

Syllabus of Environmental Science

Semester I

Major

Course Type: **MAJ-1**

Semester: **1**

Course Code: **BENVMAJ01T**

Course Title: **FUNDAMENTALS OF ENVIRONMENT & ECOLOGY**

(L-P-Tu): **5-0-1**

Credit: **6**

Practical/Theory: **Theory**

Course Objective: }To develop concept on environment, man environment relation and environmental awareness }To inform about the importance of environmental education }To cultivate knowledge on Ecology, Ecosystem and Biome

Learning Outcome: Students will learn about the holistic concept of Environment, Environmental Education and Concept of Ecology, Ecosystem and Biome

Environment: (LECTURE – 30)

Definition and importance of environment; Types and components of environment; Lithosphere, Atmosphere, Hydrosphere, Biosphere; Scope and multidisciplinary nature of the subject; Man-environment relationships; Environmental awareness; Concept of environmental contaminants & pollutants

Environmental Education: (LECTURE – 15)

Environmental education at primary, secondary, and tertiary level; Goals of environmental education; Applications of and Career in Environmental Science

Concept of Ecology, Ecosystem and Biome: (LECTURE – 45)

Concepts of Ecology: Definition and divisions of ecology; Ecological classification: Aquatic, desert and marine (plants & animals) and their morphological, physiological and biochemical adaptation; Ecological factors - climatic, edaphic, physiographic and biotic; Limiting factor and Shelford's Law, Liebig law; Concept of Biological clock, circadian rhythm

Suggested Books

1. Environmental Science: S.C. Santra; New Central Book Agency
2. Ecology and Environment: P.D. Sharma; Rastogi Publication.
3. Fundamental of Ecology: E.P. Odum, W.B. Saunders Company, USA
4. Textbook of Environmental Studies: Erach Bharucha; University Grants Commission; University Press 2013
5. Fundamentals of Environmental Studies: Mahua Basu & S. Xavier; Cambridge University Press, 2016
6. Fundamentals of Environmental Studies-Mahua Basu (Cambridge University Press)
7. A Text book of Environment Agrawal, Sikdar and Deb (2002); MacMillan
8. Environmental Science: Earth as a Living Planet, Botkin & Keller (1998); John Wiley & Sons
9. Elements of Ecology: Thomas M Smith & Robert Leo Smith; LPE, Pearson Education
10. Principles of Environmental Science: Inquiry and Applications: William P Cunningham & Mary Ann Cunningham; The McGraw-Hill Companies, 4th Edn.

**Syllabus of Environmental Science
Semester II
Major**

Course Type: **MAJ-2**
Semester: **2**
Course Code: **BENVMAJ02T**
Course Title: **ECOSYSTEM & BIOMES**
(L-P-Tu): **5-0-1**
Credit: **6**
Practical/Theory: **Theory**

Course Objective: }To develop Basic concept on ecosystem; its types }To impart basic knowledge on population ecology, community ecology and biomes

Learning Outcome: Students will know about the concept of Ecosystem, Major Ecosystem types, Population Ecology, Community Ecology and Biomes

Concepts of Ecosystem: (LECTURE – 20)

Ecosystems: Concept & classification (terrestrial and aquatic); Structure and function of ecosystems: trophic levels, food chain, food web and ecological pyramids; Energy flow in ecosystem: Energy flow models (single and double channel model); Productivity (concept & types: primary and secondary); Biogeochemical cycles (carbon, nitrogen and phosphorous cycle)

Major Ecosystem Types: (LECTURE – 15)

Grassland ecosystem, forest ecosystem, agro-ecosystem, lentic and lotic ecosystem, wetland ecosystem, estuarine ecosystem, and marine ecosystem.

Population Ecology: (LECTURE – 20)

Concept and characteristics of population (natality, mortality, age structure, population pyramids, population density, population dispersion, population growth, life table and survivorship curves); Population interactions (competition, predation, parasitism, symbiosis, commensalism, mutualism, and ammensalism)

Community Ecology: (LECTURE – 15)

Concept of community & classification; Community structure (horizontal and vertical stratification); Community Characteristics (qualitative and quantitative); Ecological Succession (concept, processes, stages and types of successions); Concept of Climax

Biomes: (LECTURE – 20)

Concept & characteristics of biome; Types and distribution of major biomes (e.g., desert, grass lands, tropical evergreen rain forests and tundra); Endemism and endemic species of India

Suggested Books

1.
 1. Environmental Science: S.C. Santra, New Central Book Agency
 2. Ecology and Environment: P.D. Sharma., Rastogi Publication.
 3. Fundamental of Ecology: E.P.Odum, W.B.Sauders Company, USA
 4. Elements of Ecology: Thomas M Smith & Robert Leo Smith; LPE, Pearson Education

5. Ecology and Environmental Biology- -T K Saha, Books and Allied Publisher
6. Botkin & Keller (1998): Environmental Science: Earth as a Living Planet; John Wiley & Sons
7. Elements of Ecology: Thomas M Smith & Robert Leo Smith; LPE, Pearson Education
8. Concept of Ecology, E. J. Kormondy, Prentice Hall of India Pvt. Ltd.
9. Environmental Biology, Biswarup Mukherjee, Tata McGraw Hill Co. Ltd., New Delhi.
10. Ecology a bridge between science & society, by E. P. Odum, Sinauer associates

Syllabus of Environmental Science
Semester III
Major

Course Type: **MAJ-3**

Semester: **3**

Course Code: **BENVMAJ03T**

Course Title: **NATURAL RESOURCES**

(L-P-Tu): **5-0-1**

Credit: **6**

Practical/Theory: **Theory**

Course Objective: }To develop Basic concept on natural resources }To create understanding of the importance of energy resources, water resources, soil resources, forest resources and mineral resources

Learning Outcome: Students can gain concept of Natural resources, Energy resources, Water resource, Soil resource, Forest resource, Mineral resources

Natural Resources: (LECTURE – 15)

Concept and classification of natural resources; Depletion and degradation of natural resources

Energy Resources: (LECTURE – 20)

Definition and introduction; Classification of energy resources: Conventional (Fossil fuels: Coal, Natural gas) and Non-conventional (Nuclear energy, Solar energy, Hydro-electric power, Wind energy, Tidal energy, Geothermal energy, Biomass, Biogas and Bio-diesel); Renewable and Non-renewable; Alternate emerging energy resources. Green energy, carbon footprint and ecological footprint

Water Resource: (LECTURE – 20)

Surface and Ground water resources (importance and uses); Recharge of groundwater table; Hydrological cycles, geological formation as aquifers, type and characteristics of aquifers; Groundwater plume; Darcy's law; Depletion of groundwater; Artificial recharging of ground water

Soil Resource: (LECTURE – 20)

Concept, weathering and soil formation; Basic concept of physical, chemical and mineralogical composition of soil; Soil humus; Soil profile; Types of soil in India; Soil erosion (causes and types); Soil conservation

Forest Resource: (LECTURE – 10)

Concept and major forest types and their distribution (World and India); Causes and consequences of deforestation; Timber and non-timber forest products; Agro- forestry; shifting cultivation; Management and conservation of forests: Sustainable forest management, Forest Protection Committee, afforestation

Mineral Resources: (LECTURE – 5)

Classification & Indian occurrences; Basic concept of mineralization

Suggested Books

1. Environmental Science: S.C. Santra, New Central Book Agency
2. Ecology and Environment: P.D. Sharma., Rastogi Publication
3. Agrawal, Sikdar and Deb (2002): A Text book of Environment; MacMillan
4. Textbook of Environmental Studies: Erach Bharucha; University Grants Commission; University Press 2013
5. Fundamentals of Environmental Studies: Mahua Basu & S. Xavier; Cambridge University Press, 2016
6. Water Technology: An Introduction for Environmental Scientist and Engineers: N F Gray,, Viva Books Pvt. Ltd., New Delhi, 2000
7. Principles of soil science, M M Rai; Macmillan Publishers India Ltd
8. The Nature and properties of soil, Brady, Weil; Pearson Education India
9. Energy Resources-Occurrence, production, conversion, use-W.H Wiser, Springer
10. Renewable energy sources and Emerging technologies-Kothari, Singal, Ranjan, PHI Learning Publisher
11. Mineral Resources and Policy in India, K N Jetli; Ingram Short Title Publisher
12. Forest Resources of India-Problems, Policies and Initiatives-A Y Pangannavar; New Century Publications
13. Introductory soil science by Dilip Kumar Das, Kalyani

**Syllabus of Environmental Science
Semester IV
Major**

Course Type: **MAJ-4**

Semester: **4**

Course Code: **BENVMAJ04T**

Course Title: **ENVIRONMENTAL POLLUTION**

(L-P-Tu): **5-0-1**

Credit: **6**

Practical/Theory: **Theory**

Course Objective: }To develop basic concept on pollution, pollutants and its types }To develop sound knowledge on sources, causes and effects of air, water, soil, noise and radiation pollution

Learning Outcome: Students will become familiar with the concept, cause, effect of Pollution, Air Pollution, Water Pollution, Soil Pollution, Noise Pollution, Radioactive Pollution

Pollution: (LECTURE – 10)

Environmental pollution: Concept and definition; Pollutants: Classification: primary and secondary, biodegradable and non-biodegradable; point and non-point sources of pollution

Air Pollution: (LECTURE – 15)

Sources and effects of primary and secondary pollutants; Particulate pollutants, aerosols; Consequences of air pollution; Indoor air pollution; Hazardous air pollutants

Water Pollution: (LECTURE – 20)

Concept and definition; Types and sources of water pollutants; Domestic, agricultural & industrial effluents; Surface water and groundwater pollution; Lake acidification; Marine pollution; Oil spills; Salt water intrusion; Eutrophication

Soil Pollution: (LECTURE – 15)

Sources of soil pollution (domestic, industrial, agricultural practices and mining); Chemical and biological agents and their effects on soil; Salinization of soil; Methods of mitigating and controlling soil pollution

Noise Pollution: (LECTURE – 15)

Sources of noise pollution; Measurement of noise pollution; Effects of noise pollution of human health; Shock waves; Silence zone; Abatement of noise pollution

Radioactive Pollution: (LECTURE – 15)

Radioactivity; Radioactive decay; Units of measurement of radiation; Half-life period; Kinds and sources of radiation; Effects of ionizing and non-ionizing radiation; Prevention and remedial measures

Suggested Books

1. Environmental Science: S.C. Santra, New Central Book Agency
2. Clean technology, Johansson, A., Lewis Publishers.
3. Zero Pollution Industry, Nemerow, N.L. Wiley Inter Sciences
4. Industrial Pollution Prevention Handbook, Freeman, H.M., McGraw Hill
5. Pollution Prevention: Fundamentals and Practice Int. Ed.-2000, Paul L. Bishop, McGraw Hill
6. A text book of Environmental Chemistry and Pollution Control: S.S. Dara., S. Chand & Company Ltd.
7. Chemistry of the Environment, 2nd Edn., Thomas G Spiro & William M Stigliani; Prentice-Hall of India, New Delhi, 2003
8. Environment and Pollution Laws: S K Mohanty, Universal Law Publishing Co. Pvt. Ltd., Delhi, 2005
9. Air Pollution, Dr Aradhana Salpekar; Jnanada Prakashan
10. Environmental Chemistry: A.K. De, New age (P) Ltd
11. Environmental Chemistry with Green Chemistry, Asim K Das, Books and Allied (P) Ltd

**Syllabus of Environmental Science
Semester IV
Major**

Course Type: **MAJ-5**

Semester: **4**

Course Code: **BENVMAJ05S**

Course Title: **LIMNO-BIOLOGICAL ANALYSIS**

(L-P-Tu): **0-6-0**

Credit: **6**

Practical/Theory: **Practical**

Course Objective: Course Objectives: }To develop analytical skill }To develop sound knowledge on identification of aquatic flora and fauna

Learning Outcome: Students learn to analyze water parameters and learn Identification of Microfauna and Microflora

PRACTICAL COURSES

Major Experiments:

1. **Estimation of water parameters**—pH, DO, BOD, Free and Combined CO₂, Hardness, Alkalinity, Acidity, Chloride, Residual Chlorine, Oil & Grease, TSS, TDS,

2. **Identification with reasons** (at least one from each A & B must be set during examination):

a) **Study on Aquatic organisms** (Microfauna and Microflora)

i) Study of Microfauna: *Brachionus*, *Keratella*, *Cyclops*, *Cypris*, *Diaptomus*, Nauplius larva, *Bosmina*, *Moina*, *Eubranchipus*

ii) **Study on Aquatic organisms** (Macrofauna): Fish, Molluscs

iii) **Study** **of**

Microflora: *Spirogyra*, *Zygnema*, *Pistia*, *Eichhornia*, *Ceratophyllum*, *Ipomea*, *Azolla*, *Lemna* (major), *Lemna* (minor), *Limnophilia*, *Marselia*, *Nymphaeae*, *Nelumbo*

Suggested Books

1. Handbook of Methods in Environmental Studies: Water and Waste Water Analysis Hardcover, S K Maiti; Oxford Book Company
2. Methods for the Examination of Water and Wastewater 20th eds.; Lenore, S. Clesceri, Arnold E. Greenberg, Andrew D. Eaton; American Public Health Association
3. Textbook of quantitative chemical analysis. G.H. Jeffery, J. Bassett, J. Mentham, R.C. Denny. Longman Scientific Technical. John Wiley and Sons.
4. Water Technology: An Introduction for Environmental Scientist and Engineers: N F Gray,, Viva Books Pvt. Ltd., New Delhi, 2000
5. Aquatic Ecology and Biodiversity, O, Martin; Callisto Reference
6. Environmental Chemistry: A.K. De, New age (P) Ltd
7. Chemistry for Environmental Engineering: Clair N Sawyer, Perry L. Mccarthy & Gene F. Parkin., Mc Graw - Hill Inc

**Syllabus of Environmental Science
Semester V
Major**

Course Type: **MAJ-6**
Semester: **5**
Course Code: **BENVMAJ06C**
Course Title: **ENVIRONMENTAL BIOLOGY**
(L-P-Tu): **4-2-0**
Credit: **6**
Practical/Theory: **Combined**

Course Objective: }To make the students familiar with Cell and Genetics }To develop sound knowledge on Biochemistry }To impart knowledge on importance of biological wealth and biodiversity

Learning Outcome: Students know about Cell and Genetics, Fundamentals of Genetics Biological Wealth, Biodiversity

Cell and Genetics: (LECTURE – 22)

Cell: Characteristics and types of Prokaryotic, and Eukaryotic cells; Concept of a gene, chemical nature of gene; Ultra structure and functions of plasma membrane, structure and function of Mitochondria, Ribosome, Golgi body, Chloroplast, Endoplasmic reticulum, Nucleus, Chromosome; Cellular reproduction: Stages of Mitosis and Meiosis

Fundamentals of Genetics: (LECTURE – 25)

Mendel's Law of inheritance and gene interaction; Darwinism and Modern Synthetic Theory of evolution; Gene pool, Genetic drift

Fundamentals of Biochemistry: Elementary ideas on carbohydrates, proteins, lipids and enzymes; Idea on structure of macro-molecules - DNA and RNA; Basics of gene cloning; Recombinant DNA technology

Biological Wealth: (LECTURE – 10)

Value of wild species; sources of agriculture, forestry, aquaculture

Biodiversity: Concept, types and importance of biodiversity; Direct & indirect values of biodiversity; levels of biodiversity; mega-diversity countries; Hotspots of biodiversity **(LECTURE – 13)**

**PRACTICAL
ENVIRONMENTAL BIOLOGY
(LECTURE – 20)**

PRACTICAL COURSES

1. Major experiment

a) Cytological preparation of Mitotic stages from onion root tips (*Allium cepa*) or Cytological preparation of Meiotic stages from grasshopper testis

b) Determination of primary productivity of a pond ecosystem

2. Visit to and study of a terrestrial or an aquatic ecosystem

Suggested Books

1. Genetics, R.P. Meyyan; Saras Publication
2. Cell and Molecular Biology: Concept and Experiments, 3rd Edn, Gerald Karp, John Willey & Sons, INC, New York, 2002
3. Cell and Molecular Biology, EDP De Robertis, EMF De Roberts, Jr, 8th Edn, Lea & Febiger, International Edition, 1988
4. The Cell: A Molecular Approach: Geoffrey M Cooper, ASM Press, Washington DC & Sinauer Associates, Inc, Sunderland, Massachusetts
5. Molecular Biology of Cell, 5th Edn., Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts and Peter Walter, GS, Taylor & Francis Group, 2008
6. Modern Trends in Environmental Biology: CBS: Tripathi G.
7. Molecular Cell Biology; Berk, Darnell, Kaiser, Krieger, Lodish, Matsudaira, Scott, Zipursky; W.H. Freeman and Company Publisher
8. An Advanced Textbook on Biodiversity: Principles and Practice, K V Krishnamurthy; Oxford and IBH Publishing Co Pvt. Ltd
9. Snustad, D.P. & Simmons, M.J. 2011. *Principles of Genetics* (6th edition). John Wiley & Sons.
10. Biochemistry. Debajyoti Das. Academic Publisher, Kol-73
11. Biochemistry: U. Satyanarayana; Books and Allied (P) Ltd.

Syllabus of Environmental Science Semester V Major

Course Type: **MAJ-7**

Semester: **5**

Course Code: **BENVMAJ07S**

Course Title: **ANALYSIS OF SOIL AND WATER**

(L-P-Tu): **0-6-0**

Credit: **6**

Practical/Theory: **Practical**

Course Objective: To develop skill for soil and water parameter analysis }To impart practical knowledge on Gram staining of bacteria, staining of zooplankton and MPN count

Learning Outcome: Students will become skilled to estimate soil and water parameters; they learn to do Gram staining of bacteria, Staining of zooplankton, MPN count, they will study local flora and fauna (Biodiversity Register)

PRACTICAL COURSES

1. Major Experiments:

a) **Estimation of Soil parameters:** pH, Temperature, Soil moisture, Organic carbon, Density, Porosity, NPK

b) **Estimation of Water parameters:** Iron, Phosphate, Sodium, Potassium

2. Minor experiment

- a) Gram staining of bacteria
 - b) Staining of zooplankton
 - c) MPN count
3. Study on local flora and fauna (Biodiversity Register)

Suggested Books

1. Handbook of Methods in Environmental Studies: Water and Waste Water Analysis Hardcover, S K Maiti; Oxford Book Company
2. Microbes & Microbial Technology (HB): Springer; Ahmad
3. Laboratory Manual in Biochemistry: Newage; Jayaraman
4. Methods for the Examination of Water and Wastewater 20th eds.; Lenore, S. Clesceri, Arnold E. Greenberg, Andrew D. Eaton; American Public Health Association
5. Chemistry for Environmental Engineering: Clair N Sawyer, Perry L. Mccarthy & Gene F. Parkin., Mc Graw - Hill Inc
6. Soil Chemical Analysis-Advanced course, M L Jackson; Scientific publisher
7. Soil Testing Manual, G S Wagh; Nirali Prakashan

Syllabus of Environmental Science Semester VI Major

Course Type: **MAJ-8**

Semester: **6**

Course Code: **BENVMAJ08T**

Course Title: **ENVIRONMENTAL PHYSICS & ENVIRONMENTAL CHEMISTRY**

(L-P-Tu): **5-0-1**

Credit: **6**

Practical/Theory: **Theory**

Course Objective: }To build up fundamental knowledge on environmental physics and chemistry }To make the students familiar with the different aspects of atmospheric chemistry

Learning Outcome: Students grow sound knowledge on Environmental Physics, Environmental Chemistry Atmospheric Chemistry

Environmental Physics: (LECTURE – 30)

Basic concept of light and matter; Relation between energy, wavelength and frequency; Black body radiation; Beer-Lambert law; First and second law of thermodynamics, entropy, enthalpy, heat transfer processes, Gibb's free energy; Photovoltaic cells; Osmosis, osmotic pressure, plant cell as osmotic

system and relationship with turgor pressure, wall pressure and osmotic pressure; Water potential concept, types; Water potential changes in plasmolysis and deplasmolysis, imbibition

Environmental Chemistry: (LECTURE – 35)

Concept of general chemistry: Molecular weight, equivalent weight,; Strength of solution; Redox reactions; Metals and non-metals; Aromatic and aliphatic organic compounds; Saturated and unsaturated hydrocarbons; Classification and distribution of elements in the earth; Ions, particles and radicals in the atmosphere; Principles of chemical reactions, acids, bases and salts, solubility of salts, concept of pH, buffer solutions; Box model; Gaussian plume model, mixing heights

Atmospheric Chemistry: (LECTURE – 25)

Structure & composition of atmosphere; photochemical reactions in atmosphere; smog formation, types of smog (sulphur smog and photochemical smog); chemistry of acid rain; Free radicals and ozone layer depletion: Role of CFCs in ozone depletion; Movement of pollutants (diffusion and dispersion); Wind rose, atmospheric stability, plume behavior

Suggested Books

1. Environmental Chemistry: A.K. De, New age (P) Ltd.
2. Chemistry for Environmental Engineering: Clair N Sawyer, Perry L. McCarthy & Gene F. Parkin., Mc Graw - Hill Inc
3. A text book of Environmental Chemistry and Pollution Control: S.S. Dara., S. Chand & Company Ltd.
4. Chemistry of the Environment, 2nd Edn., Thomas G Spiro & William M Stigliani; Prentice-Hall of India, New Delhi, 2003
5. Atmospheric Chemistry (HB): Royal Society of Chemistry; Holloway
6. Biophysics; G. R. Chatwal, Himalaya Publishing House
7. Environmental Chemistry with Green Chemistry, Asim K Das, Books and Allied (P) Ltd., 2010
8. Physical Chemistry, P C Rakshit; Sarat Book Hous
9. Introduction to Environmental Engineering and Science, Gilbert M Masters; Pearson Edition
10. Environmental Chemistry, S.E Manahan; CRC Press, Taylor and Francis Group
11. Introduction to Biophysics, P K Banerjee; S Chand

**Syllabus of Environmental Science
Semester VI
Major**

Course Type: MAJ-9

Semester: 6

Course Code: BENVMAJ09T

Course Title: ENVIRONMENTAL GEOGRAPHY

(L-P-Tu): 5-0-1

Credit: 6

Practical/Theory: Theory

Course Objective: }To build up fundamental concept of earth processes }To make the students familiar with the weather, climate, climatic parameters and Indian monsoon } To create understanding on different aspects of Physical Geography; Elementary idea about remote s

Learning Outcome: This paper imparts knowledge of Earth Processes, Climatology, Physical Geography, Remote sensing & GIS among students

Earth Processes: (LECTURE – 15)

Origin and evolution of earth; Big Bang theory, Geological time scale; Major rock types; Continental drift theory, Plate tectonic theory

Climatology: (LECTURE – 25)

Elements of climates; Spatial and temporal patterns of climate; Climate parameters in India and climatic classification (Koppen's classification); Indian Monsoon

Physical Geography: (LECTURE – 20)

Concept of Landform and their types; Indian landforms; Climate, Soil, Flora, Fauna, Ecological specialty, Present status of Landforms, viz., Mountain, Plains, and Plateau

Remote Sensing & GIS: (LECTURE – 30)

Elementary Idea of Remote Sensing (definition, source of energy, energy interactions with the atmosphere and Earth's surface materials); Principle of Remote sensing, types of remote sensing; Remote sensing platforms; Principle and function of sensors; Types of satellites; Latest Indian operating satellites and their utilities; Advantages and limitations of remote sensing; GIS: Principle and application

Suggested Books

1. Geomorphology & Environment, Editors Savindra Singh, H S Sharma and Sunil K De, ACB Publications, 2004.
2. Textbook on Physical Geology, G.B. Mahapatra, CBS Publishers & Distributors
3. Fundamental of Physical Geography, Majid Husain, Rawat publications
4. General Climatology, Howard J. Critchfield, Pearson publisher
5. Atmosphere, Weather and Climate, Roger G. Barry and Richard J. Chorley, Routledge
6. Environmental Geology, Carla W. Montgomery, Mc Graw Hill
7. Environmental Geology, Andrew DeWet, Kirsten Menking, Dorothy Merritts , Macmillan Learning
8. Remote Sensing and GIS, Basudeb Bhatta, Oxford publisher

9. Basic of Remote Sensing and GIS, S. Kumar
10. Remote Sensing and Image Interpretation, Lillesand, Kiefer and Chapman, Wiley Publisher
11. Fundamental of Remote Sensing, George Joseph, University Press
12. Barry, R. G. 2003. Atmosphere, Weather and Climate. Routledge Press, UK.
13. Lal D.S. 2006, Climatology, Sharda Pustak Bhawan, Allahabad
14. Singh S. 2009, Climatology, Prayag Pustak Bhawan, Allahabad

**Syllabus of Environmental Science
Semester VI
Major**

Course Type: **MAJ-10**

Semester: **6**

Course Code: **BENVMAJ10S**

Course Title: **ENVIRONMENTAL MONITORING TECHNIQUES**

(L-P-Tu): **0-6-0**

Credit: **6**

Practical/Theory: **Practical**

Course Objective: }To develop analytical skill on plant biochemistry }To make the students familiar with the Stereoscopic study and visual interpretations of satellite imagery and airborne image

Learning Outcome: Students develop practical skill among them on Estimation of plant biochemical parameters, Interpretation of Satellite Imagery; they learn about Meteorological study, Principle and Monitoring technique of air quality, Noise measurement, Rain Water Harvest

PRACTICAL COURSES

a) Major Experiments:

Estimation of Protein, Total chlorophyll, Phenol, Proline, Ascorbic acid, and Sugar from plant material

b) Minor experiment

Interpretation of Satellite Imagery: Stereoscopic study and visual interpretations of satellite imagery and airborne image

c) Submission of Report on

i) Meteorological study: Air temperature, Relative Humidity, and Average Rainfall

ii) Principle and Monitoring technique of air quality (SO_x, NO_x, SPM)

iii) Noise measurement

iv) Model of Rain Water Harvesting

Reference Books

1. Laboratory Manual in Biochemistry, Jayaraman; Newage

2. Biochemical Methods, Sadasivam, Manickam; New Age International (P) Ltd.

**Syllabus of Environmental Science
Semester VII
Major**

Course Type: MAJ-11

Semester: 7

Course Code: BENVMAJ11T

Course Title: ENVIRONMENTAL MANAGEMENT TOOLS & LAWS

(L-P-Tu): 5-0-1

Credit: 6

Practical/Theory: Theory

Course Objective: }To develop sound knowledge on EIA, Environmental accounting and Auditing }To provide information on different Environmental Laws, Policy, and Conventions

Learning Outcome: Students gain knowledge on EIA, Environmental Accounting and Environmental Audit, Environmental Laws, Policy, and Conventions

Environmental Management Tools - EIA (LECTURE – 30)

Environmental Impact Assessment; Goals and evolution of impact assessment, technology assessment; Environmental inventory; Techniques and methods of EIA

Environmental Management Tools - Environmental Accounting and Environmental Audit (LECTURE – 25)

Environmental accounting--objectives, financial accounting, social accounting; Concept, importance and procedures of environmental audit; Overview on environmental audit programmes in India; Life cycle assessment (LCA): Concept and Procedure

Environmental Laws, Policy, and Conventions (LECTURE – 35)

Basic concept on law, rules, act, treaty; Public Policy and PILs; Environmental provisions in the Indian Constitution- Article 48A, 51A (g); Role of Hon'ble Supreme Court and Hon'ble High Court in Environmental Protection; Green Bench

Objectives & Principles of The Environment Protection Act, 1986; The Air (Prevention and Control of Pollution) Act, 1981; The Water (Prevention and Control of Pollution) Act, 1974; The Noise Pollution (Regulation and Control) Act, 2000; Public Liability Insurance Act, 1991; National and International Treaties, Conventions, Declarations, *etc.*

Suggested Books

1. Environmental Impact Assessment, Canter, L. McGraw Hill
2. Environmental and Social Impact Assessment: An Introduction, Barrow; John Wiley & Sons
3. Environmental Impact Assessment: A Guide to Best Professional Practices (HB) Taylor & Francis (CRC)
4. Environment and Pollution Laws, S K Mohanty; Universal Law Publishing Co. Pvt. Ltd., Delhi, 2005
5. Environmental law in India, P Leelakrishnan; LaxisNexis
6. Environmental Law and Policy in India-Cases and Materials; Divan, Rosencranz; Oxford Publisher

Course Type: MAJ-12
 Semester: 7
 Course Code: BENVMAJ12T
 Course Title: DISASTER MANAGEMENT
 (L-P-Tu): 5-0-1
 Credit: 6
 Practical/Theory: Theory

Course Objective: }To get know-how of natural and man-made Disasters }To develop skill and knowledge on Disaster management

Learning Outcome: Students gain sound knowledge on the concept of Disasters, Natural disasters, Man-made disasters, Disaster management cycles & framework

Disasters: (LECTURE – 15)

Concept, definition; Hazards and disasters; Risk and vulnerability in disaster; Types, trends, causes and consequences and control of various disasters: Geological, Hydro-meteorological, Biological and Technological disasters

Natural disasters: (LECTURE – 30)

Definition, concept and types; Causes, distribution, consequences and mitigation measures for Earthquake, *Tsunami*, Cyclone, Flood, Drought and Landslide, Forest fires

Man-made disasters: (LECTURE – 15)

Gas and radiation leaks, toxic waste disposal, oil spills, forest fires; Case studies of disaster in Meghalaya: earthquake and flood.

Disaster management cycles & framework: (LECTURE – 30)

Disaster Management Cycle; Basic principles of Disaster Management; Role of Governments, Non-Governments and State Government agencies; National and state bodies for Disaster Management; Early warning systems: cyclone, tsunami, flood; Usage of GIS and RS techniques in disaster management

Suggested Books

1. Natural disasters, Patrick L. Abbott., Mc Graw –Hill
2. Natural hazards, Edward Bryant, Cambridge
3. Natural Hazards and Disasters, Donald Hyndman, David Hyndman; Cengage learning,
4. Causes, Consequences and Management of Disasters, Frampton C., Hardwick and McNaught, 1999; Hodder and Stoughton, London
5. Encyclopaedia of Disaster Management, Vol. 1, 2 and 3, Goel S. L., 2001; Deep and Deep Publications, New Delhi
6. Natural Hazards and Disaster Management: Vulnerability and Mitigation, Singh R. B. (ed.), 2006; Rawat Publications, New Delhi
7. Natural Hazards: Earth's Processes as Hazards, Disasters and Catastrophe, Keller E. A. and Blodgett R. H., 2006; Prentice Hall, New Jersey

8. Disaster Management, Amit Kumar; Sonali Publications

Course Type: MAJ-13

Semester: 7

Course Code: BENVMAJ13T

Course Title: WASTE MANAGEMENT & ECOTOXICOLOGY

(L-P-Tu): 5-0-1

Credit: 6

Practical/Theory: Theory

Course Objective: }To grow basic knowledge on solid waste, E waste and hazardous waste }to develop skill and knowledge on waste management }To develop concept of toxic chemicals and Ecotoxicology

Learning Outcome: Students become familiar with Solid waste management, Hazardous waste, E-waste, Toxic chemicals, Ecotoxicology

Solid waste management: (LECTURE – 20)

Concept, origin, classification and characteristics of solid waste; Solid waste management; Solid Waste (Management) Rules, 2016; Plastic wastes; Biomedical wastes

Hazardous waste: (LECTURE – 10)

Concept, sources and classification; Effects and disposal methods of hazardous wastes; Hazardous Waste (Management) Rules, 2016

E-waste: (LECTURE – 10)

Concept, sources and composition; Disposal methods: recycling and resource recovery, scientific disposal methods; E-waste (Management) Rules, 2022

Toxic chemicals: (LECTURE – 20)

Toxic chemicals in air, soil, water and wastewater; Chemistry and impacts of Acid Mine Drainage; Toxic Metals: Biological effects of heavy metals (cadmium, arsenic, chromium, mercury); Chemical speciation (concept and importance)

Ecotoxicology: (LECTURE – 30)

Definition and Concept; mechanism of toxicity; Branches of toxicology; Types of interactions in toxicology; Concept of Dose-Response relationship, LD₅₀, LC₅₀, Threshold Limit Value (TLV), Therapeutic index; Basic concept on bioaccumulation, biomagnification, bioconcentration

Suggested Books

1. Hazardous Waste Management, M.D. Lagrega et al., McGraw Hill
2. Environmental Management Systems Marguglio; CRC Press INC
3. Solid and Hazardous Waste Management (PB): CBS; Cherry, PM Asnani, P. U. 2006.
4. Solid waste management. *India Infrastructure Report 570*.
5. Bagchi, A. 2004. *Design of Landfills and Integrated Solid Waste Management*. John Wiley & Sons.

6. Blackman, W.C. 2001. *Basic Hazardous Waste Management*. CRC Press.
7. McDougall, F. R., White, P. R., Franke, M., & Hindle, P. 2008. *Integrated Solid Waste Management: A Life Cycle Inventory*. John Wiley & Sons.
8. US EPA. 1999. *Guide for Industrial Waste Management*. Washington D.C.
9. White, P.R., Franke, M. & Hindle P. 1995. *Integrated Solid waste Management: A Lifecycle Inventory*. Blackie Academic & Professionals.
10. Zhu, D., Asnani, P.U., Zurbrugg, C., Anapolsky, S. & Mani, S. 2008. *Improving Municipal Solid waste Management in India*. The World Bank, Washington D.C
11. Environmental Chemistry: A.K. De, New age (P) Ltd.
12. Landfill Waste Pollution and Control, Kenneth Westlake., Albion Publishing
13. Hazardous waste Management, Wentz, C.A., McGraw Hill
14. A Text Book of Environmental Chemistry and Pollution Control: S.S. Dara., S. Chand & Company Ltd.
15. Casarett and Doull's Toxicology: The Basic Science of Poisons, 2nd Edn. John Doull, Curtis D
16. Fundamental Toxicology, Ed by John H Duffus and Howard G J Worth, RSC Publishing, 2006 7.
17. Fundamentals of Ecotoxicology, 3rd Edn., Michael C Newman, CRC Press, Taylor & Francis Group, London, 2010
18. Principles of Biochemical Toxicology, 3rd Edn, Jogh Timbrell, Taylor & Francis , 2000
19. Environmental Toxicology, David A Wright, and Pamela Welbourn, Cambridge University Press, 2002
20. Environmental Chemistry with Green Chemistry, Asim K Das, Books and Allied (P) Ltd., 2010

**Syllabus of Environmental Science
Semester VIII
Major**

Course Type: **MAJ-14**

Semester: **8**

Course Code: **BENVMAJ14T**

Course Title: **ANALYTICAL METHODS IN ENVIRONMENTAL SCIENCE**

(L-P-Tu): **3-0-1**

Credit: **4**

Practical/Theory: **Theory**

Course Objective: }To grow basic knowledge and skill on different analytical techniques }to develop basic knowledge on sample preparation and extraction

Learning Outcome: Students develop skill among them about different Separation techniques, Sample Preparation and extraction, Chromatography and Mass spectroscopy and miscellaneous methods

Separation techniques: (LECTURE – 20)

Adsorption, centrifugation, chromatography, crystallization, decantation, distillation, drying, electrophoresis, elutriation, evaporation, leaching, flotation, flocculation, filtration, reverse osmosis, dialysis (biochemistry), fractional distillation, fractional freezing, magnetic separation, precipitation, crystallization, sedimentation, sieving, stripping, sublimation, vapour-liquid separation, winnowing and zone refining's.

Sample Preparation and extraction: (LECTURE – 15)

Concept and importance, sample pre-treatment, preparation, post treatment techniques: pressurized liquid and subcritical hot-water extraction, microwave assisted extraction, solid phase extraction, QuEChERS approach of extraction, solid phase micro extraction, single drop micro extraction (SDME), membrane extraction, liquid-liquid extraction.

Chromatography and Mass spectroscopy: (LECTURE – 15)

Principle, instrumentation and application of gas, liquid, adsorption, paper, gel, size exclusion, HPLC, TLC, electrophoresis and ion exchange chromatography. Mass spectroscopy: Principle, instrumentation and application of mass spectroscopy, types of mass spectroscopy, fragmentation, ionization and characterization of organic and inorganic materials.

Miscellaneous methods: (LECTURE – 10)

Principle, instrumentation and application of classical analytical methods: gravimetric, volumetric and thermal methods); Automatic analytical methods and Hybrid analytical methods

Suggested Books

1. Handbook of Methods in Environmental Studies: Water and Waste Water Analysis Hardcover, S.K. Maiti; Oxford Book Company
2. Research Methodology Methods and Techniques, C. R Kothari, New Age International (P) Limited Publishers
3. VOGEL'S Text Book of Quantitative Chemical Analysis, Longman Scientific & Technical with John Wiley & Sons
4. Chemistry for Environmental Engineering: Clair N Sawyer, Perry L. Mccarthy & Gene F. Parkin., Mc Graw - Hill Inc.
5. Methods for the Examination of Water and Wastewater 20th eds.; Lenore, S. Clesceri, Arnold E. Greenberg, Andrew D. Eaton; American Public Health Association
6. Environmental Applications of Instrumental Chemical Analysis (HB), T&F CR
7. Textbook of Quantitative Chemical Analysis. G.H. Jeffery, J. Bassett, J. Mentham, R.C. Denny. Longman Scientific Technical. John Wiley and Sons.
8. Introduction to Environmental Engineering and Science: Gilbert M Masters; Pearson Edition

Course Type: **MAJ-15**
 Semester: **8**
 Course Code: **BENVMAJ15T**
 Course Title: **WILDLIFE ECOLOGY AND ECOTOURISM**
 (L-P-Tu): **3-0-1**
 Credit: **4**
 Practical/Theory: **Theory**

Course Objective: }To provide information on wildlife ecology and wild life management }To develop basic concept on wildlife tourism }To make skillful on Ecotourism practices

Learning Outcome: Students gain knowledge on Wildlife ecology, Wildlife Management, Wildlife tourism, Ecotourism practices

Wildlife Ecology: (LECTURE – 15)

Concept, scope and importance of wildlife; Wildlife values; Concept and importance of population in wildlife studies; Animal-habitat interactions; Effects of intra- and inter-specific competition on wildlife; Prey-predator relationship; Animal movement, concept of home range and territory.

Wildlife Management: (LECTURE – 15)

Concept and importance of wildlife management; Construction and importance of life-tables in wildlife management; Habitat manipulation: food, water, shade improvement; Making observations and records: field notes, datasheets; Wildlife photography: types of camera, camera traps; Field equipment: altimeter, pedometer, field compass, binoculars, radio collaring.

Wildlife Tourism: (LECTURE – 15)

Basic concepts, importance and scope; Sustainable development in wildlife tourism; Negative impact of wildlife tourism: Disruption of breeding behaviour, disruption of parent- offspring bonds, increased mortality, vanity hunts and poaching, increased vulnerability, disruption feeding behaviour; Positive impacts: Habitat restoration by eco-lodges and other tourism operations, conservation breeding, quality interpretation, culling and population maintenance, conservation hunting/harvest, anti-poaching practices and tools.

Ecotourism Practices: (LECTURE – 15)

Evolution and concept; importance and types of ecotourism; Components and principles of ecotourism; Impacts of ecotourism; Ecotourism criteria; Ecotourists: types and code of ethics; Quebec Declaration on Ecotourism. Ecotourism practices; Community based tourism; Transportation, facilities, service; Examples and case studies of ecotourism in practice.

Suggested Books

1. Tourism and Hotel Industry: Manohar Puri and Gian Chnad, Pragun Publications, New Delhi, 2006
2. Principles and Practices of Ecotourism, Krishna Kumar Mishra; Notion Press
3. An Introduction to Ecotourism, Ajay Chauhan; Anmol Publication

4. Wild life tourism, environmental learning and ethical encounters-ecological and conservation aspects; Lima and Green; Springer
5. Wild life tourism; Newsome, Dowling, Moore; Channel View publication
6. Wilderness of wildlife tourism; J K Fatima; CRC Press
7. Wildlife ecology, conservation and management; Fryxell, Sinclair, Caughley; Wiley Blackwell Publisher

Course Type: MAJ-16

Semester: 8

Course Code: BENVMAJ16T

Course Title: **SOCIAL ENVIRONMENTAL ISSUES & CONTEMPORARY ENVIRONMENTAL MOVEMENTS**

(L-P-Tu): 3-0-1

Credit: 4

Practical/Theory: Theory

Course Objective: }To provide information on environmental movements; environmental organizations }To make aware of different social issues }To develop knowledge on environment and society; sustainability

Learning Outcome: Students learn about Environment & society, Social issues, Environmental Movements, Environmental Organizations, Environmental sustainability

Environment & society: (LECTURE – 15)

Ecosystem services to society; Environmentalism, Environmental refugees; Ecofeminism; International and national environmental organizations; Human population growth and problem, regulation of population; Green politics

Social issues: (LECTURE – 15)

Global environmental issues; Wasteland reclamation; Unsustainable to Sustainable Development; Urban problems related to energy; Resettlement and rehabilitation of people: Environmental awareness; Environmental ethics; Women and Child welfare; Role of Information Technology in environment and human health

Environmental Movements: (LECTURE – 10)

Origin of environmental movements; Environmental movements in India: Bishnoi Movement, Silent Valley, *Narmada Bachao Andolan*, Chipko Movement, Tehri dam conflict

Environmental Organizations: (LECTURE –5)

National and International (IPCCC, WWF, IUCN); Some Prominent environmentalists of India

Environmental sustainability: (LECTURE – 15)

Concept of sustainable city, urban planning, social responsibility; International treaties & conventions, viz., Wetlands (Ramsar), International Trade in Endangered Species (CITES), Biodiversity (CBD), Transboundary Movements of Hazardous Waste (Basal), Montreal Protocol, Climate Change –CoP

Suggested Books

1. Environmentalism: A global History; R Guha; Penguin Publisher
2. Our Environment: Threats, Challenges and sustainable solutions; Scholastic India

3. Environment and Society, G Kushwaha; Gen Next Publication
4. Environmental Movements of India; K Mallick; Amsterdam University Press
5. Social Problems and Issues in India; Kumari, Singh, Sondhi; Satyam Law International
6. Nature, Environment and Society; P W Sutton; Red Globe Press London
7. International Organizational and Environmental Protection: Conservation and Globalization in the 20th Century, Kaiser and Meyer; Berghahn Books.

Course Type: **MAJ-17**

Semester: **8**

Course Code: **BENVMAJ17T**

Course Title: **ENVIRONMENTAL MICROBIOLOGY & BIOTECHNOLOGY**

(L-P-Tu): **5-0-1**

Credit: **6**

Practical/Theory: **Theory**

Course Objective: }To grow basic knowledge on Environmental Microbiology and Biotechnology }To develop skill on Biotechnological Approaches }To make familiar with the concept and application of Bioremediation

Learning Outcome: This paper inculcate sound knowledge on Environmental Microbiology, Environmental Biotechnology, Biotechnological Approaches, Bioremediation among students

Environmental Microbiology: (LECTURE – 30)

Scope and importance of microorganisms; Microorganism in different environments: Soil, water, air and extreme environments; Reproduction and growth, methods for determining bacterial numbers; Role of microorganisms in waste treatment, anaerobic (methanogenesis) and aerobic (trickling filter, activated sludge, oxidation pond) treatment of wastewater, production of enzymes and alcohol

Environmental Biotechnology: (LECTURE – 30)

Concept and scope of environmental biotechnology; Applications of biotechnology in environment: Fermentation technique, composting, vermicomposting, bioleaching, bio-augmentation; Genetically modified organisms

Biotechnological Approaches: (LECTURE – 15)

Definition, types, applications and advantages of bio-fertilizer, bio-pesticide, biofuel, and biogas

Bioremediation: (LECTURE – 15)

Concept and definition; *In-Situ* and *Ex-Situ* bioremediation techniques; Microbial remediation; Phytoremediation; Mycoremediation; Organisms involved in bioremediation processes; Super bugs in bioremediation

Suggested Books

1. Microbes & Microbial Technology (HB): Springer; Ahmad
2. Fundamentals of Microbiology and Immunology, Banerjee and Banerjee; New Central Book Agency (P) Ltd.
3. Environmental Biotechnology (PB): CBS; Allen, K
4. Handbook of Media for Environmental Microbiology, Taylor & Francis; Atlas

5. Encyclopaedia of Environmental Microbiology, 6 Vol. Set: John Wiley (Original); Bitton
6. Wastewater Microbiology; Bitton, G., John Wiley, NY
7. Evans, G.G. & Furlong, J. 2010. *Environmental Biotechnology: Theory and Application* (2nd edition). Wiley-Blackwell Publications.
8. Jordening, H.J. & Winter J. 2005. *Environmental Biotechnology: Concepts and Applications*. John Wiley & Sons.
9. Nelson, D.L. & Cox, M.M. 2013. *Lehninger's Principles of Biochemistry*. W.H. Freeman.
10. Rittman, B.E. & McCarty, P.L. 2001. *Environmental Biotechnology. Principles and Applications*. McGraw-Hill, New York.
11. Scagg, A.H. 2005. *Environmental Biotechnology*. Oxford University Press.
12. Snustad, D.P. & Simmons, M.J. 2011. *Principles of Genetics* (6th edition). John Wiley & Sons.
13. Wainwright, M. 1999. *An Introduction to Environmental Biotechnology*. Springer.
14. Phytoremediation: Methods & Reviews (HB): Springer Humana; Wiley

Course Type: **MAJ-18**

Semester: **8**

Course Code: **BENVMAJ18T**

Course Title: **ENVIRONMENTAL ECONOMICS & MANAGEMENT**

(L-P-Tu): **5-0-1**

Credit: **6**

Practical/Theory: **Theory**

Course Objective: }To grow basic knowledge on Environmental Economics }To make the students familiar with the concept and application of environmental management system

Learning Outcome: Students develop sound knowledge on Environmental Economics and Environmental Management

Environmental Economics (LECTURE – 40)

Concept & scope of environmental economics; Concept of supply and demand; Types of Market; Types of economic system, Ecological economics; Environmental Kuznets's Curve; Economics of pollution control; Measurement of environmental costs, Externality and Trade off; Cost-Benefit analysis; Valuation of environment (contingent valuation methods, travel cost, Hedonic pricing); Polluter's Pay Principle; Natural resource accounting (NRA) (concept and methods of NRA)

Environmental Management (LECTURE – 50)

Definition and concept of environmental management; Environmental management system; Sustainable development and Agenda-21

Management strategies of air pollution, water pollution, noise pollution, soil conservation in respect to Indian scenario, &

Wastewater treatment and water purification; Drinking water standard (IS10005); National ambient air quality standards; Namami Gange, concept of Smart city

Integrated system for waste management: Municipal Solid Wastes (MSW); Biomedical wastes; Plastic wastes; Hazardous wastes; Radioactive wastes; Bio-safety Protocol

Suggested Books

1. The Economic Approach to Environmental & Natural Resources, James R. Kahn., Thomsom Learning Publisher
2. Economics of Environment, Dorfman and Dorfmann; Norton Publisher
3. The Economics of Natural Resource and Environment, Pearce and Turner; Harvester & Wheatsheaf
4. Economic Theory of Exhaustible Resources, Dasgupta and Heal (1979); CUP
5. Handbook of natural Resource and Energy Economics/3 Volumes, Kneese & Sweeny (1993); North-Holland
6. Environmental Economics: A survey/OEL Crooper & Dates (1992)
7. Natural Resources Accounting: A Framework for India, Parikh (1993)
8. Environmental Economics, Charles D Kolstad (2000); Oxford University Press
9. Environmental Management Systems Marguglio; CRC Press INC
10. Handbook of Environmental Management & Technology, 2e (PB): John Wiley Original), Burke
11. Solid and Hazardous Waste Management (PB): CBS; Cherry, PM
12. Bansil, P.C. 2004. *Water Management in India*. Concept Publishing Company, India.
13. Brebbia, C.A. 20 *Water Resources Management VII*. WIT Press.
14. CEA. 2011. *Water Resources and Power Maps of India*. Central Board of Irrigation & Power.

Syllabus of Environmental Science Semester I Minor

Course Type: **ME-1**

Semester: **1**

Course Code: **BENVMEA11C**

Course Title: **MUSHROOM CULTIVATION**

(L-P-Tu): **2-2-0**

Credit: **4**

Practical/Theory: **Combined**

Course Objective: }To develop concept on mushroom morphology; its classification }To grow practical as well as theoretical knowledge on mushroom cultivation techniques

Learning Outcome: Students develop practical skill on Mushroom morphology, Mushroom Classification, cultivation techniques, Cultivation System & Farm design; Compost & Composting, Spawn and Spawning, Casting materials and practical knowledge on Mushroom cultivation

Mushroom Morphology: (LECTURE – 15)

Different parts of a typical mushroom & variations in morphology of edible and poisonous mushroom

Mushroom Classification: (LECTURE – 15)

Based on occurrence, habitats, colour of spores, morphology, Structure and texture of fruit bodies.

Cultivation Techniques: (LECTURE – 15)

Cultivation System & Farm design: Fundamentals of cultivation system- small village unit & larger commercial unit. Principles of mushroom farm layout- location of building plot, design of farm, bulk chamber, composting platform.

Compost & Composting: Principles of composting. Methods of Composting- Long method of composting (LMC) & Short method of composting (SMC).

Spawn & Spawning: Methods of spawn preparation, preparation of spawn substrate, preparation of pure culture, storage of spawn.

Casting materials & Case running: Importance of casing mixture, Quality parameters of casing soil, different types of casing mixtures, commonly used materials

PRACTICAL (Demonstration) (LECTURE – 15)

Cultivation of Button, Oyster and Straw Mushrooms: Collection of raw materials, compost & composting, spawn & spawning, casing & case run, cropping & crop management, picking & packing.

Suggested Books

1. Mushroom Cultivation in India, B C Suman, V P Sharma, Daya Publishing House
2. A Textbook on Mushroom Cultivation: Theory and Practice, Ashok Aggarwal, Yash Pal Sharma EshaJangra, Newways Publishers
3. Mushroom Cultivation: An Illustrated Guide to Growing Your Own Mushrooms at Home, Tavis Lynch; Quarry Books Publishers
4. Mushroom Cultivation and Its Diseases, Dr. Ravinder Singh Rana; Sankalpa Publishers
5. Biology, Cultivation and Applications of Mushrooms, Arun Arya, Katerina Rusevska; Springer
6. Mushroom Cultivation, V. Kumaresan; Saras Publication
7. Current Vistas in Mushroom Biology and Production, R. C. Upadhyay, Satish Kumar Singh, R. D. Rai; Mushroom Society of India

Syllabus of Environmental Science
Semester IV
Minor

Course Type: **ME-4**

Semester: **4**

Course Code: **BENVMEA24T**

Course Title: **Forestry & Nursery Technology**

(L-P-Tu): **2-2-0**

Credit: **4**

Practical/Theory: **Theory**

Course Objective: }To develop basic concept on Forestry and Silviculture }To develop skill of Nursery Technology and Plantation Technology }To generate awareness on Forest Management

Learning Outcome: Students develop knowledge on principles of silviculture, nursery technology, plantation technology, forest soils, forest mensuration and biostatistics, silvicultural, forest management and working plan, forest logging

Principles of Silviculture: Introduction of forest, forestry, silviculture and silvics; Importance, scope of silviculture and its classification; Tree morphology: root system, stem. Tree growth: Forest regeneration; Natural regeneration, methods of natural regeneration, artificial regeneration. Tending operations: weeding, cleaning and thinning. (**Lecture – 10**)

Nursery Technology: Introduction, importance and objectives of nursery; Classifications, adoption of nursery technology. Weeding, Green manuring, organic compost/manure, farm yard manure (FYM), bio-fertilizers, mycorrhiza and fertilizer application, propagation macro- and micro-propagation. (**Lecture – 10**)

Plantation Technology: Introduction, aims and objectives of plantation forestry. Plantation organization and structure. Failures of plantations- Stump plantation - advantages, and patterns of planting. Nurse crops, cover crops and mulching. Fencing and types of fencing, Energy plantations. Afforestation of problematic sites. (**Lecture – 10**)

Forest Soils: Parent materials and soil formation, soil profile, classification of soil, physical and chemical properties of forest soil. Soil water and plant nutrients. Soil erosion and conservation. (**Lecture – 5**)

Forest Mensuration and Biostatistics: Forest Mensuration: Definition, importance and principles of measurements, principles of height measurement. Measurements of diameter, girth (circumference) of trees and standard rules of breast height measurement. Bark thickness and tree height measurement and their instruments. (**Lecture – 8**)

Forest Management and Working Plan: Working plan: objectives and scope of working plan, unit of working plan, WPO (Working Plan Officer) and preparation of working plan of forest division. Reserve and protected

area management. Various Government and private agencies involved in wildlife conservation. **(Lecture – 7)**

Forest Logging: Introduction, scope and logging in Indian and other countries. Forest ergonomics, felling and conservation. Forest labor, labor organization and timber grading.

(Lecture – 5)

Project: Submission of Dissertation/Project Report on Seedling and Plant Propagation/Plantation at local area/Composting/Fodder cultivation and control of soil erosion/Vermicomposting. **(Lecture–5)**

Suggested Books

1. Forest Resources of India-Problems, Policies and Initiatives-A Y Pangannavar; New Century Publications
2. General Silviculture for India, Harry G. Champion & S.K. Seth; Natraj Publishers
3. Forest Ecology, J B Lal; Natraj Publishers
4. Elementary Forest Mensuration, JERRAM, M. R. K; Thomas Murby and Company
5. Forest Mensuration, A N Chaturvedi and L S Khanna; International Book Distributors
6. General Silviculture, L S Khanna; Natraj Publishers
7. Management of Forest, F C Osmaston; Natraj Publishers
8. Preparation of Forest Working-Plans in India, W.E. Dearcy; Atlantic Publisher
9. Forest Engineering Without Tears, N. J. Masani; Natraj Publishers

Syllabus of Environmental Science Semester V Minor

Course Type: **ME-5**

Semester: **5**

Course Code: **BENVMEA35T**

Course Title: **ENVIRONMENTAL HEALTH, DISEASE AND ENVIRONMENTAL TOXICOLOGY**

(L-P-Tu): **3-0-1**

Credit: **4**

Practical/Theory: **Theory**

Course Objective: }To make the students familiar with the concept of Health, disease, epidemiological methods and health education }To impart sound knowledge on some communicable and non-communicable diseases }To grow the concept on Environmental toxicology

Learning Outcome: Students grow concept of Environmental Health, Disease, Environmental Toxicology

Environmental Health (LECTURE = 15)

Concept of health and disease; Principles of epidemiology and epidemiological methods, aims of epidemiology; Nutrition and health; Health education

Disease (LECTURE = 25)

Concept on water, air, vector borne diseases; some communicable diseases- Viral hepatitis, dengue; Non-communicable diseases - Cardiovascular, Diabetes; and Cancer; COPD; Mental health

Environmental Toxicology (LECTURE = 20)

Eco-toxicology: Definition and Concept; mechanism of toxicity; Branches of toxicology; Types of interactions in toxicology; Concept of Dose-Response relationship, LD₅₀, LC₅₀, Threshold Limit Value (TLV), Basic concept on Bioaccumulation, Bio-magnifications.

Suggested Books

1. Casarett and Doull's Toxicology: The Basic Science of Poisons, 2nd Edn. John Doull, Curtis D Klaassen and Mary O Amdur; Macmillan Publishing Co. Inc. Canada
2. Fundamental Toxicology, Ed by John H Duffus and Howard G J Worth, RSC Publishing, 2006
3. Fundamentals of Ecotoxicology, 3rd Edn., Michael C Newman, CRC Press, Taylor & Francis Group, London,, 2010
4. Principles of Biochemical Toxicology, 3rd Edn, Jogh Timbrell, Taylor & Francis , 2000
5. Environmental Toxicology, David A Wright, and Pamela Welbourn, Cambridge University Press, 2002
6. Park's textbook of Preventive and Social Medicine, 18th Edn., K Park, M/s Banarsidas Bhanot, Jabalpur, 2005
7. Environmental Toxicology: Biological and Health Effects of Pollutants Ming-Ho-Yu

Syllabus of Environmental Science Semester VII Minor

Course Type: **ME-7**

Semester: **7**

Course Code: **BENVMEA47T**

Course Title: **ENVIRONMENTAL MANAGEMENT**

(L-P-Tu): **3-0-1**

Credit: **4**

Practical/Theory: **Theory**

Course Objective: }To grow basic knowledge on Environmental Management }To develop concept of conventional, non-conventional, renewable, non-renewable sources of energy }To develop knowledge of waste management

Learning Outcome: Students know about Environmental Management, Energy and Waste Management

Environmental Management: (LECTURE – 15)

Concept on Environmental Management and Environmental Management System; Management of air, water, noise, soil; Drinking Water Standard

Energy: (LECTURE – 25)

Basic concept, definition, and types of energy; Classification viz., conventional, non-conventional, renewable, non-renewable; Fossil fuels, Solar energy, Hydroelectricity; Wind energy, Energy from waste; biofuel; Energy use pattern in India

Waste Management: (LECTURE – 20)

Waste generation and characterization; Integrated Solid Waste Management; Hazardous waste management; Municipal Solid Waste Management; Biomedical waste management

Suggested Books

1. Environmental Management Systems Marguglio; CRC Press INC
2. Handbook of Environmental Management & Technology, 2e (PB): John Wiley Original), Burke
3. Solid and Hazardous Waste Management (PB): CBS; Cherry, PM
4. Bansil, P.C. 2004. *Water Management in India*. Concept Publishing Company, India.
5. Brebbia, C.A. 2013. *Water Resources Management VII*. WIT Press.
6. Asnani, P. U. 2006. Solid waste management. *India Infrastructure Report 570*.
7. Bagchi, A. 2004. *Design of Landfills and Integrated Solid Waste Management*. John Wiley & Sons.
8. Blackman, W.C. 2001. *Basic Hazardous Waste Management*. CRC Press.
9. McDougall, F. R., White, P. R., Franke, M., & Hindle, P. 2008. *Integrated Solid Waste Management: A Life Cycle Inventory*. John Wiley & Sons.
10. US EPA. 1999. *Guide for Industrial Waste Management*. Washington D.C.
11. White, P.R., Franke, M. & Hindle P. 1995. *Integrated Solid waste Management: A Lifecycle Inventory*. Blackie Academic & Professionals.
12. Environmental pollution Management & Control for the Sustainable Development, Dr R.K Khitoliya; S. Chand & Company Ltd
13. Zhu, D., Asnani, P.U., Zurbrugg, C., Anapolsky, S. & Mani, S. 2008. *Improving Municipal Solid waste Management in India*. The World Bank, Washington D.C.
14. Energy Resources-Occurrence, production, conversion, use-W.H Wiser, Springer
15. Renewable energy sources and Emerging technologies-Kothari, Singal, Ranjan, PHI Learning Publisher
16. Environmental Management, G N Pandey; Bikash Publishing
17. Environmental Management, N K Uberoi; Excel Books Publisher

Syllabus of Environmental Science
Semester I/II/III
SEC

Course Type: SEC-1

Semester: 1

Course Code: BENVSEC01T

Course Title: **TOOLS AND TECHNIQUES IN ENVIRONMENTAL SCIENCE**

(L-P-Tu): 3-0-0

Credit: 3

Practical/Theory: Theory

Course Objective: }To develop concept on Statistics }To develop understanding of air quality, water quality and noise monitoring } To enhance knowledge about meteorological parameters }To develop idea on basic concept of Remote Sensing and GIS

Learning Outcome: This paper imparts knowledge on the concept of Statistics, Air quality Monitoring, Water quality monitoring, Meteorological parameters, Noise monitoring, Remote Sensing and GIS to students

Statistics: (LECTURE – 15)

Types of data: Primary and secondary; Methods of collection of environmental data; Mean, median, mode and variance of a given environmental data set; Frequency distribution; Measures of central tendency; Measures of dispersion; Correlation and Regression, Hypothesis testing, T-test, Chi-square test

Air quality Monitoring: (LECTURE – 10)

Ambient air quality monitoring; Measurement of suspended particulate matter (PM_{2.5}, PM₁₀), carbon monoxide; Oxides of nitrogen; Oxides of sulphur; Determination of RSPM in atmosphere (roadside and classroom)

Water quality monitoring: (LECTURE – 10)

Water quality parameters; Water sampling techniques; Principles and procedures for measurement of pH, conductivity, total solids, hardness, chloride, dissolved oxygen, combined CO₂, phosphate, nitrate, heavy metals (Atomic Absorption Spectrophotometry method); and Total coliform count

Meteorological parameters: (LECTURE – 03)

Light intensity, ambient temperature and relative humidity

Noise monitoring: (LECTURE – 02)

Monitoring of noise level in public area (campus and roadside)

Remote Sensing and GIS: (LECTURE – 05)

Basics of Remote Sensing and GIS; Use of remote sensing and GIS in resource survey and land-use mapping

Suggested Books

1. Basic of Remote Sensing and GIS, S. Kumar; Laxmi Publication
2. Fundamental of Statistics, S. Gupta; Himalaya Publishing House

3. VOGEL'S Text Book of Quantitative Chemical analysis, Longman scientific & Technical with John Wiley & Sons
4. Remote sensing and image interpretation, Lillesand, Kiefer and Chapman, Wiley publisher
5. Fundamental of Remote Sensing, George Joseph, University Press
6. Introduction to Environmental Engineering and Science: Gilbert M Masters; Pearson Edition
7. Chemistry for Environmental Engineering: Clair N Sawyer, Perry L. Mccarthy & Gene F. Parkin., McGraw - Hill Inc.
8. Methods for the Examination of Water and Wastewater 20th eds.; Lenore, S. Clesceri, Arnold E. Greenberg, Andrew D. Eaton; American Public Health Association Handbook of Methods in Environmental Studies: Water and Waste Water Analysis Hardcover – 18, May 2011; S.K. Maiti; Oxford Book Company
9. Air Pollution , Dr Aradhana Salpekar; Jnanada Prakashan
10. Introduction to Biostatistics, Dr Pranab Kr Banerjee; S Chand
11. A Text book of Environmental Chemistry and Pollution Control: S.S. Dara., S. Chand & Company Ltd
12. Atmospheric Chemistry (HB): Royal Society of Chemistry; Holloway
13. Remote sensing and GIS, Basudeb Bhatta, Oxford publisher
14. Environmental Chemistry: A.K. De, New age (P) Ltd.
15. Environmental Chemistry with Green Chemistry, Asim K Das, Books and Allied (P) Ltd.

Syllabus of Environmental Science
Semester I
VAC

Course Type: **VAC-1**

Semester: **1**

Course Code: **BVACENV01T**

Course Title: **ENVIRONMENTAL STUDIES**

(L-P-Tu): **2-2-0**

Credit: **4**

Practical/Theory: **Theory**

Course Objective: }To develop Basic concept and awareness on environment, different environmental issues }To develop understanding of Natural resources, ecology ecosystem, }To impart knowledge on biodiversity and its conservation } To enhance knowledge about enviro

Learning Outcome: This compulsory paper has been introduced to produce general awareness regarding Environment, its problems, possible management processes, basic need for environmental studies, practical knowledge of environment related project works etc. among students

Unit 1: Basics of Environmental Studies: (05)

Definition, Nature, Scope and Importance; Components of environment: Environmental education

Unit 2: Natural Resources: Renewable and Nonrenewable Resources (10)

Nature and natural resources their conservation and associated problems:

- Forest resources: Uses, types and importance, Joint Forest Management & Tribal population, Deforestation and its effects
- Water resources: Distribution of water on Earth; Use, over exploitation of surface and ground water; Dams: Benefits and problems; Flood and Drought
- Mineral resources: Mineral resources in India; Use and exploitation, Social impacts of mining
- Food resources: World food problems and food insecurities.
- Energy resources: Renewable and Nonrenewable energy sources; Use of alternate energy sources - Case studies
- Land resources: Land as a resource; Land degradation, landslides, soil erosion, desertification
- Use of resources for sustainable development

Unit 3: Ecology and Ecosystems (08)

Concept of ecology, Population ecology, Community ecology

- Concept of an ecosystem, different types of ecosystem
- Food chains, food webs and ecological succession
- Energy flow in the ecosystem and energy flow models

Unit 4: Biodiversity and its conservation (08)

Biodiversity: Levels of biological diversity

- Values of biodiversity
- Hot-Spots of biodiversity, Mega-biodiversity countries
- Threat to biodiversity
- Threatened and endemic species of India
- Conservation of biodiversity (*In-situ* and *Ex-situ*)
- Ecosystem services: Ecological, Economic, Social, Ethical, Aesthetical and Informational values

Unit 5: Environmental Pollution and Management (08)

(a) Nature, Causes, Effects and Control measures of – Air pollution, Water pollution, Soil pollution, Noise pollution

(b) Solid waste management: Causes, effects and disposal methods; Management of biomedical and municipal solid wastes

Disaster management: Floods, Earthquake, Cyclone and Landslides

Unit 6: Environmental Policies and Practices (10) Constitutional Provisions for protecting environment- Article 48 (A), 51A (g)

- Environmental Laws: The Environment (Protection) Act, 1986; The Air (Prevention and Control of Pollution) Act, 1981; The Water (Prevention and Control of Pollution) Act 1974; Forest (Conservation) Act, 1980
- The wildlife Protection Act, 1972
- Climate change, Global warming, ENSO, Acid rain, Ozone layer depletion; Montreal and Kyoto Protocols

Unit 7: Human Communities and Environment (06)

- Human population growth; Impacts on environment
- Environment and human health: Concept of health and disease; Common communicable and Non- communicable diseases; Public awareness
- Environment movements in India: Chipko Movements, Silent Valley Movement, *Narmada Banchao Aandolan*.

Unit 8: Field Work Report/Project Report/Term paper (based on any one of the following topics and to be evaluated by internal teachers only) (05)

- Environmental assets - River/Forest/Grassland/Hill/Mountain *etc.*
- Environmental pollution - Urban/Rural/Industrial/Agricultural
- Study of common Plants/Insect /Birds/Wild life *etc.*
- Study of simple ecosystems: Pond/River/Hill slope *etc.*

Suggested Books

1. Environmental Science: S.C. Santra, New Central Book Agency
2. Ecology and Environment: P.D. Sharma., Rastogi Publication.
3. Fundamentals of Environmental Studies-Mahua Basu (Cambridge University Press)
4. Agrawal, Sikdar and Deb (2002): A Text book of Environment; MacMillan
5. Textbook of Environmental Studies: Erach Bharucha; University Grants Commission; University Press2013
6. Environmental Studies; Anindita Basak; Pearson India
7. A Text Book on Environmental Studies, Goswami, Mandal, Singh; Ashok Book Stall