling of waste water, Recycling of industrial effluent after treatment.

UNIT IV

Soil Pollution and Management

Soil pollution: Sources- Industrial, Domestic, Agricultural (Pesticides, heavy metals, industrial effluents, waste disposal) - Effects of soil pollutants on plants, animals and ground water - Soil sampling devices, methods and analysis - *Soil remediation techniques:* Physical, chemical and biological (bioremediation and phytoremediation).

UNIT V

Noise and Radioactive Pollution and Management

Noise Pollution: Sources, sound pressure levels, decibels, intensity and duration - Effects of noise pollution on human and animals - Noise permissible standards - Noise control measures - greenbelt and noise protective instruments - *Radioactive pollution*: Sources, radioactive elements, Effects of radiation on surrounding environment - Radioactive waste disposal methods.

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ELECTIVE III: 14UPEVS1E03

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

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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: 14UPEVS1E04

ENERGY AND GREEN TECHNOLOGIES

UNIT I

Energy Sources

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, gobar gas

UNIT II

Energy Management

Energy management – solar energy input conventional fuels – oil, coal, natural gas, uranium, risk of nuclear accidents

UNIT III

Bioenergy

Bio energy – Biomass and biofuels – Woody biomass for biofuel - Biogas technology - Petroplants (energy plantations) used for biofuel – Cellulosic ethanol production

UNIT IV

Energy from wastes

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 V

Green Chemistry

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. Calle FR, de Groot P, Hemstock SL, Woods J (2007) The Biomass Assessment Handbook: Bioenergy for a sustainable environment, Earthscan, UK.
2. El Bassam N (2010) Handbook of Bioenergy Crops – A Complete Reference to Species, Development and Applications, Earthscan, UK.
3. Khanal SK, Surampalli RY, Zhang TC, Lamsal BP, Tyagi RD, Kao CM (2010) Bioenergy and Biofuel from Biowastes and Biomass, American Society of Civil Engineers, Virginia, USA.
4. Lee S and Shah YT (2013) Biofuels and Bioenergy: Processes and Technologies, CRC Press, Boca Raton, FL, USA.

5. Rashmi Sanghi and Srivasta MM (2006) Green Chemistry, Narosa Publishing House, New Delhi.
6. Stanley E Manahan (2001) Environmental Chemistry, Lewis Publications, USA.
7. Wang L (2014) Sustainable Bioenergy Production, CRC Press, Boca Raton, FL, USA.

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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 V: 14UPEVS1E05

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.

References

1. Estes JE and Senger LW (1973) Remote Sensing Techniques for Environmental Analysis, Hamilton Publication and Co., Santa Barbara, CA, USA.
2. Kohl M, Magnussen SS and Marchetti M (2010) Sampling Methods, Remote Sensing and GIS Multiresource Forest Inventory, Springer, Berlin.
3. Merril Eisenbud and Thomas Gessell (1997) Environmental Radioactivity from Natural, Industrial and Military Sources, 4th edition, Academic Press, London
4. Mesev V (2007) Integration of GIS and Remote Sensing, John Wiley & Sons, UK.
5. Nayak S and Zlatanova S (2008) Remote Sensing and GIS Technologies for Monitoring and Prediction of Disasters, Springer, Berlin.
6. Srikantaswamy S (2008) Essential of Remote Sensing, Gajanana Publications, Mysore.

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1. www.isprs.org
2. www.unesco-ihe.org
3. www.wmo.int
4. www.fao.org/docrep/009/a0906e/a0906e00.html

5. www.academia.edu

ELECTIVE VI: 14UPEVS1E06

ENVIRONMENTAL ENGINEERING

UNIT I

Design facilities for water treatment plant

Principles and Design of plain sedimentation tank - Sedimentation with coagulation, Slow and rapid filtration - Pressure filters water softening by zeolite and ion exchange process - Reverse osmosis - Disinfection of water.

UNIT II

Design of pre and primary waste water treatment plant

Principle and design of screen - Equalization tank, grit chambers, rectangular and circular sedimentation tank.

UNIT III

Design facilities for aerobic treatment of waste water

Principles of biological treatment - Design of trickling filters - Activated sludge process - Oxidation Ditch.

UNIT IV

Anaerobic treatment of wastewater

Design facilities for anaerobic treatment of waste water and sludge - Sludge digestion and thickening - Sludge drying beds - Design of anaerobic digesters and septic tank.

UNIT V

Design of air pollution control equipments

Principle and design of minimum stack height - Settling chamber - Cyclone collector - Fabric filter and Electrostatic Precipitators (ESP).

References

1. Air Pollution Control Technology Manual (1998) Overseas Environmental Cooperation Center, Japan.
2. Anne Maczulak (2010) Environmental Engineering: Designing a Sustainable Future, Infobase Publishing, NY, USA.
3. Louis Theodore (2008) Air Pollution Control Equipment Calculations, John Wiley & Sons, NJ, USA.
4. Mihelcic JR, Fry LM, Myre EA, Phillips L and Barkdoll BD (2009) Field Guide to Environmental Engineering for Development Workers - Water, Sanitation, and Indoor Air, American Society of Civil Engineers, USA.

5. Pawlowski A, Dudzinska MR and Pawlowski L (2013) Environmental Engineering, CRC Press, Boca Raton, FL, USA.

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1. http://www.suez-environnement.com/design-construction-water-plants/
2. http://www.opp.psu.edu/about-opp/divisions/cpd/images/WTP-Longlist.pdf
3. http://winnipeg.ca/waterandwaste/water/treatment/plant.stm
4. http://www.eolss.net/sample-chapters/c09/e4-11-05.pdf
5. http://www.thomasnet.com/products/air-pollution-control-equipment-780809-1.html
6. http://file.zums.ac.ir/ebook/109

SUPPORTIVE PAPERS

SUPPORTIVE I: 14UPEVS1S01

ECOLOGY AND ENVIRONMENT

UNIT- I

Introduction

Environmental Science - Definition, Scope and Importance - *Components of the environment*: Atmosphere, Hydrosphere, Lithosphere and Biosphere – Structure and composition - History and scope of Ecology - Terminologies in ecology.

UNIT – II

Ecosystem

Types of ecosystems – Terrestrial and aquatic ecosystems, Structure and functional aspects of ecosystem - Food Chain, Food Web, Energy flows, Ecological pyramids - Productivity of an ecosystem - Biogeochemical cycling - Ecological succession.

UNIT – III

Population ecology

Population ecology - Levels of Organization, population characteristics - density, natality, mortality, survivorship curves, age distribution, growth curves and models - Population interactions - Co-evolution, Neutralism, symbiosis, commensalism, mutualism, antagonism, antibiosis, parasitism, predation; competition- inter and intra specific.

UNIT – IV

Natural resources

Classification and significance of natural resources – Soil, forest, water, wildlife and minerals - Concepts and approaches of natural resource conservation - Natural resources of India - Legal provisions to conserve natural resources in India

UNIT – V

Biodiversity

Introduction to Biodiversity - Species, Genetic, Community and Ecosystem diversity - *Biodiversity Conservation*: Principles and Strategies – In-situ and Ex-situ Conservation - Megadiversity zones and Hot Spots - *Use of Biodiversity:* Food, medicine, raw material, aesthetic and cultural value.

References

1. Jha LK (1997) Natural Resource Management. APHA Publishing Corporation, New Delhi.
2. Odum EP (1996) Fundamentals of Ecology. W.B. Saunders, USA. Indian Reprint 1996, Natraj Publishers, Dehradun, India.
3. Ramade F (1991) Ecology of Natural Resources. John-Wiley & Sons, New York..
4. Rana SVS (2005) Essentials of Ecology and Environmental Sciences, Prentice-Hall of India Private Limited, New Delhi, India.
5. Sharma PD (2000) Ecology and Environment. Rastogi Publications, Meerut, India.

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1. http://www.newagepublishers.com/samplechapter/000964.pdf
2. www.ecosystem.org/types-of-ecosystems
3. www.ecologyconnections.ca/pop3research.php
4. http://ocw.korea.edu/ocw/college-of-life-sciences-and-biotechnology/general-biology/PDF/10-1GeneralBiol%20CH50.pdf
5. www.uic.edu/classes/bios/bios101/competitionmurray.PPT
6. india.gov.in/topics/environment-forest/natural-resources
7. www.jamaicachm.org.jm/BHS/conservation.htm

SUPPORTIVE II: 14UPEVS1S02

ENVIRONMENTAL QUALITY MANAGEMENT

UNIT- I

Environmental sustinability

Introduction and scope of environmental management - Basic concepts of sustainable development - Industrial ecology and recycling industry.

UNIT – II

Energy management

Role of natural products and bio-diversity in international trade - Fundamentals of fossil fuels use - Energy production and trade, Energy balance and energy audit - Eco-marketing.

UNIT – III

EIA Process

Environmental Impact Assessment (EIA) - General guidelines for the preparation of environmental impact statement (EIS) - Scope and types of environmental audit - Cost-benefit analysis - Environmental Management Plan (EMP)

UNIT – IV

Environmental quality standards

International organization for standardization (ISO) - ISO 14000, 19000 and 22000 standards and certification - Environmental clearance for establishing industry

UNIT – V

Environmental safety and risk management

Environmental safety - Risk management and emergency preparedness - International summit and treaties - Important dates dedicated to environmental management.

References

1. Biswas AK and Agarawal SBC (2002) Environmental Impact Assessment for Developing Countries, Butterworth-Heinemann Ltd. Reed International.
2. Boland RGA (1993) (Ed) Environmental Management Training. Sterling Publishers Pvt. Ltd. New Delhi.
3. Canter L (1996) Environmental Impact Assessment. 2nd Edition. McGraw-Hill Book Company, New York.
4. Kulkarni V and Ramachandra TV (2006) Environmental Management. Capital Publishing Co., New Delhi.
5. Tiwari RK (2007) Global Environmental Policies. ABD Publishers.

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1. www.epa.gov/sustainability/basicinfo.htm

2. www.un.org/millenniumgoals/environ.shtml
3. oee.nrcan.gc.ca/sites/oee.nrcan.gc.../energy-audit-manual-and-tool.pdf
4. envfor.nic.in/division/introduction-8
5. cpcb.nic.in/National_Ambient_Air_Quality_Standards.php
6. envirocare.co.in/environmental-standards-in-india.htm

SUPPORTIVE III: 14UPEVS1S03

ENVIRONMENTAL POLLUTION

UNIT –I

Environmental Pollution

Environmental pollution – Types , causes and effects - Sources of pollution – Point and non-point sources - Classification of pollutants - Contaminant types - Control measures and management perspectives for environmental pollution

UNIT – II

Air Pollution

Air pollution - Natural and anthropogenic sources of pollution - Primary and secondary pollutants - Transport and diffusion of pollutants - Behaviour of pollutants in the atmosphere - Methods of monitoring and control of air pollution - SO_2, NOx, CO, SPM.

UNIT – III

Water Pollution

Water pollution - Types sources and consequences of water pollution - Physico-chemical and bacteriological sampling - Water quality and standards - Sewage and wastewater treatment and recycling

UNIT – IV

Soil Pollution

Soil pollution chemical and bacteriological sampling as analysis of soil quality - Soil pollution control, Industrial waste effluents, heavy metals and their interactions with soil components.

UNIT – V

Noise Pollution

Noise pollution - Sources of noise pollution - Measurement and indices - *Marine Pollution*: Sources of marine pollution and its control - Effects of pollutants on human beings, plants, and animals

References

1. Baird C and Cann M (2008) Environmental Chemistry. W.H. Freeman and Company.
2. Botkin, Daniel B and Keller, Edward A (2007) Environmental Science: Earth as a Living Planet. 6th ed. John Wiley & Sons, USA.
3. Cunningham W P and Cunningham MA (2004) Principles of Environment Science. Enquiry and Applications. 2nd ed. Tata McGraw Hill, New Delhi.
4. Sharma BK (2000) Environmental Chemistry, Goel Publishing House, Meerut.

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1. www.uccee.org/Environmental_Pollution.html

2. www.who.int/topics/environmental_pollution/en/
3. www.nrdc.org/water/
4. environment.nationalgeographic.com/environment
5. www.noisecontrol.com/the-common-causes-of-noise-pollution
6. www.conserve-energy-future.com/causes-and-effects-of-soil-pollution.php

SUPPORTIVE IV: 14UPEVS1S04

GLOBAL ENVIRONMENTAL ISSUES AND MANAGEMENT

UNIT I

Climate change

Global Environmental problems - Causes and concerns. Climate change – Global climate scenario, Causes, effects and control measures

UNIT II

Ozone depletion, Acid rain and Photochemical smog

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 effect and global warming

Green house gases – Green house effect and climate change - Global warming facts – Effects of Global warming – Control and remedial measures of green house effect

UNIT IV

Environmental degradation

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

Disaster Episodes

Eutrophication and restoration of Lakes - Wet land degradation - Environmental disaster (man made) episodes; Mina mata, Itai itai, London smog, Los Angeles smog, Bhopal gas tragedy.

References

1. Nanda AN (1996) Environmental Education
2. Agarwa. KM, Sikdar PK and Deb SC (2002) A text book of Environment –MacMiller India Ltd., Calcutta
3. Tyler Miller Jr. G (1996) Living in the Environment – Principles, Connections and Solutions –Wadsworth Publishing Co. New York.
4. Botki, DB Changing the Global Environment, Academic Press, San Diago

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2. www.nature.org › Where We Work
3. www.nrdc.org/globalwarming/

4. www.climatehotmap.org/
5. www.globalwarming.org
6. dolr.nic.in/dolr/wasteland_atlas.asp
7. www.ncbi.nlm.nih.gov/pubmed/7734058

PRACTICALS

SEMESTER I

PRACTICAL I: 14UPEVS1CP01

Cell Biology & Biochemistry, Fundamentals of Environmental Sciences and Environmental Chemistry

1. Examination of Prokaryotic and Eukaryotic cells.
2. Protein quantification.
3. Estimation of primary productivity of an ecosystem
4. Determination of minimum quadrat size for community study
5. Estimation of pH and conductivity
6. Estimation of Total Suspended Solids & Total Dissolved Solids
7. Determination of Acidity
8. Determination of Alkalinity
9. Estimation of Dissolved Oxygen and Biological oxygen Demand
10. Estimation of Chemical oxygen demand
11. Estimation of particle size distribution of the soil
12. Determination of specific gravity and moisture content of the soil

SEMESTER II

PRACTICAL II: 14UPEVS1CP02

Environmental Microbiology, Environmental Impact Assessment & Disaster Management and Environmental Pollution & Management

1. Lab rules and regulations. Glassware maintenance, sterilization and Disinfection techniques
2. Media preparation
3. Staining techniques- simple, Grams & Spore
4. Enumeration of microbes from sewage, soil & air
5. Estimation of suspended particulate matter (SPM)
6. Most Probable Number (MPN) techniques
7. Preparation of EIA report for Environmental Clearance (EC)
8. Preparation of checklists for EIA study
9. Flame Photometric analysis of Na, K, & Ca & Mg
10. Phosphate estimation
11. Sampling and analysis of SO_2 and NO_x
12. Determination of noise levels at various sites

SEMESTER III

PRACTICAL III: 14UPEVS1CP03

Waste Management, Environmental Toxicology and Environmental Biotechnology

1. Preparation of vermicompost
2. Segregation of municipal waste
3. Isolation of genomic DNA and RNA
4. Isolation of Plasmid DNA and RNA
5. PCR techniques
6. Isolation of environmental mutants
7. Mitotic cell division –abnormalities – onion root tip squash
8. Melanophore indexing
9. Comet assay technique
10. LC_{50} and LD_{50} determination of pesticides

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