

ANNAMALAI UNIVERSITY
BACHELOR OF SCIENCE
B.SC. ENVIRONMENTAL MANAGEMENT
(With effect from 2021 - 2022)

The Course of Study and the Scheme of Examinations

S. No.	Part	Study Components		Ins. Hrs / week	Credit	Title of the Paper	Maximum Marks		
		Course Title					CIA	Uni. Exam	Total
		SEMESTER I							
1.	I	Language	Paper-1	6	4	Tamil/Other Languages	25	75	100
2.	II	English (CE)	Paper-1	6	4	Communicative English I	25	75	100
3.	III	Core Theory	Paper-1	6	4	Basics of Earth Science	25	75	100
	III	Core Practical	Practical-1	4	0	Basics of Earth Science	0	0	0
4.	III	Allied -1	Paper-1	4	3	Environmental Botany	25	75	100
	III	Allied- 1	Practical-1	2	0	Environmental Botany	0	0	0
5.	III	PE	Paper 1	6	3	Professional English I	25	75	100
6.	IV	Environmental Studies		2	2	Environmental Studies	25	75	100
		Sem. Total		36	20		150	450	600
		SEMESTER II					CIA	Uni. Exam	Total
7.	I	Language	Paper-2	6	4	Tamil/Other Languages	25	75	100
8.	II	English (CE)	Paper-2	6	4	Communicative English II	25	75	100
9.	III	Core Theory	Paper-2	5	4	Environment and Ecology	25	75	100
10.	III	Core Practical	Practical-1	3	2	Basics of Earth Science and Environment and Ecology	25	75	100
11.	III	Allied-1	Paper-2	4	3	Environmental Zoology	25	75	100
12.	III	Allied-1 Practical	Practical-1	2	2	Environmental Botany and Zoology	25	75	100
13.	III	PE	Paper 1	6	3	Professional English II	25	75	100
14.	IV	Value Education		2	2		25	75	100
15.	IV	Soft Skill		2	1		25	75	100
		Sem. Total		36	25		225	675	900
		SEMESTER III					CIA	Uni. Exam	Total
16.	III	CoreTheory	Paper-3	6	4	EnvironmentalChemistry	25	75	100
17.	III	CoreTheory	Paper-4	6	4	NaturalResource Management	25	75	100
18.	III	CoreTheory	Paper-5	6	4	Environmental Microbiology	25	75	100
	III	CorePractical	Paper-2	3	-	EnvironmentalChemistryandEnvironmentalMicrobiolo-gy	0	0	0
19.	III	Allied-2	Paper-3	5	3	EnvironmentalEconomics	25	75	100
20.	IV	SkillBased Subject	Paper-1	2	2	RemoteSensingandGIS	25	75	100
21.	IV	Non-MajorElective	Paper-1	2	2	GlobalEnvironmentalIssues Management	25	75	100

		Sem.Total		30	19		150	450	600
		SEMESTER IV					CIA	Uni. Exam	Total
22.	III	CoreTheory	Paper-6	6	4	EnvironmentalPollutionandControlMeasures	25	75	100
23.	III	CoreTheory	Paper-7	6	4	PollutionMonitoringandAnalyticalTechniques	25	75	100
24.	III	CoreTheory	Paper-8	6	4	EnergyandEnvironment	25	75	100
25.	III	CorePractical	Paper-2	0	3	EnvironmentalChemistryandEnvironmentalMicrobiology	25	75	100
26.	III	CorePractical	Paper-3	3	3	EnergyandEnvironment,EnvironmentalPollution,ClimatechangeandSustainableManagement	25	75	100
27.	III	Allied-2	Paper-4	5	5	EnvironmentandEco-Tourism	25	75	100
28.	IV	SkillBased Subject	Paper-2	2	2	AquacultureandEnvironment	25	75	100
29.	IV	Non-Major Elective	Paper-2	2	2	OccupationalSafety,HealthandManagement	25	75	100
		Sem.Total		30	27		200	600	800
		SEMESTER V							
30.	III	CoreTheory	Paper-9	6	5	WasteManagementandRecycling	25	75	100
31.	III	CoreTheory	Paper-10	6	5	BiostatisticsandInstrumentation	25	75	100
32.	III	CoreTheory	Paper-11	6	5	EnvironmentalSafety,HealthandManagement	25	75	100
	III	CorePractical	Paper-4	3	0	BiostatisticsandInstrumentationWasteManagementandRecycling	0	0	0
33.	III	Elective	Paper-1	6	3	Environmental Toxicology	25	75	100
34.	IV	SkillbasedSubject	Paper-3	3	2	ForestConservation&Management	25	75	100
		Sem.Total		30	20		125	375	500
		SEMESTER VI							
35.	III	CoreTheory	Paper-12	6	4	NaturalHazardandDisasterManagement	25	75	100
36.	III	CoreTheory	Paper-13	5	4	EnvironmentalImpactAssessment	25	75	100
37.	III	CoreTheory	Paper-14	5	4	EnvironmentalLaws,PoliciesandTreaties	25	75	100
38.	III	CorePractical	Paper-4	0	3	BiostatisticsandInstrumentationWasteManagementandRecycling,	25	75	100
39.	III	CoreProject	Paper - 15	5	5	Group / Individual Project	25	75	100
40.	III	Elective	Paper-2	3	3	Climate change and	25	75	100

						Current issues			
41.	III	Elective	Paper-3	3	3	Environmental Nano Science	25	75	100
42.	IV	Skillbasedsubject	Paper-4	3	2	EnvironmentalBiotechnology&HerbalScience	25	75	100
43.	V	Extension Activities		-	1		100	0	100
		Sem.Total		30	29		300	600	900
									4300

Part	Subject	Papers	Credit	Total Credits	Marks	Total Marks
Part I	Languages	2	4	8	100	200
Part II	Communicative English	2	4	8	100	200
Part III	Allied (Odd Semester)	2	3	6	100	200
	Allied (Even Semester)	2	5	10	100	200
	Allied Practical	1	2		100	100
	Electives	3	3	9	100	300
	Core	14	(3-5)	59	100	1400
	Core practical	4	(2-3)	11	100	400
	Professional English	2	3	6	100	200
	Compulsory Project (Group/Individual Project)	1	5	5	100	100
Part IV	Environmental Science	1	2	2	100	100
	Soft skill	1	1	1	100	100
	Value Education	1	2	2	100	100
	Lang. & Others /NME	2	2	4	100	200
	Skill Based	4	2	8	100	400
Part V	Extension Activities	1	1	1	100	100
	Total	43		140		4300

CORE PAPER-3

Name of the Course: B.Sc. Environmental Management Semester: III Name of the Paper: Environmental Chemistry Credits: 4

Paper type: Core Hour of Teaching: 6

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ENVIRONMENTAL CHEMISTRY

Course Objectives

1. To learn about the fundamental of Environmental Chemistry
2. To study the atmospheric structure and composition
3. To understand the water chemistry and relation with environment
4. To learn about soil chemistry and characteristics
5. To study the pollutants and their interaction with environment

UNIT-I

FUNDAMENTALS OF ENVIRONMENTAL CHEMISTRY

Fundamental concepts in Environmental Chemistry- Environmental segments- Preparation of Standard Solutions- Molarity, Molality, Normality, Percent and PPM (mg/l) solutions- Acid-base Reactions- pH and pOH and Buffer Solutions - Solubility and Solubility Product- Solubility of Gases in Water - The Carbonate System- Unsaturated and Saturated Hydrocarbons- Radionuclides.

UNIT-II

ATMOSPHERIC CHEMISTRY

Structure and composition of Atmosphere- Particles in the atmosphere- Physical behaviour of particles in the atmosphere- Formation of Inorganic and Organic Particulate Matter- Composition of inorganic particles- Toxic metals- Radioactive particles- The composition of organic particles- Effect of particles- Control of particulate emissions

UNIT-III

WATER CHEMISTRY

Formation of Water- Water Resources- Sources and Types- Hydrological Cycle- Unique Properties of Water- Role of Water in the Environment- Physical, Chemical and Biological Parameters of Water- Dissolved Oxygen- Biochemical Oxygen Demand- Chemical Oxygen Demand. Water Pollutants- Distribution of Chemical Species in Water- Organic Matter and Humic Matter in Water.

UNIT-IV

SOIL CHEMISTRY

Formation of soil- Types of soil- Physical and Chemical Properties of Soil: Structure, Texture, Temperature, Bulk Density, Permeability, Moisture, Air, pH, Cation Exchange Capacity, Macro and Micro nutrients, Humus and Organic Matter, C/N Ratio.

UNIT-V

POLLUTANT CHEMISTRY

Chemistry of various Organic and Inorganic Compounds - Pesticides - Biochemical effects of Pesticides - Heavy metals - Cadmium - Itai-Itai disease - Mercury - Minamata disease - Lead - Chromium - Zinc - Impact of heavy metals on man and animals - Thalidomide tragedy - Bio-chemical Effects of Carbon monoxide and Sulphur dioxide.

Course Outcome

1. After studying Unit I, the students will be able to know the concepts in Environmental Chemistry.
2. After studying Unit II, the students will be able to understand the chemical process in the air, water and soil.
3. After studying Unit III, the students will be able to describe the water quality parameters and water pollutants.
4. After studying Unit IV, the students will be able to analyze and recognize the properties of soil and water.
5. After studying Unit V, the students will be able to understand various types of organic and inorganic pollutants and their effects on environment.

Text Books

1. De, A.K. (2007) Environmental Chemistry, Seventh Edition, New Age International Publishers.
2. Sharma, B. K. and H. Kaur, (1994) Environmental Chemistry, Goel Publishing House Ltd., Meerut, UP
3. Pani, B. (2007) Textbook of Environmental Chemistry. I.K. International Publishing House.

Reference

1. Girard, J. (2013) Principles of Environmental Chemistry (3rd edition). Jones & Bartlett.
2. De, A.K. (2003) Environmental Chemistry, Wiley Eastern Limited, New Delhi.
3. Balram Pani, (2007) Textbook of Environmental Chemistry, I.K. International Publishing House Pvt. Ltd.
4. Manahan, S.E. (2010) Environmental Chemistry, Ninth Edition, CRC Press
5. Dara, S.S., Mishra, D.D. (2009) A Textbook of Environmental Chemistry and Pollution Control, 10th Edition, S. Chand & Company.

E-Materials

1. http://www.nptel.ac.in/courses/122106030/Pdfs/3_1.pdf
2. http://www.crystal.med.upenn.edu/sharp-lab-pdfs/sharp_EncLifeSci.pdf
3. <http://www.fao.org/docrep/field/003/AC172E/AC172E04.htm>
4. <http://www.essentialchemicalindustry.org/materials-and-applications/surfactants.html>
5. <http://agriinfo.in/?page=topic&superid=5&topicid=174>
6. <http://www.citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.800.8713&rep=rep1...pdf>
7. <https://www.onlinebiologynotes.com/chemical-parameters-of-water-quality-chemical-characteristics-of-water/>

CORE PAPER-4

Name of the Course: B.Sc. Environmental Management Semester: III

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NATURAL RESOURCE MANAGEMENT

Course Objectives

1. To learn about the natural resource and their importance
2. To study the forest resources and its use and conservation
3. To study water resources and its management
4. To study the land resources and land degradation and protection
5. To understand values of mineral resource and their impact on Environment

UNIT- I

INTRODUCTION NATURAL RESOURCES

Natural Resources- Concepts and Approaches of Natural Resources Conservation- Classification- Renewable Resources, Non-Renewable Resources- Natural Resources of India- Role of Individual in Conservation of Natural Resources.

UNIT -II

FOREST RESOURCES MANAGEMENT

Conservation of forest resources-

Distribution of forests, Wood production, Forest land use changes in India, Future demand of forest land, Carbon sequestration- Deforestation: Causes and impacts-

Forest management tools: Social forestry, Agro-forestry and Urban forestry-

Ecodevelopment committees, Ecotourism, Climate change reduction, Carbon trading.

UNIT- III

WATER RESOURCES MANAGEMENT

Water Resources- Source, distribution, Over Exploitation and issues-

Integrated Water resource management- Conservation and Management of Water-

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- IV

LAND AND SOIL RESOURCES MANAGEMENT

Distribution of Soil resources- Role of Agricultural Practices in Soil Degradation- Soil erosion-

Soil Fertility and Nutrient Management- Diagnosis of Soil Nutrient Deficiencies-

Soil Conservation: Principles, Benefits and Methods of Soil Conservation; Green Manuring, Animal Manures and Restoration of Degraded and Wastelands.

UNIT- V

MINERAL RESOURCES MANAGEMENT

Mineral Resources and Reserves- Types, Sources, Distribution and Uses of valuable minerals- Exploration of Mineral Resources from Land and Oceans- Steps in Mineral Exploitation, Impact of Exploitation of Minerals on Environment- Conservation Strategies of Valuable Mineral Resources.

Course Outcomes

1. After studying Unit I, the students will be able to know the types of natural resources.
2. After studying Unit II, the students will be able to understand the importance of forest resources, uses and their conservation,
3. After studying Unit III, the students will be able to understand the different types of water resources, and how to manage the water resources.
4. After studying Unit IV, the students will be able to analyze and recognize the properties of soil and water.
5. After studying Unit V, the students will be able to understand various types of organic and inorganic pollutants and their effects on environment.

Text Books

1. Jha LK (1997) Natural Resource Management. APH Publishing Corporation, New Delhi.
2. Sharma, J.P. (2011) Environmental Studies. University Science Press, New Delhi.

Reference Books

1. Ma Dicken KG and Vergora NT (1990) Agroforestry: Classification & Management. John Wiley & Sons, New York.
2. Owen OS & Chiras DD (1995) Natural Resources Conservation. Prentice-Hall India, New Delhi.
3. Sarah Fehley (2011) Natural Resource Management, Oriental Enterprises, Dehradun, India.
4. Nautiyal Sand Kaul AK (1999) Forest Biodiversity & its Conservation Practices in India.
5. Taylor, Russel D., Torquebiau, Emmanuel (2011) Natural Resource Management and Local Development, Springer Netherlands.

E-Materials

1. <https://www.india.gov.in/topics/environment-forest/natural-resources>
2. <http://cedindia.org/program-areas/natural-resource-and-environment-management/>
3. <http://www.icimod.org/?q=1258>
4. <https://www.sida.se/contentassets/320aedac0f1047daa30a1400af89c7a0/13185.pdf>
5. <https://www.un.org/esa/agenda21/natlinfo/countr/india/natur.htm>
6. <https://www.encyclopedia.com/environment/energy-government-and-defense-magazines/natural-resource-management>

COREPAPER-5

Name of the Course: B.Sc. Environmental Management Semester: III Name of the Paper: Environmental Microbiology Credits: 4

Paper Type: Core Hour of Teaching: 6

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ENVIRONMENTAL MICROBIOLOGY

Course Objectives

1. To impart knowledge about microorganisms, and their growth and reproduction
2. To understand the microbial ecology and their interactions with environment
3. To learn about the role of microorganisms in biogeochemical cycles
4. To study the existence and role of microbes in water and soil quality
5. To study about the role of microbes in environmental bioprocesses

UNIT-I

INTRODUCTION OF MICROBIOLOGY

History and Discovery of Microorganisms-

Louis Pasteur's Contribution and Discoveries and Koch Postulates- Scope of Microbiology-

Physical and Chemical Methods of Sterilization Techniques used in Microbiology-

Microbial Culture Media- Isolation and Culturing of Microorganisms-

Growth and Reproduction of Bacteria, Virus, and Bacteriophage.

UNIT-II

MICROBIAL ECOLOGY

Concept of Microbial Ecology- Succession and Colonization of Microbes in Environment-

Positive and Negative Roles of Microbes in Environment-

Environmental factors influencing the Growth and Survival of Microorganisms-

Microbial interactions-

Mutualism, Commensalism, Competition, Amensalism, Parasitism and Predation. Plant-

Microbes Interactions.

UNIT-III

MICROBES AND ENVIRONMENT

Role of Microbes in Biogeochemical Cycles-

Carbon, Nitrogen Cycle (Nitrogen Fixation, Ammonification, Nitrification, Denitrification), Sulphur,

Iron and Phosphorous Cycles. Rhizosphere-

Rhizosphere Microorganisms and their role in Nitrogen Fixation-

Anabaena, Azospirillum and Rhizobium- Nitrogenase- Hydrogenase. Metal Leaching-

Phosphate Solubilization.

UNIT - IV

WATER AND SOIL MICROBIOLOGY

Microbiological Water Quality Standards- Detection of Faecal Microbial Contamination-

Indicator Organisms- Detection of Virus- Microbial Indicators of Water Pollution-

Water Purification and Recycling Process-

Waterborne Diseases. Soil Microbiology: Humus, Microflora of Soil, Microbial Degradation of Lignin and Pesticides. Microbial Composting of Biowastes

UNIT - V

ENVIRONMENTAL APPLICATIONS OF MICROBES

Role of Microbes in Environmental Processes- Biodegradation- Biotransformation- Bioremediation- Biomining: Bioleaching, Metal Extraction- Microbially Enhanced Oil Recovery- Microorganisms and Sewage Treatment- Trickling Filters, Activated Sludge Process, Oxidation Ponds- Sludge Treatment: Anaerobic Digestion, Biogas Production- Microbiological Coal Desulfurization.

Course Outcomes

After studying Environmental Microbiology course, the students will be able to

1. Understand the microbial growth, reproduction, and culturing techniques.
2. Understand the interaction of microbes in an ecosystem and their role in biogeochemical cycles.
3. Understand and identify the environmental microbial bioprocess.
4. Gain knowledge in application of microbes for environment remediation.
5. Develop microbial based environmental treatment processes.

Text Books

1. Sharma, P. D. (2005) Environmental Microbiology, Alpha Science International, Ltd.
2. Dubey and Maheshwari, 1999, A text book of Microbiology, 1/e, Chand publications, New Delhi.
3. Mohapatra PK (2008) Text Book of Environmental Microbiology, IK International Publishing House Limited.

Reference Books

1. Subba Rao NS (2004) Soil Microbiology. 4th Edition, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Subba Rao NS (1995) Biofertilizers in Agriculture and Forestry. 3rd Edition, Oxford and IBH Pub. Co. Pvt. Ltd., New Delhi.
3. Singh DP & SK Dwivedi (2005). Environmental Microbiology and Biotechnology. 1st Edition, New Age International (P) Ltd., Publishers, New Delhi.
4. Brock TD, Madigan MT, Martinko JM and Parker J (1994) Biology of Microorganisms, VII Ed., Prentice-Hall, New Jersey, USA.
5. Ronald M. Atlas, Richard Bartha, (1997) Microbial Ecology, 4/e, Benjamin Cummings Publishing Company, USA.

E-Materials

1. <https://microbenotes.com/category/environmental-microbiology/>
2. <https://microbewiki.kenyon.edu/index.php/MicrobeWiki>
3. <https://www.onlinebiologynotes.com/sewage-treatment-process-of-wastewater-treatment/>
4. https://www.jsps.go.jp/english/e-plaza/e-sdialogue/data/Slide_C.pdf
5. <https://ocw.mit.edu/courses/civil-and-environmental-engineering/1-89-environmental-microbiology-fall-2004/lecture-notes/>
6. https://www.uvi.edu/files/documents/Research_and_Public_Service/WRRI/Introduction_to_Environmental_Microbiology.PDF
7. <https://www.geoengineer.org/education/web-class-projects/cee-549-geoenvironmental-engineering->

winter-

2013/assignments/bioremediation#applicability-to-soil-and-contaminant-types

8. <http://www.pollutionissues.com/A-Bo/Bioremediation.html>

9. https://fac.ksu.edu.sa/sites/default/files/lecture_2microbial_interactionsppt.pdf

10. <https://www.onlinebiologynotes.com/bioremediation-concept-types-advantages-and-limitations/>

11. <https://www.onlinebiologynotes.com/microbial-ecology-and-role-of-microorganism-in-ecosystem/>

COREPAPER-6

Name of the Course: B.Sc. Environmental Management

Semester: IV

Name of the Paper: Environmental Pollution and Control Strategies

Credits: 4

Paper Type: Core

Hours of Teaching: 6

ENVIRONMENTAL POLLUTION AND CONTROL STRATEGIES

Course Objectives

1. To learn about major air pollutants and their sources and control methods
2. To study about water pollutant and control measures
3. To study about soil pollution and soil remediation to minimize environmental degradation
4. To understand the noise pollution and its control measures
5. To know about thermal and radioactive pollution and their effects

UNIT- I

AIR POLLUTION & CONTROL

Natural & Anthropogenic Sources of Air Pollution. Primary Pollutants - Hydrocarbon, CO, SO₂, Lead, Aerosols - Secondary Pollutants - PAN, Photochemical Smog and Ozone, Acid Rain - Greenhouse Effect - Global Warming - Ozone Depletion. Air Pollution Control & Management - Monitoring of Air Pollution - Sampling and Analysis Techniques of SO_x, NO_x, hydrocarbons and particulate matter - Ambient Air Quality Standards of CPCB.

UNIT- II

WATER POLLUTION

Physical, Chemical & Biological Characteristics of Waste Water - Water Pollutants - Sources & Effects of Water Pollution - Waterborne Diseases - Eutrophication - Waste Water Treatment - Primary - Secondary - Tertiary - Pollution in River Ganges - River Cleaning - Namami Gange Programme.

UNIT- III

SOIL POLLUTION

Soil Pollutants - Biodegradable - Non-Biodegradable - Causes of Soil Pollution - Impacts of Soil Pollution - Pesticides in Soil Environment and their Effects - Soil Degradation - Need for Soil Conservation and Restoration of Soil Fertility - Control of Soil Pollution. Soil Remediation Techniques - *In-situ* and *Ex-situ* Remediation.

UNIT- IV

NOISE POLLUTION

Natural and Manmade Sources of Noise Pollution - Types of Noise - Industrial Noise - Transport Noise - Neighborhood Noise - Effects of Noise Pollution on Human Health - Working Efficiency. Physical & Mental Health - Noise Exposure Levels and Standards - Noise Pollution Control and Abatement Measures.

UNIT- V

THERMAL AND RADIOACTIVE POLLUTION

Thermal Pollution: Definition- Sources- Chemical and Biological Effects-

Thermal Pollution from Power Plants and their Control Measures-

Radioactive Pollution: Definition, Sources, Radioactive Decay, Units of Radioactivity and Radiation

Dose- Monitoring- GM and Scintillation Counter- Effects of Radiation on Environment.

Course outcomes:

1. After studying Unit I, the students will be able to understand and explain the air pollution, sources, and control methods.
2. After studying Unit II, the students will be able to understand and analyze the impact of water pollution on environment, and explain the treatment of wastewater.
3. After studying Unit III, the students will be able to recognize the sources of soil pollution, soil degradation, and realize restoration of soil fertility.
4. After studying Unit IV, the students will be able to understand Noise pollution & their impact on human health & take steps to reduce noise pollution.
5. After studying Unit V, the students will be able to gain knowledge about thermal and radioactive pollution and take precaution measures.

Text Books

1. B.K. Sharma & H. Kaur, 1999, Air pollution, Goel Publishing House, Meerut.
2. V.P. Kudesia, 1985, water pollution, Pragati Prakashan, Meerut.
3. S.S. Dara, 2001, Environmental Chemistry & Pollution control, S. chand & company, Ramnagar, New Delhi.
4. De. A.K, Environmental Chemistry, Wiley Eastern Ltd, New Delhi.
5. S.A. Abbasi, 1998, Environmental & its control, Congent publication (p) Limited, New Delhi

Reference

1. Bhatia H.S, 1998, Environmental Pollution & its control, Golgotia publications (p) limited, New Delhi.
2. Khopkar, S.M, 1993, Environmental pollution Analysis, Wiley Eastern limited, New York.
3. Down to earth, center for science & Environment.
4. Rao M.N & H.V.N. Rao, 1989, Air pollution, Tata McGraw Hill publishing co ltd, New Delhi.

E-MATERIALS

1. <https://www.nrdc.org>.
2. <https://www.epa.gov>.
3. <https://data.gov.in>.
4. <https://orfonline.org>.
5. <https://www.ncbi.nlm.nih.gov/pmc>

CORE PAPER-7

**Name of the Course: B.Sc. Environmental
Management**

Semester: IV Credits: 4

Name of the Paper: Pollution Monitoring and Analytical Techniques

Hours of Teaching: 6

Paper Type: Core

POLLUTION MONITORING AND ANALYTICAL TECHNIQUES

Course Objectives

1. To impart knowledge about pollution monitoring methods
2. To learn about the water and wastewater quality analytical methods
3. To study the soil quality parameters and analytical methods
4. To learn the air sample collection and quality analysis methods
5. To understand the principles and methods of analytical instruments

UNIT- I

INTRODUCTION TO POLLUTION MONITORING

Environmental Quality-Definition-Pollution Monitoring-Water Sampling-Collection of Water Samples-Handling and Preservation-Analytical Devices-Methods for Sampling Particulates and Gaseous Emission-Measurement of Noise-National Environmental Standards.

UNIT- II

WATER QUALITY ANALYSIS

Physical Parameters-Colour-Temperature-Turbidity.Chemical Parameters-pH-Electrical Conductivity-Total Solids-Dissolved Oxygen-Total Alkalinity-Iron-Nitrate-Biochemical Oxygen Demand-Chemical Oxygen Demand.Biological Parameters-MPN(Most Probable Number)and MFT(Membrane Filter Techniques)-SPC(Standard Plate Count)-National Water and Water Quality Standards.

UNIT- III

SOIL QUALITY ANALYSIS

Collection of Soil Samples-Physico-Chemical Analysis of Soil-Density-Specific gravity-Texture-pH-Electrical Conductivity-Chlorides-Nitrate-Phosphate-Organic matter-Standard Soil Quality Standards.

UNIT- IV

AIR QUALITY ANALYSIS

Environmental Standards-Ambient Air Quality Standards - Drinking Water Quality Standards-Effluent Standards for Land Disposal-Disposal on Inland Water-Noise Level Standards.

UNIT- V

POLLUTIONANALYTICALEQUIPMENTS

Colorimetric-pHmeter-ElectricalConductivityMeter-Nephelometer-HighPressureLiquidChromatography(HPLC)-GasChromatographywithMassSpectroscopy-FlameAtomicAbsorptionSpectrometry-Chemiluminiscence-BioluminescenceTest-SoundLevelMeter-X-rayDiffraction.

CourseOutcomes

1. AfterstudiedUnitI, thestudentswillbeabletounderstandtheair, water, soilsamplecollectionmetho dsforpollutionmonitoring.
2. AfterstudiedUnitII, thestudentswillbeabletounderstandandanalyzethewaterqualityparametersa ndmethodsofanalysis.
3. AfterstudiedUnitIII, thestudentswillbeabletohandlethequalityanalysisanddeterminepollutedsoi l.
4. AfterstudiedUnitIV, thestudentswillbeabletounderstandairsamplingmethodsandanalysisofairp ollutionmethods.
5. AfterstudiedUnitV, thestudentswillbeabletogainknowledgeaboutthermalandradiopolluti onandtakeprecautionmeasures.

TextBooks

1. KrishnanKannan, K., 1997. FundamentalsofEnvironmentalPollution, S.ChandCompany, NewD elhi.
2. MuraliKrishna, K. V. S. G. (2015) AirPollutionandControl, UniversitySciencePress.
3. Goel, P. K. (2006) WaterPollutionCauses, EffectsandControl, NewAgeInternationalPublishers.

ReferenceBooks

1. Dara, S. S., 2000. Atextbookofenvironmentalchemistryandpollutioncontrol. S.ChandCompany, NewDelhi.
2. ChristianGD(2001), AnalyticalChemistry, 5thedition, JohnWileyandSonsInc., India
3. Wilson, K, Walker, J(2010) PrinciplesandTechniquesofBiochemistryandMolecularBiology, 7th edition, CambridgeUniversityPress.

CORE PAPER-8

Name of the Course: B.Sc. Environmental Management Semester: IV

Name of the Paper: Energy and Environment Credits: 4

Paper Type: Core Hour of Teaching: 6

ENERGY AND THE ENVIRONMENT

Course Objectives

1. To understand the conventional energy resources
2. To understand the sustainable use of energy resources
3. To learn the present energy scenario and the need for energy conservation
4. To explain the concept of alternative energy resources
5. To analyze the environmental aspects of renewable energy resources

UNIT- I

ENERGY SOURCES

Introduction to Nexus between Energy, Environment and Sustainable Development; Energy transformation from source to services; Energy sources, sun as the source of energy; biological processes-photosynthesis-Classification of energy sources-Conventional, Non-conventional energy Resources-Fossil fuel reserves-estimates, duration; theory of renewability, renewable resources.

UNIT- II

NON-RENEWABLE ENERGY SOURCES

First and second law 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-Atomic energy sources.

UNIT- III

ENVIRONMENTAL EFFECTS OF NON-RENEWABLE ENERGY SOURCES

Environmental Pollution from Energy Sources-Causes and Effects-Air Pollution, Water Pollution, Solid, Soil/land Pollution, Noise Pollution, Radioactive Pollution and Thermal Pollution.

UNIT- IV

RENEWABLE ENERGY SOURCES

Alternative Energy Sources-Solar Energy, Geothermal, Tidal, Wind Energy, Hydro-Electric Power-Ocean Thermal Energy Conversion-Biomass Energy Resources-Types of biomass Energy-Physicochemical characteristics of biomass as Fuel-Biomass conversion routes-Biomethanation, Biofuels, Biohydrogen, and Bioelectricity.

UNIT- V

RENEWABLE ENERGY AND SUSTAINABLE DEVELOPMENT

Renewable energy services and their implications for sustainable development - Economy - Environmental - Human Health - Energy and Economy - Emission Reduction - International Conventions on Energy and Sustainability - United Nations Framework Convention on Climate Change (UNFCCC) - UN Sustainable Development Goals.

Course Outcome

1. After studying Unit I, the students will be able to know the major sources and uses of energy and their advantages and disadvantages.
2. After studying Unit II, the students will be able to explain various non-renewable energy sources.
3. After studying Unit III, the students will be able to know the impacts of fossil fuels on environment and human health.
4. After studying Unit IV, the students will be able to understand and justify the need of renewable energy sources as an alternative to fossil fuels.
5. After studying Unit V, the students will be able to understand the concept of renewable energy and sustainable development.

Text Books

1. Boyle GF (2004) Renewable Energy - Power for a Sustainable Future, Second edition, Oxford University Press, UK.
2. Dhupper, R. (2015) Textbook on Energy Resources and Management. CBS Publication.

Reference Books

1. Robert A. Ristinen, Jack J. Kraushaar (2015) Energy and the Environment, 3rd Edition. Wiley Publications.
2. Kothari, D. P., Singal, K. C., Rnajan, R. (2011) Renewable Energy Sources and Emerging Technologies, Prentice Hall India Learning Private Limited.
3. John Andrews and Nick Jelly (2007) Energy Science: Principle, Technologies, and Impacts - Oxford University Press, UK.

E-Materials

1. <http://www.indiaenvironmentportal.org.in>
2. <http://www.cpcb.nic.in>
3. <http://www.gpcb.gov.in>

COREPAPER-9

Name of the Course: B.Sc. Environmental Management Semester: V

Name of the Paper: Biostatistics and Instrumentation Credits: 5

Paper Type: Core Hours of Teaching: 6

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BIOSTATISTICS AND MATHEMATICAL MODELLING

Course Objectives

1. To help students understand the basic concept about computer and computer programmes, hardware and softwares.
2. To impart knowledge on statistical data analysis with context of environmental studies.
3. To apply Biostatistical tools in environmental problems.

UNIT- I

BASICS OF COMPUTER

Introduction and Basic Concepts of Computer, Parts of Computer, Types of Computer Number System . Computer Organization, Software, Computer Virus Language and its Application.

UNIT- II

BASIC COMPUTER PROGRAMMES

Basic principles of a digital computer. Compression of hardware and software. Computer operating systems- WINDOWS- MS Word, Excel- powerpoint. Network- Internet, World Wide Web, Search Engines, E-mail. Application of Computer in Environmental Science; use of Computer in Environmental Modelling.

UNIT- III

DATA AND DATA COLLECTION

Data- Methods of Collection- Classification- Tabulation- Types of tables. Diagrammatic and Graphical representation.

UNIT- IV

DATA ANALYSIS

Measures of Central Tendency- Calculation of Mean, Median and Mode, Moments, Skewness and Kurtosis. Measures of Dispersion- Range and Deviation, Mean Deviation, Standard Deviation and Standard Error.

UNIT- V

MATHEMATICAL MODELLING IN ENVIRONMENT

Mathematical Ecology- Classification of Mathematical Modelling- Process of Modelling Population Growth Model- Population Interaction- Lotka and Volterra Prey Predator System, Point Source Stream Pollution Model, Box Model Energy Flow in Multi Ecosystem.

Course Outcome

1. After studied Unit I, the students will be able to learn the function of computers, hardware's and softwares.
2. After studied Unit II, the students will be able to get computer operations skills and document processing.
3. After studied Unit III, the students will be able to distinguish the data types and collect the data.
4. After studied Unit IV, the students will be able to analyze the data through various statistical methods.
5. After studied Unit V, the students will be able to apply the statistical modeling to environment and ecosystem studies.

Text Books

1. Palanisamy, M. (1989) A Textbook of statistics, paramount publication, palani.
2. Vittal, R. R. (1986) Business Mathematics and Statistics, Murugan Publications.
3. Sanjaysaxena (2003) A First Course in computers, Vikas publishing house Pvt. Ltd, New Delhi

Reference Books

1. Arumugam, N. (2015) Basic concepts of Biostatistics, Saras Publication.
2. Gurumani, N. (2010) An Introduction to Biostatistics, M. J. Publishers.
3. Marden, M. P. (2011) Research Methods for Science I Edition.
4. McKillup, S. (2006) Statistics Explained. An Introductory Guide for Life Scientists.
5. Cambridge University Press, Cambridge, UK.
6. Zar, J. H. (1998) Biostatistical Analysis. Prentice Hall, N. J.

E-Material

1. www.stat.cmu.edu/~brian/701/notes/paper-structure.pdf
2. www.cengage.com/resource_uploads/downloads/1133629601_397200.pdf
3. <https://www.scribd.com/document/.../Statistical-Analysis-of-Data-with-report-writing>

CORE PAPER-10

Name of the Course: B.Sc Environmental Management Semester: V

Name of the Paper: Solid Waste Management and Recycling Credits: 5

Paper Type: Core Hours of Teaching: 6

SOLID WASTE MANAGEMENT AND RECYCLING

Course Objectives

1. To learn about different types of solid wastes and their problems
2. To impart knowledge about solid waste collection and disposal
3. To learn the processes of solid waste treatment and recycling
4. To study about the hazardous waste and management
5. To learn about biomedical waste and handling.

UNIT-I

MUNICIPAL SOLID WASTE

Definition of Solid Waste- Types and sources of solid waste- Domestic, Municipal, Agricultural, Industrial, and Mining- Physico-Chemical Characteristics of Solid Waste- Solid Waste Generation- Problem and Impact of Municipal Solid Waste- Methane Gas Emission due to MSW.

UNIT- II

SOLID WASTE COLLECTION AND DISPOSAL

Disposal of Solid Waste- Collection- Process of Collection- Segregation of Waste- The Role of Rag Pickers- Biodegradable- Non-biodegradable- Reusable- Recyclable- Non-Recyclable- Combustible- Noncombustible- Hazardous- Solid Waste Management (SWM) Rules, 2016- Swachh Bharat Abhiyan.

UNIT- III

WASTE PROCESSING AND RECYCLING

Solid Waste Processing Technologies- Recycling, Recovery of Materials for Recycling- Open Dumping- Incineration- Types of Incinerators- Waste to Energy- Sewage Sludge Onsite Incinerators- Pyrolysis- Landfill- Landfill Regulation- Emission, Leachate and Monitoring- Composting- Aerobic Composting- Anaerobic Composting- Vermi Composting.

UNIT- IV

HAZARDOUS WASTE

Hazardous Waste- Definition, Types, Characteristics and Health Impacts, Waste Dumping Site, Storage, Transport- Handling of Wastes- Packing, Labelling and Transport, Disposal- Import and Export of Hazardous Waste, Treatment Methods- Neutralization, Oxidation Reduction, Precipitation, Solidification, Stabilization, Incineration and Final Disposal. Hazardous Waste (management and handling) Rule 1989.

UNIT- V

BIOMEDICAL WASTE

Biomedical Waste: Definition-Collection, Packing, Transportation and Storage-

Categories of Biomedical waste-

Colour Coding and Types of Container for Disposal of Biomedical Waste (Management and Handling) Rule 1988.

Course Outcomes

1. After studying Unit I, the students will be able to understand the different types of solid wastes and their sources and characteristics.
2. After studying Unit II the students will be able to recognize different types of waste collection, transport method and follow proper disposal method.
3. After studying Unit III, the students will be able to explain various waste recycling methods.
4. After studying Unit IV the students will be able to distinguish hazardous wastes and
5. After studying Unit V, the students will be able to gain knowledge about thermal and radioactive pollution and take precaution measures.

Text Books

1. Kinnaman, T. C. and Takeuchi, K. (2014). Handbook on Waste Management, Edward Elgar Publishing, UK.
2. Ramesha Chandrappa and Jeff Brown, (2012). Solid Waste Management: Principles and Practice, Springer Science and Business Media Publishers.

Reference Books

1. Asnani, P. U. 2006. Solid waste management. India Infrastructure Report 570.
2. Bagchi, A. 2004. Design of Landfills and Integrated Solid Waste Management. John Wiley & Sons.
3. Blackman, W. C. 2001. Basic Hazardous Waste Management. CRC Press.
4. McDougall, F. R., White, P. R., Franke, M. & Hindle, P. 2008. Integrated Solid Waste Management: A Life Cycle Inventory. John Wiley & Sons.
5. USEPA. 1999. Guide for Industrial Waste Management. Washington D. C.

E-Material

1. <http://mohua.gov.in/upload/uploadfiles/files/Part2.pdf>
2. <https://globalrec.org/wp-content/uploads/2014/03/Hazardous-Wastes-Management-and-Handling-Rules-1989.pdf>
3. http://www.hp.gov.in/dhsrhp/pdf/Biomedical_waste.pdf
4. <http://www.cpeo.org/techtree/ttdescript/pyrols.html>
5. www.satavic.org/vermicomposting.html
6. <http://web.mit.edu/urbanupgrading/urbanenvironment/sectors/solid-waste-landfills.html>
7. www.cement.org/waste/wt_apps_radioactive.asp
8. www.ipma.co.in/recycle.asp

CORE PAPER-11

Name of the Course: B.Sc. Environmental Management Semester: V

Name of the Paper: Environmental Health and Safety Credits: 5

Paper Type: Core Hours of Teaching: 6

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ENVIRONMENTAL HEALTH AND SAFETY

Course Objectives

1. To know the concept and importance of environmental safety and health
2. To study and understand about communicable diseases
3. To understand the occupational diseases and their causes
4. To know the safety measures to be taken at occupation sites
5. To impart knowledge on environment management system

UNIT- I

ENVIRONMENTAL HEALTH

Environmental Health-Concept and Scope-Need for good health-Factors affecting health-Malnutrition-Deficiency diseases-Kwashiorkor-Marasmus-Balanced diet-Food adulterants.

UNIT- II

PUBLIC HEALTH

Public Health-Communicable diseases-Mode of transmission (Epidemic and Endemic diseases) Bacterial diseases-Tuberculosis-Typhoid-Filariasis-Viral diseases-Hepatitis-AIDS-Rabies-Waterborne and Airborne diseases.

UNIT- III

OCCUPATIONAL HAZARDS

Occupational Health Hazard-Concepts and Scope-Occupational Hazard-Physical-Chemical and Biological hazards-Occupational Diseases-Pneumoconiosis-Silicosis-Anthraxosis-Byssinosis-Farmer's lungs-Lead poisoning-Skin Diseases-Prevention and Control of Occupational Diseases.

UNIT- IV

OCCUPATIONAL SAFETY

Industrial Safety and Management Techniques-Accidents-Causes-First aid-Prevention and Control-Risk analysis and assessment-Health education-Safety Measures in Industry.

UNIT-V

ENVIRONMENT MANAGEMENT SYSTEM

Environmental Management System (EMS)-ISO 14000 and ISO 14001-Compensation Act-Public Liability Insurance Act-Health Organization-NIOH (National Institute of Occupational Health) AIHPH (All India Institute of Hygiene and Public Health) NHO (National Health Organization) WTO (World Trade Organization) OSHA (Occupational Safety and Health Administration)

afetyandHealthAdministration)-Standards.

CourseOutcome

1. AfterstudiedUnitI,thestudentwillbeabletounderstandtheconceptandscopeofEnvironmentalHealth.
2. AfterstudiedUnitII,thestudentwillbeabletorecognizedifferenttypesofpublichealthissues.
3. AfterstudiedUnitIII,thestudentwillbeabletoundemandoccupationalhealthhazards,andtakestepstocontrolmeasures.
4. AfterstudiedUnitIV,thestudentwillbeabletoidentifythesuitablestafetymeasurestopreventindustrialoccupationalhazards.
5. AfterstudiedUnitV,thestudentwillbeabletoutilizetheenvironmentalmanagementsystem.

TextBooks

1. Shaw,J.Chadwick(1998)PrinciplesofEnvironmentalToxicology,Taylor&FrancisLtd.
2. AnnaleeYassi,TordKjellstr"om,TheodeKok,TeeGuidotti(2001).BasicEnvironmentalHealth,OxfordUniversityPress.

ReferenceBooks

1. Scoot,R,M,(1997)conceptsofindustrialhygiene,lewispublisher,NewYork.
2. DiberardinsL.J.,(1998).HandBookofOccupationalsafetyandhealth,johnWiley,NewYork.
3. ParkJ.E,andParkPreventiveandsocialmedicine.
4. SchillingR.S.E(1973).Occupationalhealthpractices,BufferWorth,London,
5. Gurjar,B.R.,Molina,L.T.,OjhaC.S.P.(2010).AirPollution:HealthandEnvironmentalImpacts.CRCPress,Taylor&Francis.
6. MonroeT.Morgan(2003)EnvironmentalHealth,ThirdEdition,Thomson/WadsworthPublishers.
7. Koren,H.(2002).HandbookofEnvironmentalHealthandSafety-PrincipleandPractices,FourthEdition,LewisPublishers,CRCPress.

E-Material

1. https://dgfasli.gov.in/sites/default/files/service_file/Nat-OSH-India-Draft%281%29.pdf
2. www.ehs.ucsb.edu/
3. http://safety.ucanr.edu/Safety_Notes/
4. <https://doresearch.stanford.edu/policies/research-policy-handbook/environmental-health-and-safety/health-and-safety-principles>
5. <https://www.cdc.gov/niosh/docs/98-145/pdfs/98-145.pdf?id=10.26616/NIOSH PUB98145>
6. <https://www.gooduniversitiesguide.com.au/careers-guide/occupational-health-and-safety-officer>
7. <https://doresearch.stanford.edu/policies/research-policy-handbook/environmental-health-and-safety/health-and-safety-principles>

CORE PAPER-12

Name of the Course: B.Sc. Environmental Management Semester: VI

Name of the Paper: Natural Hazard and Disaster Management Credits: 5

Paper Type: Core Hour of Teaching: 5

NATURAL HAZARD AND DISASTER MANAGEMENT

Objectives

To know about the natural and anthropogenic hazards, their impacts on environment & mitigation strategies and to train the people for their preparedness to face disaster.

UNIT- I

NATURAL HAZARDS

Natural Hazards- Types of Natural Hazards- Hydrological- Atmospheric- Geological Hazard- Earthquake- Causes, Impact on Environment- Control Measures- Tsunami- Cyclones- Landslides- Causes, Impact on Environment- Preventive Measures.

UNIT- II

ANTHROPOGENIC HAZARDS

Anthropogenic Hazards- Impacts of Anthropogenic Activities- Rapid Urbanization- Injudicious Groundwater Extraction- Sand Mining From River Bank- Deforestation- Mangroves Destruction- Warfare- Chemical Weapons- Biological Weapons- Major Accidents From Industries- Love Canal Disaster- London Smog- Chernobyl Accident- Bhopal Gas Tragedy.

UNIT- III

DISASTER

Disaster- Definition of Hazard, Natural, Technological Hazard, Concept of Risk & Vulnerability- Reasons of Vulnerability- Industrial Accidents- Two Components of Risk- Likelihood And Consequences, Qualitative Likelihood, Measurement Index (LMI)- Categories of Direct Losses, Indirect Losses, Tangible Losses & Intangible Losses- Application of Geoinformatics in Hazard, Risks And Vulnerability Assessment.

UNIT- IV

DISASTER MANAGEMENT SYSTEM

Disaster Impacts & Response- Identification of Dead- Search Rescue- First Aid- Relief Phase- Vaccination, Basic Sanitation and Personal Hygiene- Environmental Disaster- Assessment- Planning- Resettlement- Rehabilitation- Role of NGOs And GOs- Relief Camp- Psychotherapy- Simplified Yoga and Meditation- Stress Management.

UNIT- V

DISASTER MANAGEMENT IN INDIA

Policy For Disaster Reduction- Disaster Management Act 2005-

National Guidelines and Plan on Disaster Management -
National Disaster Management Authority (NDMA) -
NIDM (National Institute of Disaster Management) - State Disaster Management Authorities -
National Disaster Response Force.

Course Outcomes

1. The students will be able to differentiate vulnerability, risk & hazard.
2. To gain knowledge about the different types of Natural Disasters.
3. To impart knowledge on anthropogenic hazards & its impact on environment.
4. To know about the national & international agencies, NGOs for a major role in disaster management.
5. Knowledge gained will enable the students to volunteer themselves in disaster management program thus helping affected community.

Text Books

1. Natural hazards, Edwards B (2005), Cambridge University Press, UK.
2. Natural Disaster, Sharma R. K & Sharma G. (2005), A. P. H Publishing Corporation, New Delhi.
3. Disaster Management: A Disaster Manager's Handbook, Carter, N. W. (1992), Asian Development Bank, Manila.
4. A Manual On Disaster Management, Diwan, P. (2010), Pentagon Earth, New Delhi.
5. Early Warning Systems For Natural Disaster Reduction, Zschau, J and Koppers, N. (2003), Springer-Verlag, Berlin, Heidelberg.

Reference Books

1. Natural Hazards & Disaster Management - Vulnerability & mitigation, Singh R. B. (2006), Rawat Publications.
2. Disaster Planning: The Preservation of Life & Property, Foster, H. D. (1980), Springer Verlag, New York.
3. Disaster Management, Singh S. K, S. C. & Singh S (1998) Mittal Publications, New Delhi.
4. Natural Disaster Reduction, Mishra G. K & Mathur G. C. (1993), Reliance Publishing House, New Delhi.

E-Materials

1. <https://www.GIS.Development.net>
2. <https://iirs.nrsa.org>
3. <https://quake.usgs.gov>

CORE PAPER-13

Name of the Course: B.Sc. Environmental Management Semester: VI

Name of the Paper: Environmental Impact Assessment Credits: 5

Paper Type: Core Hour of Teaching: 5

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Course Objectives:

1. To impart knowledge about Environmental Impact Assessment
2. To identify methods and parameters to be included in EIA
3. To learn about the methods and steps involved in EIA
4. To prepare the EIA study report and post-EIA management system
5. To access the case studies of major developmental projects

UNIT- I

INTRODUCTION TO EIA

EIA-Introduction-Concept of EIA-Scope and objectives of EIA-EMP-Historical perspectives of EIA-Organization responsible for EIA-Pre-project analysis-Site selection and Area classification-Siting and Setting Criteria for EIA Projects.

UNIT- II

EIA ASSESSMENT PARAMETERS

Environmental Indicators-Abiotic and Biotic factors-Socio and Economic aspects-Environmental quality-Air, Water, Soil, Flora and Fauna-Field survey and data collection-Environmental auditing.

UNIT -III

EIA METHODOLOGIES

Various Steps of EIA-Content of EIA-Analytical and Integrated Approach Assessment Methodology-Ad hoc, Overlay Network, Matrix and Checklist-Environmental Values and Technique-Cost benefit Analysis-Environmental Clearance.

UNIT- IV

ENVIRONMENTAL IMPACT STATEMENT

Environmental Impact Statement (EIS) and Environmental Management Plan (EMP) Environmental Management System Standards (ISO 14000 series). EIA Notification, 2006 and 2020 amendments. Eco-labeling schemes.

UNIT- V

EIA CASE STUDIES

Case Studies for Major Developmental Projects: Hydroelectric and Thermal Power Plants, Mining, Highway Roads, Airport, Cement Industries.

Course outcomes

1. After studied Unit I, the students will be able to explain the importance and principles of EIA processes.
2. After studied Unit II, the students will be able to identify and list out the parameters to be evaluated for EIA.
3. After studied Unit III, the students will be able to understand and follow the methods of EIA.
4. After studied Unit IV, the students will be able to summarize the EIA report and an appropriate environmental management plan.
5. After studied Unit V, the students will be able to access and analyze EIA case studies report of different developmental projects.

Text Books

1. EIA Manual (2001) Ministry of Environment, Forest and Climate Change, New Delhi.
2. Barthwal, R. R. (2012) Environmental Impact Assessment, New Age International Publishers.
3. Khandeshwar, S. R., Raman, N. S., Gajbhiye, A. R. (2019) Environmental Impact Assessment, I. K. International Publishing House Pvt. Ltd.

Reference Books

1. Barrow, C. J. (2000) Social Impact Assessment: An Introduction. Oxford University Press.
2. Glasson, J., The Rivel, R., Chadwick, A. (1994) Introduction to Environmental Impact Assessment. London, Research Press, UK.
3. Judith, P. (1999) Handbook of Environmental Impact Assessment. Blackwell Science.
4. Marriott, B. (1997) Environmental Impact Assessment: A Practical Guide. McGraw-Hill, New York, USA.
5. Canter, L. W. (1997) Environmental Impact Assessment. McGraw-Hill, New York.
6. Peter Wathern (2015) Environmental Impact Assessment: Theory and Practice, Taylor & Francis, London.

E-Materials

1. <http://environmentclearance.nic.in/>
2. http://environmentclearance.nic.in/writereaddata/Draft_EIA_2020.pdf
3. www.fao.org/docrep/V8350E/v8350e06.htm
4. <http://www.moef.nic.in/division/eia-manual>
5. <http://www.moef.nic.in/circulars>
5. <https://www.adb.org/documents/adb-environmental-assessment-guidelines>
6. <https://www.iaia.org/eia-index-of-websites.php>
7. <https://www.csaocean.com/services/environmental-impact-assessment-eia>
8. <https://www.elaw.org/files/mining-eia-guidebook/Chapter2.pdf>

CORE PAPER-14

Name of the Course: B.Sc. Environmental Management Semester: VI

Name of the Paper: Environmental Laws, Policies and Treaties Credits: 5

Paper Type: Core Hour of Teaching: 5

ENVIRONMENTAL LAWS, POLICIES AND TREATIES

Course Objectives

To impart knowledge about Environmental Laws, regulations, policies and treaties of India and International.

UNIT-I

INTRODUCTION TO ENVIRONMENTAL LAW

Fundamental Rights-

Evolution and Development of Environment Laws with Reference to Stockholm Conference 1972-

Environmental Legislation- Legal Definition _ Article 48A- Article 51G- National Green Tribunal-

Environmental Ethics- Principle- Importance.

UNIT-II

LEGISLATION FOR ENVIRONMENTAL PROTECTION

The Wildlife (Protection) Act, 1972- The Water (Prevention and Control of Pollution) Act, 1974-

The Air (Prevention and Control of Pollution) Act, 1981- The Environment (Protection) Act, 1986-

The Forest (Conservation) Act, 1980- The Noise pollution (Regulation and Control) Rules 2000-

The Biological Diversity Act, 2002- The National Green Tribunal Act, 2010-

Solid Waste (Management and Handling) Rules, 2000-

Biomedical Waste (Management and Handling) Rules 1998- Solid Waste Management Act 2016.

UNIT-III

RULES FOR ENVIRONMENTAL PROTECTION IN INDIA

Bio-

Medical Waste (Management & Handling) Rules, 1998; Recycled Plastics Manufacture and Usage Rules, 1999; Noise Pollution (Regulation and Control) Rules, 2000; Municipal Solid Waste (Management and Handling Rules) 2000; The Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2008; Wetland Rules 2009; Coastal Regulation Zones (CRZ) Rules 2011; E-waste Management and Handling Rules 2011; Plastics Manufacture, Sale and Usage Rules, 2011

UNIT-IV

ENVIRONMENTAL POLICY

Definition- Benefits of developing an Environmental Policy- International Agreements-

Montreal Protocol 1987- Kyoto Protocol 1997- Copenhagen-

Paris summit Convention on Climate Change-

Carbon Credit and Carbon Trading. The National Forest Policy, 1998-

Policy Statement for the Abatement of Pollution 1992.

UNIT-V

ENVIRONMENTAL TREATIES

United Nations Conference of Environment and Development 1992-Rio-de-Janerio (Rio Declaration, Agenda 21) Scheme and Labelling of Environment Friendly Products-Indus Water Treaty-Ganges Water Treaty-Vienna Convention for the Protection of Ozone Layer 1985.

Course Outcomes:

1. To know about the constitution of India environmental legislation and Environmental ethics.
2. To impart knowledge on legislation for environmental protection.
3. To know about the National Green Tribunal Act and biomedical waste management rules.
4. To understand about the environmental policies and international agreements.
5. To gain knowledge about environmental treaties.

Text Books

1. TNPCB Pollution Control Legislation-TNPCB, Vol-1&2, Chennai, 1999.
2. Agarwal VK, 2005, Environmental Laws in India, Challenges for Enforcement, Bulletin of The National Institute of Ecology.
3. Jadhav H & Bhosale Y. M, 1995, Environmental Protection & Laws, Himalayan Publications, New Delhi.
4. Diwan S & Rosencranz A, 2002, Environmental Law and Policy in India, Cases, Materials & Statutes, Oxford University Press.

Reference

1. Nanditha Krishna, Environmental Laws of India- A Introduction, C.P.R. Environmental Education Center, Chennai, 1998.
2. Center for Science & Environment, The State of India's environment, The Second Citizen, Report, C.S.E New Delhi, 2018.
3. Abraham, C. M, 1999, Environmental Jurisprudence in India, Kluwer Law International.

E-Materials

1. <https://www.sciencedirect.com>
2. <https://www.epd.gov.hk>.
3. <https://www.gsa.gov>.
4. <https://www.iced.cag.gov.in>.
5. <https://www.unece.org>.

ALLIED PAPER-1

Name of the Course: B.Sc. Environmental Management Semester: I

Name of the Paper: Environmental Botany Credits: 4

Paper Type: Allied Hours of Teaching: 5

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ENVIRONMENTAL BOTANY

Course Objectives

1. To know about the classification of plants
2. To understand the plant cell structure and biology.
3. To examine the anatomy of the plants of different groups.
4. To study the plant genetics and
5. To evaluate the economic values of important plants

UNIT- I

PLANT CLASSIFICATION

Fundamentals of Classification, Basic unit of Classification- Classification of Plants- Taxonomic Hierarchy- Artificial, Natural Classification, and Artificial Systems based on superficial features. Natural system based on form relationships. Phylogenetic systems based on evolutionary and genetic relationships. Merits and Demerits of Classification systems.

UNIT- II

PLANT CELL BIOLOGY

Prokaryotic and Eukaryotic Cell- Cell Organelles- Mitochondria, Chloroplast and Nucleus, Cell Division- Mitosis- its Significance.

UNIT- III

PLANT ANATOMY AND LIFE HISTORY

Anatomy of Dicot Stem, Root- Monocot Stem, Root- Leaf structure and anatomy- Structure and Life History of Lichens, Gracilaria, Agaricus, Lycopodium, Cycas, Pinus- Teak.

UNIT- IV

PLANT GENETICS

Mendel- Reason for Mendel's success- Characters selected by Mendel- Monohybrid Experiment- Homozygous, Phenotype, Genotype- Backcross & Testcross- Di-hybrid Experiments- Mendel's Laws, Law of Dominance, Law of Segregation and Law of Independent Assortment.

UNIT- V

ECONOMIC BOTANY

Economic Botany- Medicinal Plants, Edible oil seeds, Pulses, Vegetables, Fruits, Mushrooms, Single Cell Protein- Spirulina- Seaweeds: Gracilaria.

Course Outcomes

1. After studied Unit I, the students will be able to explain the importance and principles of EIA processes.
2. After studied Unit II, the students will be able to identify and list out the parameters to be evaluated for EIA.
3. After studied Unit III, the students will be able to understand and follow the methods of EIA.
4. After studied Unit IV, the students will be able to summarize the EIA report and appropriate environmental management plan.
5. After studied Unit V, the students will be able to access and analyze EIA case studies report of different developmental projects.

Text Books

1. Singh Pandey Jain (2017) A Text Book of Botany. Publisher: Rastogi.
2. Pandey S.N., Trivedi, P.S. (2015) A text Book of Botany, S. Chand Publisher
3. Mathawat, G.S.P., Sharma, D. and R.K. Sahni, A text book of Botany, Ramesh Book depot, Jaipur, 1996.
4. Verma, V., A text book of Economic Botany, Emkay Publications, New Delhi, 1980.

References Books

1. Mehrotra, R.S., **Plant Pathology**, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 1991.
2. Muneeswaran, A., **Allied Botany**, Titan Nooks, Madurai, India, 2004.
3. Pandey, B.P., **Economic Botany**, S. Chand and Co., New Delhi, 1999.
4. Rao, K.N. Krishnamoorthy, K. and G.S. Rao., **Ancillary Botany**, Rajalakshmi Publication, Nagercoil, 1979.
5. Jeffery, C (1982). An Introduction of Plant Taxonomy, Cambridge, Press.
6. Smith Gilbert, M (1995) Cryptogrammic Botany, VOL 1 & 2, McGraw Hill, New York.
7. Verma, P. Sand V.K. Agarwal, (1989) Principles of Ecology, S. Chand & Company, New Delhi.
8. Hill, A. W (1951) Economic Botany, McGraw Hill Publications.
9. Dash, M. C (1995) Fundamental of Ecology, McGraw Hill, Publications.

ALLIED PAPER-2

Name of the Course: B.Sc. Environmental Management Semester: II

Name of the Paper: Environmental Zoology Credits: 4

Paper Type: Allied Hours of Teaching: 5

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ENVIRONMENTAL ZOOLOGY

Course Objectives

To know about the distribution of animals in the universe, evolutionary history & economic importance of animals. To know about the breeding phenomenon in fishes and ornamental fish culture.

UNIT-I

ZOO GEOGRAPHY

Animal Distribution-Definition-Classification Of Animal Distribution-Patterns Of Distribution-Cosmopolitan Distribution-Discontinuous Distribution-Bipolar Distribution-Isolated Distribution-With Examples-Factors Affecting Distribution-Factors Influencing Distribution.

UNIT-II

EVOLUTION

Origin Of Life-Theories Of Evolution-Lamarck-Theory Of Use & Disuse-Theory Of Inheritance Of Acquired Characters-Neo-Lamarckism-Darwin's Theory Of Natural Selection-Variation-Geometric Ratio Of Increase In Production-Struggle For Existence-Survival Of The Fittest-Sexual Selection-Neo-Darwinism.

UNIT-III

ECONOMIC ZOOLOGY

Productive Insects-Honeybee-Culture-Production Of Honey-Economic Importance Of Honey-Silk-Worm-Culture-Production Of Silk-Economic Importance Of Silk,Lac Insect-Culture-Production Of Lac-Economic Importance Of Lac.

UNIT-IV

INDUCED BREEDING IN FISHES

Hypophysation-Principles Of Hypophysation-Procedure-Collection-Preparation-Injection-Mechanism Of Pituitary Action-Advantages-Seed Collection-Collection From Natural Habitat-Bundh Breeding-Transport Of Fish Seeds-Open System-Closed System.

UNIT-V

ORNAMENTAL FISH CULTURE

Aquarium-Aims of Aquarium-Requirements of Aquariums-Types of Aquariums-Setting of Aquarium-Aquarium Fishes-Gold Fish-Angel Fish-Fighter Fish-Koi-Molly-Sword Tail-Zebra Fish-Guppy-Fish Marketing-Definition-Marketing Channels-Types of Fish Marketing-Risk of Fish Marketing.

Course Outcomes:

1. Gain knowledge on animal distribution.

2. To understand the evolutionary significance of animal kingdom.
3. To impart knowledge regarding utilization of animals.
4. To impart knowledge on breeding pattern of fishes.
5. To gain knowledge on ornamental fish culture.

Text Books

1. Fundamentals of ecology, Veerbala Rastogi (1988), S Chand & Company, New Delhi.
2. Organic Evolution, Arumugam N, (2001), Saras Publication.
3. Economic Zoology, Ravindranath K. R. (2005), Dominant Publishers, New Delhi.
4. A Text Book of Aquaculture, Srinivasulu Reddy, M & Sambasivarao K. R. S, (2004), Discovery Publishing House, New Delhi.
5. Aquaculture. Principles & Practices, Pillay T. V. R. (1990), Blackwell Publication, Oxford.

Reference

1. Applied Zoology, Pradip, Jaybde (2008), Discovery Publishing House, New Delh.
2. Fish & Fisheries of India, Jhingran C. G (1981), Hindustan Publishing Corporation.

E-Materials

1. <https://www.researchgate.net>
2. <https://www.aquaculturealliance.org> s

ALLIED PAPER-3

Name of the Course: B.Sc. Environmental Management Semester: III

Name of the Paper: Environmental Economics Credits: 4

Paper Type: Allied Hours of Teaching: 5

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ENVIRONMENTAL ECONOMICS

Course Objectives

1. Inculcate the knowledge in ecological and economic system
2. Impart principles of ecological economics
3. Understand root cause of environmental issues and means of economic solution

UNIT- I

INTRODUCTION TO ENVIRONMENTAL ECONOMICS

Environmental Economics: environmental policy; Ecological economics; resource economics; positive and normative economics. Important issues in environmental economics.

UNIT- II

ENVIRONMENT AND ECONOMIC DEVELOPMENT

Important issues in the Environment- pollution, depletion of non-renewable, degradation of natural resources- tragedy of commons, climate change, outbreak of new diseases, degraded ecosystem.

UNIT- III

ENVIRONMENTAL REGULATION

Regulatory approach and economic incentives (USA, European Union, the Russian Federation). Choices for Environmental protection and cost-Biocentrism, Anthropocentrism and sustainability.

UNIT -IV

BASIC REGULATORY INSTRUMENTS

Command & control and incentives. Economic instruments of environmental protection: direct instruments- pollution charges, tradable pollution permits, permits v charges, other direct economic instruments; in direct instruments- taxes/charges, price reforms.

UNIT- V

ECONOMIC PLANNING AND SUSTAINABLE DEVELOPMENT

Market, Efficiency and market; Externalities. The Coase theorem; single polluter- Pigovian fees; The multiple polluters- The Equi-marginal Principle. Benefit cost analysis. Eco efficiency and new technologies- valuing environmental resources, option value and willingness to pay economic.

Course Outcomes

1. The linkage between economic activities and environmental quality.
2. Impact of economic activities on Earth's resources.
3. Importance of economic instruments in environmental regulation.
4. Significance of environmental protection.

Text Books

1. Tom Tietenberg and Lewis (2010). Environmental Economics & Policy, Pearson, 6th Edition,
2. Field, B. C. and Field, M. K. (2006). Environmental Economics: an introduction. McGraw-Hill Series
3. Charles D. Kolstad (2004). Environmental economics, New York, Oxford University Press.

Reference Books

1. Ulaganathan Sankar (2001) Development and the Environment. In: Environmental Economics, Oxford India 333-446 pp.
2. Nayudu, G. S. (2008). Economic planning and sustainable Development. In: Environmental Economics, Adhyayan Publishers & Distributors, New Delhi.

E-Material

1. <https://globalisation-and-the-environment.blogspot.com/2007/08/top-10-environmental-economics-blogs.html>
2. <http://www.planetarc.com>

ALLIED PAPER-4

Name of the Course: B.Sc. Environmental Management Semester: IV

Name of the Paper: Environment and Ecotourism Credits: 4

Paper Type: Allied Hours of Teaching: 5

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ENVIRONMENT AND ECOTOURISM

Course Objectives

1. To understand the ill effects of tourism on environment
2. To give insight on ecological tourism
3. To highlight the areas of employment opportunities in ecotourism
4. To evoke ecological tourism

UNIT-I

INTRODUCTION TO TOURISM

Tourism: Meaning, etymology, history, types of tourism in India, Socio, Economic and environmental benefits and drawbacks of tourism industry w.r.t India and need for ecofriendly tourism

UNIT-II

ECOTOURISM

Ecotourism: definition, history, principles (as per World Wide Fund for Nature), elements and goals, importance of ecotourism, positive impact of eco development projects on ecotourism

UNIT-III

RESOURCES FOR ECOTOURISM

Biosphere reserves, national parks, sanctuaries, wetlands, coastal and freshwater, mangroves, coral reefs, deserts, mountains and forests including unique flora and fauna.

UNIT-IV

ECOTOURISM PLACES IN INDIA

Major Ecotourism places in India: Kerala, Sunderban, Goa, Himalayas, Andaman, Coorg, Sikkim, Shimla, Kodaikanal, States promoting ecotourism in India

UNIT - V

PROMOTION OF ECOTOURISM

Eco-Tourism in India: Some Major Issues and challenges India's initiatives National Eco-Tourism Policy and Guidelines of the Ministry of Tourism, Government of India, Nature Conservation Foundation, Centre for Responsible Travel (CREST), Equitable Tourism Options (EQUATIONS), responsible travel awards

Skill Based Elective Course – 01

Name of the Course: B.Sc. Environmental Management Semester: I I I

Name of the Paper: Remote Sensing and GIS Credits: 2

Paper Type: Core Hours of Teaching: 2

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REMOTE SENSING AND GIS

Objectives

- To facilitate to gain the basic knowledge of distantly sensing devices.
- To give insight on mapping technology
- To grasp the basic principles and applications of RS &GIS

UNIT- I

Introduction to Remote Sensing process

Key concepts and components of Remote sensing (RS), electromagnetic radiation, spectrum and divisions, image characteristics, RS system, photographic sensors.

UNIT- II

Digital data and image processing

Digital Data, data formats, image structure, processing overview, components, and software, image interpretation image resolution: variables, operating conditions, measurement of resolution

UNIT-III

Image pre-processing and image classification

Feature extraction, geometric correction, Map projection for representing satellite images and ground truthing, image classification, kinds of field data, measurement of accuracy

UNIT- IV

Geographical Information system (GIS)

Basics of GIS, terminologies, concepts and components for GIS, GIS software, data and data entry, spatial query, thematic map, buffer analysis Mobile GIS, Web based GIS

UNIT- V

Application of RS

RS in Air pollution, natural resources monitoring, Agriculture and plant science, Forest management, watershed management, Land use and land cover, Urban planning and management, and Natural hazards assessment and Health GIS.

Course Outcomes

Ability to interpret the remotely sensed images

Basic knowledge of how can RS &GIS be used for environmental management

TextBooks

1. Kumar,S.(2016)Basics of Remote Sensing and GIS.Laxmi Publications (P)Ltd.
2. Chandra,M. andGhosh,S.K.(2015). Remote Sensing and Geographic Information (2nd ed.)Narosa Publishing House

ReferenceBooks

1. Lillesand ,T.M. and Kiefer, R.W.(2015). Remote Sensing and Image Interpretation (7th ed.).New York, John Wiley &Sons.
2. Lillesand ,T.M. ,Kiefer, R.W. Chipman,J.W.(2004). Remote Sensing and Image Interpretation (5th h ed.).New York, John Wiley &Sons.
3. Longley, P.A. Goodchild, M.F., Manguire,D.J., Rhino, D.W.(eds) Geographical Information System, Volume I: Principal and Technical Issues, John Wiley & Sons

E-Materials

1. https://dayinterpreting.com/?gclid=EAIaIQobChMI1MSCodKo6AIV2BwrCh3OQAOBEAAYAyAAEgLEC_D_BwE
2. <http://rsgislearn.blogspot.com/2007/06/digitization-basics-and-right-methods.html>
3. <https://www.geospatialworld.net/>

Skill Based Elective Course –0 1

Name of the Course: B.Sc. Environmental Management Semester: I I I

Name of the Paper: Remote Sensing and GIS Credits: 2

Paper Type: Core Hours of Teaching: 2

REMOTE SENSING AND GIS

Objectives

- To facilitate to gain the basic knowledge of distantly sensing devices.
- To give insight on mapping technology
- To grasp the basic principles and applications of RS & GIS

UNIT- I

Introduction to Remote Sensing process

Key concepts and components of Remote sensing (RS), electromagnetic radiation, spectrum and divisions, image characteristics, RS system, photographic sensors.

UNIT- II

Digital data and image processing

Digital Data, data formats, image structure, processing overview, components, and software, image interpretation image resolution: variables, operating conditions, measurement of resolution

UNIT-III

Image pre-processing and image classification

Feature extraction, geometric correction, Map projection for representing satellite images and ground truthing, image classification, kinds of field data, measurement of accuracy

UNIT- IV

Geographical Information system (GIS)

Basics of GIS, terminologies, concepts and components for GIS, GIS software, data and data entry, spatial query, thematic map, buffer analysis Mobile GIS, Web based GIS

UNIT- V

Application of RS

RS in Air pollution, natural resources monitoring, Agriculture and plant science, Forest management, watershed management, Land use and land cover, Urban planning and

management, and Natural hazards assessment and Health GIS.

Course Outcomes

Ability to interpret the remotely sensed images

Basic knowledge of how can RS &GIS be used for environmental management

Text Books

1. Kumar, S. (2016) Basics of Remote Sensing and GIS. Laxmi Publications (P) Ltd.
2. Chandra, M. and Ghosh, S. K. (2015). Remote Sensing and Geographic Information (2nd ed.) Narosa Publishing House

Reference Books

1. Lillesand, T. M. and Kiefer, R. W. (2015). Remote Sensing and Image Interpretation (7th ed.). New York, John Wiley & Sons.
2. Lillesand, T. M., Kiefer, R. W. Chipman, J. W. (2004). Remote Sensing and Image Interpretation (5th h ed.). New York, John Wiley & Sons.
3. Longley, P. A. Goodchild, M. F., Manguire, D. J., Rhino, D. W. (eds) Geographical Information System, Volume I: Principal and Technical Issues, John Wiley & Sons

E-Materials

4. https://dayinterpreting.com/?gclid=EAIaIQobChMI1MSCodKo6AIV2BwrCh3OQAOBEAAYAyAAEgLEC_D_BwE
5. <http://rsgislearn.blogspot.com/2007/06/digitization-basics-and-right-methods.html>
6. <https://www.geospatialworld.net/>

Course Outcomes

1. Knowledge of tourism industry and its impact on the environment.
2. Substantial knowledge on ecotourism.
3. Promotion of eco-friendly businesses in-line with ecotourism.

Text Books

1. A.K. Bhatia, A.K. (1995) Tourism Development- Principles and Practices. Sterling Publishers Private Ltd., New Delhi, PP 79-110.
2. D.S. Bharadwaj, D.S. and Kandari, O.P. (1999). Domestic Tourism in India, Indus Publishing Company, Delhi (1999) PP 59-66.
3. Singh (2008). Indian Cultural Heritage Perspective for Tourism. Gyan Publishing House. p. 114.

Reference Books

1. Murugan Annmalai, (2007) "Challenges and Changes in Indian Tourism". South Asian Journal of Socio-Political Studies (SAJOSPS), 37(1): 103-106.
2. Ratandeep Singh (2000) Handbook of Environmental Guidelines for Indian Tourism. Kanishka Publishers and Distributors, New Delhi (2000) PP 22-79.
3. Larkin, T. and K.N. Kähler (2011). "Ecotourism." Encyclopedia of Environmental Issues. Rev. Ed. Pasadena: Salem Press. Vol. 2, pp. 421-424.

E-Material

1. <https://traveltriangle.com/blog/ecotourism-in-india/>
2. www.indiawildlifeportal.com
3. www.ecotourismindia.com

COREPRACTICALPAPER-1

Name of the Course: B.Sc. Environmental Management Semester: I & II Name of the Paper: Core Practical – 1 Credits: 2

Paper Type: Core Practical Hours of Practical: 3

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BASIC SOF EARTH SCIENCE & ENVIRONMENTAL AND ECOLOGY

Experiments

1. Identification of types of Rock- Igneous, Sedimentary and discuss their properties.
2. Determination of Soil Texture- Clay, Sand, Loamy.
3. Identification of Soil pH and Conductivity.
4. Examination of Soil Profile- Horizons.
5. Diagrammatic Representation of Solar and Lunar Eclipses.
6. Identification of Coal Fields- Using Map.
7. Study on Structure Local Freshwater Ecosystem- Pond/ Lake.
8. Study on the Food Chain and Food Web of Land Ecosystem.
9. Study on the Morphology and Anatomy of Hydrophytes- Stem.
10. Study on the Morphology and Anatomy of Mesophytes- Stem.
11. Study on the Morphology and Anatomy of Xerophytes- Leaf.
12. Study on Relationship between Organisms- Mutualism and Parasitism.

CORE PRACTICAL PAPER-2

Name of the Course: B.Sc. Environmental Management Semester: III

Name of the Paper: Core Practical -1 Credits: 2

Paper Type: Core Practical Hours of Practical: 3

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ENVIRONMENTAL CHEMISTRY AND ENVIRONMENTAL MICROBIOLOGY

Experiments

1. Estimation of Chlorophyll on Normal and Pollutant Affected Leaves.
2. Estimation of LC₅₀ and LD₅₀ with a Heavy Metal using a Suitable Organism.
3. Estimation of Aflatoxin Production.
4. Biomagnification of Pesticides.
5. Impact of Toxin on Plants.
6. Biochemical Effects of Lead and Cadmium.
7. Preparation of Culture Media for Microorganisms
8. Gram Staining of Bacteria.
9. Isolation of Microorganisms from the Soil.
10. Enumeration of Microbes from Sewage.
11. Determination of Bacterial Growth Curve.
12. Biodegradation of an Organic Pollutant.

COREPRACTICALPAPER-3

NameoftheCourse:B.ScEnvironmentalManagementSemester:IV

NameofthePaper:CorePractical-3Credits:2

PaperType:CorePracticalHoursofPractical:3

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ENVIRONMENTALPOLLUTION,POLLUTIONMONITORINGANDANALYTICALTECHNIQUES&ENERGYANDENVIRONMENT

Experiments

- 1.EstimationofTotalSolidsandDissolvedSolids.
- 2.EstimationofTurbidity.
- 3.EstimationofChloride.
- 4.EstimationofDissolvedOxygen.
- 5.EstimationofTotalAlkalinity
- 6.EstimationofTotalHardness.
- 7.EstimationofPhosphate.
- 8.PollutionIndicators.
- 9.DemonstrationofpHandconductivitymeter.
- 10.DemonstrationofAAS.
- 11.DemonstrationofNoiseLevelMeter.
- 12.DemonstrationofRenewableEnergySources.

COREPRACTICALPAPER-4

NameoftheCourse:B.ScEnvironmentalManagementSemester:V

NameofthePaper:CorePractical - 4Credits:2

PaperType:CorePracticalHoursofPractical:3

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**WasteManagementandRecycling,BiostatisticsandInstrumentation&EnvironmentalSafety
,HealthandManagement**

Experiments

1. Identification of Different Types of Solid Wastes.
2. Segregation of Municipal Waste.
3. Demonstration of Waste Collection Methods.
4. Demonstration of Waste Disposal - Landfill.
5. Characterization of Landfill Leachate.
6. Demonstration of Waste Recycling Methods.
7. Preparation of Vermicompost Kitchen Waste.
8. Computing Mean, Median and Mode in MS-Excel.
9. Computing Mean Deviation and Standard Deviation using MS-Excel.
10. Creation of Pie Chart and Bar Chart in MS-Excel.
11. Demonstration of Occupational Health Issues.
12. Demonstration of First Aid Procedures.

ALLIED PRACTICAL PAPER- 1

ENVIRONMENTAL BOTANY AND ENVIRONMENTAL ZOOLOGY

Experiments

1. Demonstration of Microscope.
2. Identification of Mendelian Population - Dominant - Recessive by P.T.C Test.
3. Identification of Blood Groups - A, B, AB, O.
4. Preparation of Thick and Thin Smear of Blood.
5. Study of any one Water Borne Disease - Bacterial Disease.
6. Micro Preparation and Anatomy of Dicot Stem.
7. Micro Preparation and Anatomy of Dicot Root.
8. Squash Preparation of Onion Root Tip for Mitosis.
9. Identification of Museum and Live specimen - Gracilaria, Agaricus.
10. Identification and Micro preparation of Lycopodium stem T.S, Strobilus L. and Sporophyte
11. Identification and Micro preparation of Cycas Leaflet T.S, Microsporophyll and Megasporophyll.
12. Identification of Slides and Specimens Cycas - Coralloid Root - T.S.

Non-Major Elective Paper 01

Global Environmental Issues and Management

Name of the Course: B.Sc. Environmental Management **Semester:** III

Name of the Paper: Remote Sensing and GIS Credits: 2

Paper Type: Core **Hours of Teaching:** 2

Course Objectives:

The purpose of this course is to learn about the major global environmental issues including population explosion, biodiversity loss, pollution, energy use, and climate change and how they are managed around the world.

UNIT I – Human Population and Environment

Basic demographic concepts: Growth, fertility, mortality and migration - Overview of population growth - Population distribution and Urbanization - Poverty, food security and environmental degradation - Development vs Environment

UNIT II – Global Atmospheric Changes

Regional and global Air Quality and CO₂ emission - Air pollutants and climate change - Sources of greenhouse gases - Ozone depleting substances - Global warming - El Niño and La Niña

UNIT III - Overexploitation of Natural Resources

Overexploitation of natural resources: Ecological footprint - Earth Overshoot Day - Water resources: Status of groundwater quality in India - Soil Resources: Global threats for soil quality - Loss of organic carbon. Biodiversity Resources: Deforestation, Biodiversity Loss.

UNIT IV - Global Disasters

Geological Disasters: Earthquake, Effects of earthquake; Volcanoes: Types of volcanic eruptions - Active volcanic belts in the world; Hydrological hazards: Flash flood - Flood management strategies - Flood prone zones in India - Flood forecasting and warning - Man-made disasters: Oil spills - Forest fire.

UNIT V - Sustainable Environmental Management

Sustainable utilization of renewable energy resources - Solar, Wind, Hydroelectric and Biomass energy resources. Sustainable agricultural practices: Biofertilizers and Biopesticides - National Action Plan on Climate Change - UNDP Sustainable Development Goals 2030 Agenda

Learning Outcomes

After completing this course, students will be able to:

- Clearly identify important global, national, and local issues relating to population, food, and the environment
- Explain the causes and consequences of the issues identified above.
- Communicate environmental issues in a professional manner.

Text Books

1. Frances Harris (2012) Global Environmental Issues, 2nd edition, John Wiley & Sons Ltd., UK.
2. Stavros G. Pouloupoulos and Vassilis J. Inglezakis (2016) Environment and Development: Basic Principles, Human Activities, and Environmental Implications. Elsevier, Netherlands.

References

1. Donald Hyndman and David (2005) Hyndman Natural Hazards & Disasters, Cengage Learning, USA.
2. John V. Walther (2014) Earth's Natural Resources, Jones & Bartlett Learning, USA.
3. Prasad Modak (2018) Environmental Management towards Sustainability, CRC Press, FL, USA.
4. Prasenjit Mondal and Ajay K. Dalai (2017) Sustainable Utilization of Natural Resources, CRC Press, FL, USA.
5. Rajeev Pratap Singh, Anita Singh, Vaibhav Srivastava (2017) Environmental Issues Surrounding Human Overpopulation, IGI Global, USA.
6. Raveendranathan D (2018) Development lead to Pollution and Depletion of Natural Resources, Notion Press, Chennai.
7. Serge Morand, Claire Lajaunie, Rojchai Satrawaha (2017) Biodiversity Conservation in Southeast Asia: Challenges in a Changing Environment, Earthscan from Routledge, UK.
8. Thangavel P and Sridevi G (2015) Environmental Sustainability: Role of Green Technologies, Springer, India.

Web References

1. <https://www.stateofglobalair.org/sites/default/files/soga-2018-report.pdf>
2. www.who.int/airpollution/
3. <https://unfccc.int/>
4. re.indiaenvironmentportal.org.in/files/part%20II%20groundwater%20CPCB.pdf
5. <https://www.footprintnetwork.org/our-work/earth-overshoot-day>
6. https://www.elsevier.com/_data/assets/pdf.../ElsevierDisasterScienceReport-PDF.pdf
7. siteresources.worldbank.org/INTDISMGMT/Resources/0821363328.pdf
8. https://link.springer.com/chapter/10.1007/978-981-10-1866-4_2
9. www.ipcc.ch/
10. <https://climate.nasa.gov/>
11. <https://sdgs.un.org/goals>

Elective Paper 01

Name of the Course: B.Sc. Environmental Management **Semester:** II
Name of the Paper: Environmental Toxicology **Credits:** 2
Paper Type: Elective **Hours of Teaching:** 2

Course Objectives:

The objective of this course is to focus on understanding the role of pollutants, xenobiotics in the natural environment and to understand the basics of environmental toxicology and risk assessment.

UNIT I - Basics of Toxicology

Introduction to toxicology, scope and types - Classification of toxic agents. Routes of exposure, duration and frequency of exposure, Dose response relationship - 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, Concepts of Bioassay, Types and characteristics - Field based microbial bioassay, Test models and classification - Immunotoxicity, histotoxicity and cell toxicity.

Unit III - Environmental Risk Assessment

Environmental Risk – Definition, Risk Characterization - Hazard Identification, Exposure Assessment Methods, Risk Assessment – National and International guidelines. Environmental Risk – Mitigation measures.

UNIT IV - Xenobiotics

Xenobiotics - Bioaccumulation and Biomagnifications - mechanisms of toxicity. - Drug Development and safety, Drugs and chemicals induced hepatotoxicity, food toxicity, genotoxicity, Molecular neurotoxicity.

UNIT V - 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.

Reference Books

1. Alberts B, Bray D, Hopkin K et al. (2009) Essential Cell Biology, 3rd edition,
2. Alberts B, Johnson 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. Klaassen, Curtis D; Casarett, Louis J; Doull, John, (2013). Casarett and Doull's toxicology: the basic science of poisons (8th Edition) McGraw Hill Publishers.

Elective Paper 02

Name of the Course: B.Sc. Environmental Management **Semester:** III

Name of the Paper: Climate Change and Current Issues **Credits:** 2

Paper Type: Elective **Hours of Teaching:** 2

Course Objectives:

The purpose of this course is to focus on improving understanding of the climate system and climate science and the impacts of climate change, mitigation and/or adaptation to climate change and related issues.

UNIT I Meteorological Elements for Climate Change

Structure of atmosphere: Vertical structure of atmosphere - Atmospheric stability: Adiabatic process - Air Temperature, Humidity, Condensation: Dew and Frost, Fog, and clouds - Clouds: Classification of clouds - Precipitation processes: Collision and Coalescence process and Ice-crystal or Bergeron process - Cloud seeding - Precipitation types (Rain, snow, Sleet and freezing rain, snow grains and snow pellets, hail) - Air Pressure and Winds: Atmospheric pressure - Forces that influence the wind (Pressure gradient force, Coriolis force, centripetal force, friction)

UNIT II Atmospheric Circulation, Air masses and Fronts

Atmospheric circulation: Hadley circulation - Intertropical Convergence Zone (ITCZ) - Jet streams - Global wind patterns: Trade winds, Westerlies and Polar Easterlies - Thermal circulations: Sea and land breezes, Mountain and valley breezes, Katabatic winds, Chinook (Föhn) winds, Santa Ana winds, Desert winds - Air masses: Classification and characteristics of air masses - Types of air masses - Fronts: Type of fronts: Stationary fronts, cold fronts, warm fronts, occluded fronts

UNIT III Air Quality and Consequences of Climate Change

Global Air Quality and CO₂ concentration scenario - Role of air pollutants in climate change - Sources of greenhouse gases: Coal burning, Transportation sectors (vehicle, railways, shipping and aviation) - Ozone depleting substances - Facts and figures of current global warming scenarios in the world - Extreme events of climate change: - El Niño, La Niña and El Niño Southern Oscillation (ENSO) - Recent extreme events in the world - Global consequences of El Niño - Impacts of climate change: Changes in the SW and NE monsoon patterns in India.

UNIT IV Climate Classification, Measurement of Climate

Classification of climate: Köppen's and Thornthwaite's scheme - The measurement of climate change: Tree rings, ice cores, ocean sediments, pollen records, Boreholes and other proxy measurements - Weather forecasting tools: AWIPS computer work station, Doppler radar data, metogram, satellites and weather forecasting - Types of forecasts: Nowcast, short-range forecasts, medium and long-range forecasts.

UNIT V Global/National Action Plans to Combat Climate

Key steps taken by UNFCCC to combat climate change: Kyoto Protocol - Copenhagen Accord 2009 - Cancun Agreements 2010 to establish Green Climate Funds - Paris Climate Agreement 2015, Intended Nationally Determined Contribution (INDC) to cut greenhouse gas emissions at COP 21 - Montreal Protocol for ODS, Kigali Amendment 2016 to phase out hydrofluorocarbons (HFC) - Green climate funds - Clean Development Mechanism (CDM).

Text Books

1. Donald Ahrens C and Robert Henson (2016) Meteorology Today: An Introduction to Weather, Climate, and the Environment. Eleventh Edition, Brooks/Cole, Cengage Learning, USA.
2. Galvin JFP (2016) An Introduction to the Meteorology and Climate of the Tropics. John Wiley & Sons Ltd., UK.

Reference Books

1. Alberto Troccoli, Laurent Dubus and Sue Ellen Haupt (2014) Weather Matters for Energy. Springer, New York.
2. Cowie J (2007) Climate Change: Biological and Human Aspects, Cambridge University Press, UK. 32
3. Dogra N and Srivastava S (2012) Climate Change and Disease Dynamics in India, TERI, New Delhi.
4. Filho WL (2012) Climate Change and the Sustainable Use of Water Resources, Springer-Verlag, Berlin, Heidelberg.
5. Friel S (2019) Climate Change and the People's Health (Vol. 2). Small Books Big Ideas in Popul.
6. Lawrence A. Palinkas (2020) Global Climate Change, Population Displacement, and Public Health. The Next Wave of Migration. Springer Nature Switzerland.
7. Newman J, Anand M, Henry H, Hunt S and Gedalof Z (2011) Climate Change Biology, CAB International, Cambridge, MA, USA.
8. Marselle MR, Stadler J, Korn H, Irvine KN & Bonn A (2019) Biodiversity and health in the face of climate change (p. 481). Springer Nature.

Web References

1. <http://www.un-redd.org/>
2. <http://unfccc.int/>
3. <https://www.ipcc.ch>
4. <https://www.co2.earth/>
5. <http://www.climatecentral.org/>
6. <http://climate.nasa.gov/>
7. <http://www.who.int/mediacentre/news/>
8. <http://aqicn.org/map/>

Elective Paper 03

Name of the Course: B.Sc. Environmental Management

Semester: III

Name of the Paper: Environmental Nanoscience

Credits: 2

Paper Type: Elective Hours of Teaching: 2

Course Objectives

The purpose of this course is to provide background, principles, development of nanomaterials and their applications pertaining to remediation of environmental contaminants, water purification, and to understand the impact of nanomaterials on environment and human health.

UNIT I - Introduction to Nanotechnology

Introduction to Nanoscience and Nanotechnology - Nanoscale Properties - Electrical, Optical, Chemical - Bionanotechnology, environmental nanotechnology, Nanotechnology Health risk, Nanotechnology- Ethics, Environmental Regulations of Nanomaterials.

UNIT II - Types of Nanomaterials

Types of Nanomaterials – Natural Nanomaterials: Nano Biomaterials, Natural adsorbents, polymer adsorbents, viral adsorbents, Biopolymers, Nanobacterium; Engineered Nanomaterials - Carbon based nanomaterials - Fullerenes, Carbon Nanotubes; Graphenes, Metal based Nanomaterials - Metal and Metal oxide Nanoparticles; Dendrimers - Nanocomposites - Nonporous materials.

UNIT III - Synthesis and characterization of Nanomaterials

General methods for synthesis of nanomaterials - Bottom-up approach - Top-down approach - Physical methods - ball milling, melt mixing, physical vapour deposition, sputter deposition, evaporation; Chemical methods - chemical reduction, sol-gel method, photochemical synthesis, electrochemical synthesis, emulsion synthesis, sonochemical methods, microwave assisted synthesis; Biological methods - Green synthesis of nanoparticles using microorganisms, fungi and plants metabolites.

UNIT IV - Environmental Applications of Nanomaterials

Nanomaterials for environmental remediation – Nanoscale zero-valent iron (NZVI), Titanium dioxide nanoparticles - Bimetallic nanoparticles - Silver nanoparticles - Metal oxide nanoparticles - Nano adsorbents - Nanocatalysts - Nanoflocculant. Degradation and transformation of environmental pollutants - Nano remediation - Ground Water Remediation.

UNIT V - Nanotoxicity and Environmental Impacts of Nanomaterials

Engineered Nanomaterials - environmental contamination, exposure, behavior, risks and impacts in water and soil environment - Harmful effects of engineered nanomaterials on Human, Animal Health microbial community structure and functions and bioaccumulation.

Learning Outcomes:

- Understand the background about nanotechnology and its importance
- Understand different types of nanomaterials and their synthesis
- Understand the application of nanomaterials for degradation of environmental pollutants

- Understand the impact of nanomaterials on environment.

Text Books

1. Pradeep T (2012) A Textbook of Nanoscience and Nanotechnology, Tata McGraw-Hill Education (India).
2. Murty B S, Shankar P, Raj B, Rath B B, and Murday, J (2013) Textbook of Nanoscience and Nanotechnology.

Reference Books

1. Pradeep T (2008) Nano: The Essentials - Understanding Nanoscience and Nanotechnology, Tata Mc. Graw Hill Professional.
2. Rao C N R, Muller A, Cheetham A K (2004) The Chemistry of nanomaterials: Synthesis, Properties and Applications.
3. Z.hang T C, Hu Z, Surampalli R, Tyagi R D, Lai K C K, and Lao I Mc (2009) Nanotechnologies for Water Environment Applications. American Society of Civil Engineers (ASCE) Publications.

Web References

1. <http://kb.icaai.org/pdfs/PDFFile5b28e322df0fd2.63902464.pdf>
2. <https://www.sciencedirect.com/topics/engineering/ecodesign>
3. <https://www.gdrc.org/sustdev/concepts/02-c-prod.html>
4. <http://www.cprac.org/en/sustainable/production/cleaner>
5. <https://isoconsultantkuwait.com/2019/06/21/iso-140012015-environment-management-system/>