image274image296ANNAMALAI 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** | |
|  |  | **SEMESTER I** | |  |  |  | **CIA** | **Uni.**  **Exam** | **Total** |
| 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 | Core Theory | Paper-3 | 5 | 4 | Environmental Chemistry | 25 | 75 | 100 |
| 17. | III  image266 | Core Theory | Paper-4  image267 image268 | 6 | 4  image269 | Natural Resource  Management | 25 | 75  image272 | 100  image273 |
| 18. | III | Core Theory | Paper-5 | 6 | 4 | Environmental  Microbiology | 25 | 75 | 100 |
|  | III  image288 | Core Practical | Paper-2  image289  image301 | 3 | -  image291  image302 | Environmental Chemistry and Environmental  Microbiology  image304 | 0 | 0  image294  image305 | 0  image295 |
| 19. | III | Allied-2 | Paper-3 | 5 | 3 | Environmental Economics | 25 | 75 | 100 |
| 20. | IV | Skill Based  Subject | Paper-1  image312 | 3 | 2  image313 | Remote Sensing and GIS  image315 | 25 | 75  image316 | 100 |
| 21. | IV | Non-Major Elective | Paper-1  image323  image334 | 2 | 2  image324  image335 | Global Environmental Issues Management  image337 | 25 | 75  image327  image338 | 100 |
|  |  | **Sem.Total** |  | **3**0 | **19** |  | **150** | **450** | **600** |

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|  | image343 |  | image344 image345 |  | image346 image347 | image348 |  | image349 | image350 |  |
|  |  | **SEMESTER IV** | |  |  |  | **CIA** | **Uni.** | **Total** |
| **Exam** |
| 22. | III | Core Theory | Paper-6 | 6 | 4 | Environmental Pollution | 25 | 75 | 100 |
|  |  |  |  |  | and Control Measures |  |  |  |
| 23. | III | Core Theory | Paper-7 | 5 | 4 | Pollution Monitoring and | 25 | 75 | 100 |
|  |  |  |  |  | Analytical Techniques |  |  |  |
| 24. | III | Core Theory | Paper-8 | 6 | 4 | Energy and Environment | 25 | 75 | 100 |
| 25. | III | Core Practical | Paper-2 | 0 | 3 | Environmental Chemistry and Environmental Microbiology | 25 | 75 | 100 |
| 26. | III | Core Practical | Paper-3 | 3 | 3 | Energy and Environment | 25 | 75 | 100 |
| 27. | III | Allied-2 | Paper-4 | 5 | 5 | Environment and Eco- | 25 | 75 | 100 |
|  |  |  |  |  | Tourism |  |  |  |
| 28. | IV | Skill Based Subject | Paper-2 | 3 | 2 | Aquaculture and  Environment | 25 | 75 | 100 |
| 29. | IV | Non-Major Elective | Paper-2 | 2 | 2 | Occupational Safety  ,Health and Management | 25 | 75 | 100 |
|  |  | **Sem.Total** |  | **30** | **27** |  | **200** | **600** | **800** |
|  |  |  |  |  |  |  |  |  |  |
|  |  | **SEMESTER V** | |  |  |  |  |  |  |
| 30. | III | Core Theory | Paper-9 | 6 | 5 | Waste Management and | 25 | 75 | 100 |
| Recycling |
| 31. | III | Core Theory | Paper-10 | 6 | 5 | Environmental Safety, Health | 25 | 75 | 100 |
|  |  |  |  |  | and Management |  |  |  |
| 32. | III | Core Theory | Paper-11 | 6 | 5 | Biostatistics and | 25 | 75 | 100 |
|  |  |  |  |  | Instrumentation |  |  |  |
|  | III | Core Practical | Paper-4 | 3 | 0 | Biostatistics and | 0 | 0 | 0 |
|  |  |  |  |  | Instrumentation and Waste |  |  |  |
|  |  |  |  |  | Management |  |  |  |
|  |  |  |  |  |  |  |  |  |
|  | III | Elective | Paper-1 | 6 | 3 | Principles of | 25 | 75 | 100 |
| 33. |  |  |  |  |  | Sustainable  Development and |  |  |  |
|  |  |  |  |  |  | Management |  |  |  |
| 34. | IV | Skill based  Subject | Paper-3 | 3 | 2 | Forest Conservation & Management | 25 | 75 | 100 |
|  |  | **Sem.Total** |  | **30** | **20** |  | **125** | **375** | **500** |
|  |  |  |  |  |  |  |  |  |  |
|  |  | **SEMESTER VI** | |  |  |  |  |  |  |
| 35. | III | Core Theory | Paper-12 | 6 | 4 | Natural Hazard and | 25 | 75 | 100 |
|  |  |  |  |  | Disaster Management |  |  |  |
| 36. | III | Core Theory | Paper-13 | 5 | 4 | Environmental Impact | 25 | 75 | 100 |
| Assessment |
| 37. | III | Core Theory | Paper-14 | 5 | 4 | Environmental Laws, Policies | 25 | 75 | 100 |
|  |  |  |  |  | and Treaties |  |  |  |
|  | III | Core Practical | Paper-4 | 0 | 3 | Biostatistics and | 25 | 75 | 100 |
| 38. |  |  |  |  |  | Instrumentation and Waste |  |  |  |
|  |  |  |  |  |  | Management |  |  |  |
| 39. | III | Core Project | 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 | 25 | 75 | 100 |
|  |  |  |  |  | Toxicology |  |  |  |
|  | IV | Skill based | Paper-4 | 3 | 2 | Environmental | 25 | 75 | 100 |
| 42. |  | subject |  |  |  | Biotechnology & Herbal |  |  |  |
|  |  |  |  |  |  | Science |  |  |  |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 43. | V | Extension  Activities |  | - | 1 |  | 100 | 0 | 100 |
|  |  | **Sem.Total** |  | **30** | **29** |  | **300** | **600** | **900** |
|  |  |  |  |  | **140** |  |  |  | **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  2 | 10 | 100 | 200 |
|  | Allied Practical | 1 | 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 Hours of Teaching: 5**

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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 Micronutrients, 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 di-oxide.

## Course Outcome

1. After studied Unit I, the students will be able to know the concepts in Environmental Chemistry.
2. After studied Unit II, the students will be able to understand the chemical process in the air, water and soil.
3. After studied Unit III, the students will be able to describe the water quality parameters and water pollutants.
4. After studied Unit IV, the students will be able to analyze and recognize the properties of soil and water.
5. After studied Unit V, the students will be able to understand various types of organic and inorganic pollutants 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. IK 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) Text Book 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 Text Book 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.ht](http://www.crystal.med.upenn.edu/sharp-lab-pdfs/sharp_EncLifeSci.pdf)tp[://www.*crystal.med.upenn.edu/sharp-lab-pdfs/sharp\_EncLifeSci.pdf*](http://www.crystal.med.upenn.edu/sharp-lab-pdfs/sharp_EncLifeSci.pdf)[3.ht](http://www.fao.org/docrep/field/003/AC172E/AC172E04.htm)t[p:](http://www.fao.org/docrep/field/003/AC172E/AC172E04.htm)/[/www.fao.org/docrep/field/003/AC172E/AC172E04.htm](http://www.fao.org/docrep/field/003/AC172E/AC172E04.htm) [4.ht](http://www.essentialchemicalindustry.org/materials-and-applications/surfactants.html)t[p:](http://www.essentialchemicalindustry.org/materials-and-applications/surfactants.html)/[/www.essentialchemicalindustry.org/materials-and-applications/surfactants.html](http://www.essentialchemicalindustry.org/materials-and-applications/surfactants.html) [5.ht](http://agriinfo.in/?page=topic&superid=5&topicid=174)t[p:](http://agriinfo.in/?page=topic&superid=5&topicid=174)/[/agriinfo.in/?page=topic&superid=5&topicid=174](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*](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-](http://www.onlinebiologynotes.com/chemical-parameters-of-water-quality-) chemicalcharacteristics-of-water/

## CORE PAPER - 4

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

**Name of the paper: Natural Resource Management**  **credits :** 4

**Paper type: core Hours of teaching : 6**

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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 resources 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 - Eco development 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 studied Unit I, the students will be able to know the types of natural resources.
2. After studied Unit II, the students will be able to understand the importance of forest resources, uses and their conservation,
3. After studied Unit III, the students will be understand the different types of water resources, and how to manage the water resources.
4. After studied Unit IV, the students will be able to analyze and recognize the properties of soil and water.
5. After studied Unit V, the students will be able to understand various types of organic and inorganic pollutants 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. MaDicken 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 S and 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](http://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](http://www.sida.se/contentassets/320aedac0f1047daa30a1400af89c7a0/13185.pdf) 5.https://[www.un.org/esa/agenda21/natlinfo/countr/india/natur.htm](http://www.un.org/esa/agenda21/natlinfo/countr/india/natur.htm) 6.https://[www.encyclopedia.com/environment/energy-government-and-](http://www.encyclopedia.com/environment/energy-government-and-) defensemagazines/natural-resource-management

## CORE PAPER - 5

**Name of the Course: B.Sc. Environmental Management Semester: III Name of the Paper: Environmental Microbiology Credits: 4 Paper Type: Core Hours 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 microorganims in biogeochemical cycles
4. To study the existence and role of microbes 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 in 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 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 studied Environmental Microbiology course, the students will be able to

* 1. Understand the microbial growth, reproduction, and culturing techniques.
  2. Understand the interactions of microbes in an ecosystem and their role in biogeochemical cycles.
  3. Understand and identify the environmental microbial bioprocess.
  4. Gain knowledge in applications 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 P K (2008) Text Book of Environmental Microbiology, I K 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 Jersy, USA.

1. 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/](http://www.onlinebiologynotes.com/sewage-treatment-process-of-wastewater-treatment/) 4.https://[www.jsps.go.jp/english/e-plaza/e-sdialogue/data/Slide\_C.pdf](http://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\_Environ](http://www.uvi.edu/files/documents/Research_and_Public_Service/WRRI/Introduction_to_Environ) mental\_Microbiology.PDF

7.https://[www.geoengineer.org/education/web-class-projects/cee-549-geoenvironmental-engineering-](http://www.geoengineer.org/education/web-class-projects/cee-549-geoenvironmental-engineering-) winter-2013/assignments/bioremediation#applicability-to-soil-and-contaminant-types [8.ht](http://www.pollutionissues.com/A-Bo/Bioremediation.html)t[p:](http://www.pollutionissues.com/A-Bo/Bioremediation.html)/[/www.pollutionissues.com/A-Bo/Bioremediation.html](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/](http://www.onlinebiologynotes.com/bioremediation-concept-types-advantages-and-limitations/)

11. https://[www.onlinebiologynotes.com/microbial-ecology-and-role-of-microorganism-in-ecosystem/](http://www.onlinebiologynotes.com/microbial-ecology-and-role-of-microorganism-in-ecosystem/)

## ALLIED PAPER - 3

**Name of the Course: B.Sc. Environmental Management Semester: III Name of the Paper: Environmental Economics Credits: 3 Paper Type: Allied-2 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; indirect 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 Equimarginal 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. Impacts 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.

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **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 & Distributers, 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](http://www.planetarc.com/)

## Skill Based subject – 01

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

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

## Paper Type: skill based subject Hours of Teaching: 3

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## REMOTE SENSING AND GIS

**Objectives**

* To facilitate to gain the basic knowledge of distantly sensing devises.
* 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 mage 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**

## GeographicalInformation 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, Forest management, watershed management, 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. andGhosh,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

1. https://dayinterpreting.com/?gclid=EAIaIQobChMI1MSCodKo6AIV2BwrCh3OQAOBEAAY AyAAEgLEC\_D\_BwE
2. <http://rsgislearn.blogspot.com/2007/06/digitization-basics-and-right-methods.html>
3. https://[www.geospatialworld.net/](http://www.geospatialworld.net/)

**Non-Major Elective Paper- 01**

**Name of the Course: B.Sc. Environmental Management Semester: III Name of the Paper: Global Environmental Issues and Management Credits: 2**

**Paper type: Non- Major Elective Hours of teaching : 2**

**GLOBAL ENVIRONMENTAL ISSUES AND MANAGEMENT**

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 -Population distribution and Urbanization - Poverty, food security and environmental degradation.

**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. Poulopoulos 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](http://www.stateofglobalair.org/sites/default/files/soga-2018-report.pdf)
2. [www.who.int/airpollution/](http://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](http://www.footprintnetwork.org/our-work/earth-overshoot-day)
6. https://[www.elsevier.com/\_data/assets/pdf.../ElsevierDisasterScienceReport-PDF.pdf](http://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
8. [www.ipcc.ch/](http://www.ipcc.ch/)
9. <https://climate.nasa.gov/>
10. <https://sdgs.un.org/goals>

**CORE PRACTICAL PAPER - 2**

**Name of the course : B.Sc Environmental Management semester: I&II**

**Name of the paper : Environmental chemistry & Environmental Microbiology credits: 1**

**Paper type : core practical Hours of practical : 3**

**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 Afla toxin production .**

**4 . Biomagnification of pesticides .**

**5 .Impacts of Toxins of plants.**

**6. Biochemical effects of lead & cadmium**

**7 . Preparation of culture media for microorganism**

**8 .Gram staining of Bacteria**

**9. Isolation of microorganism from the soil .**

**10.Enumeration of Microbes from sewage .**

**11 .Determination of Bacterial growth curve**

**12 .Biodegradation of an organic pollutant .**

**CORE PAPER - 6**

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| **Name of the Course: B.Sc. Environmental Management Name of the Paper: Environmental Pollution and Control Measures**  **Paper Type: Core** | **Semester: IV** |
| **Credits: 4** |
| **Hours of Teaching: 6** |

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**ENVIRONMENTAL POLLUTION AND CONTROL MEASURES**

**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 .

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- 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.

**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 - Effects of Radiation on Environment.

## Course outcomes:

1. After studied Unit I, the students will be able to understand and explain the air pollution, sources, and control methods.
2. After studied Unit II, the students will be able to understand and analyze the impact of water pollution on environment, and explain the treatment of waste water.
3. After studied Unit III, the students will be able to recognize the sources of soil pollution, soil degradation, and realize restoration of soil fertility.
4. After studied Unit IV, the students will be able to understand Noise pollution & their impact on human health & take steps to reduce noise pollution.
5. After studied 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 Mc Graw Hill publishing co ltd, New Delhi.

## E-MATERIALS

1.https://[www.nrdc.org.](http://www.nrdc.org/) 2.https://[www.epa.gov.](http://www.epa.gov/) 3.https://data.gov.in.

1. https://orfonline.org.
2. [https://www.ncbi.nim.nih.govpmc](https://www.ncbi.nim.nih.govpmc/)

## CORE PAPER - 7

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| **Name of the Course: B.Sc. Environmental Management Management** | | **Semester: IV**  **Credits: 4**  **Hours of**  **Teaching: 5** |
| **Name of the Paper:** | **Pollution Monitoring and Analytical Techniques** |
| **Paper Type: Core** |  |  |

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## 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 analyses methods
5. To understand the principles and methods of analytic 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

**POLLUTION ANALYTICAL EQUIPMENTS**

Colorimetric - pH meter- Electrical Conductivity Meter - Nephlometer - High Pressure Liquid Chromatography (HPLC) - Gas Chromatography with Mass Spectroscopy - Flame Atomic Absorption Spectrometry - Chemiluminiscence - Bioluminescence Test - Sound Level Meter - X-ray Diffraction.

## Course Outcomes

1. After studied Unit I, the students will be able to understand the air, water, soil sample collection methods for pollution monitoring.
2. After studied Unit II, the students will be able to understand and analyze the water quality parameters and methods of analysis.
3. After studied Unit III, the students will be able to handle the quality analysis and determine polluted soil.
4. After studied Unit IV, the students will be able to understand air sampling methods and analysis of air pollution methods.
5. After studied Unit V, the students will be able to gain knowledge about thermal and radioactive pollution and take precaution measures.

## Text Books

1. Krishnan Kannan, K., 1997. Fundamentals of Environmental Pollution, S. Chand Company, New Delhi.
2. Murali Krishna, K.V.S.G. (2015) Air Pollution and Control, University Science Press.
3. Goel, P.K. (2006) Water Pollution Causes, Effects and Control, New Age International Publishers.

## Reference Books

1. Dara, S.S., 2000. A text book of environmental chemistry and pollution control. S. Chand Company, New Delhi.
2. Christian GD (2001), Analytical Chemistry, 5th edition, John Wiley and Sons Inc., India
3. Wilson, K, Walker, J (2010) Principles and Techniques of Biochemistry and Molecular Biology, 7th edition, Cambridge University Press.

## 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 Hours of Teaching: 6**

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## ENERGY AND 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 laws of thermodynamics - Energy Conversion - Global Energy Crisis - Non- Renewable Energy Sources: Fossil fuels - Composition and Classification of coal, Crude Oil and Natural Gas - Consumption and Demands of Coal, Crude Oil and natural gas - Environmental Impacts of Fossil Fuel Consumption - 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 (UNFCC) - UN sustainable Development Goals.

## Course Outcome

1. After studied Unit I, the students will be able to know the major sources and uses for energy and their advantages and disadvantages.
2. After studied Unit II, the students will be able to explain various non- renewable energy sources.
3. After studied Unit III, the students will be able to know the impacts of fossil fuels on environment and human health.
4. After studied Unit IV, the students will be able to understand and justify the need of renewable energy sources alternative to the fossil fuels.
5. After studied 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](http://www.indiaenvironmentportal.org.in/) [2.ht](http://www.cpcb.nic.in/)t[p:](http://www.cpcb.nic.in/)/[/www.cpcb.nic.in](http://www.cpcb.nic.in/)

3. [http://www.gpcb.gov.in](http://www.gpcb.gov.in/)

## ALLIED PAPER - 4

**Name of the Course: B.Sc. Environmental Management Semester: IV Name of the Paper: Environment and Ecotourism Credits: 5 Paper Type: Allied-2 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 in 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, Sikim, 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 SUBJECT-2

**Name of the Course: B.Sc. Environmental Management Semester: IV Name of the Paper: Aquaculture and Environment Credits: 2 Paper Type: Skill Based Hours of Teaching: 3**

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**AQUACULTURE AND ENVIRONMENT**

## UNIT I

Culture System – Fresh Water – Brackish Water – Extensive - Intensive - Semi Intensive – Pokkali – Cage – Pen Culture – Mono – Monosex – Poly – Paddy cum Fish – Fish cum Poultry – Fish cum Dairy Fish cum Pig – Fish cum Duck – Fish Ponds – Breeding – Nursery – Rearing – Stocking – Dry and Wet Bunth – Construction and Maintenance of Fish Farm.

## UNIT II

Induced Breeding – Hypophysation – Definition – Principles Hypophysation – Procedure of Hypophysation – Collection – Preparation – Injection – Mechanism of Pituitary Action – Advantages of Hypophysation – Seed Collection – Collection from Natural Habitat – Bundh Breeding – Hypophysation – Transport of Fish Seed – Open System – Closed System.

## UNIT III

Preservation of Fishes – Fish Spoilage – Chemical Action – Autolysis – Microbial Action – Principles of Fish Preservation – Cleaning – Low Temperature – High Temperature – Dehydration – Salts – Methods of Preservation – Curing – Drying – Freezing – Fish diseases – White Spot Diseases – Costiasis – Whirling Diseases – Knot Diseases – Gill Rot – Pin Head – Rickets – Causes – Symptoms – Treatment.

## UNIT IV

Pearl culture-Definition-Types-Composition of pearl-Pearl producing animals- Cultivable species-Biology of pearl oysters-Pearl formation-Culture of pearls-Fresh water pearl culture.

## UNIT V

Sewage fed fish culture- Definition- Harmful effects of sewage-Beneficial effects of sewage- Sewage treatment for fish culture- suitable fishes for sewage fed fish culture- Production in sewage fed fish culture.

## REFERENCE

1. Jhingaran, C.G. 1981. Fish and Fisheries of India, Hindustan Publishing Corporation.
2. Pillay, T.V.R. 1990. Aquaculture. Principles and Practices. Blackwell Publishing, Oxford.
3. Srinivasalu Reddy, M. and K.R.S SambasivaRao. 2004. A Textbook of Aqua Culture. Discovery Publishing House, NewDelhi.
4. Talwar, P.K. and Jhingaram, A.G. 1991. Inland Fisheries of India and adjacent countries, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
5. N. Arumugam. 2008. Aquaculture, Saras Publications, Nagercoil, Tamilnadu

**NON-MAJOR ELECTIVE PAPER – 2**

**Name of the course : B.Sc Environmental Management semester : IV**

**Name of the paper : occupational safety health and management credits : 2**

**Paper type : Non major elective . Hours of teaching : 2**

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## OCCUPATIONAL SAFETY HEALTH AND MANAGEMENT

## UNIT-I

Occupational Hazards- Types of Occupational Hazards – Health – Definition – Need for Good Health – Factors Affecting Health – Malnutrition – Deficiency Diseases- Balanced diet-Food adulterants-Personal Hygiene.

## UNIT II

Health problems due to Air and Water Pollution - Communicable Disease - Mode of transmission (Epidemic and Endemic diseases)-Water borne - Air borne - Food borne Diseases.

## UNIT III

Occupational health hazards-Physical-Chemical and Biological hazards- Occupational diseases – Silicosis - Asbestosis - Byssinosis-Hearing loss-Prevention and Control of Occupational diseases.

## UNIT IV

Industrial safety standards- Causes of Accidents-Definition-Accident Reporting System - First aid – Frequency rate-Prevention and Control-Health education-Safety awareness.

## UNIT V

Environmental Management System (EMS)-ISO14000 and ISO14001-OSHA-The Public Liability Insurance Rules, 1991. Compensation Act.

## REFERENCE

1. Scoot, R, M, 1997 concepts of industrial hygine, lewis publisher, New York.
2. Diberardins L.J., 1998. Hand Book of Occupational safety and health, john Willey, New York.
3. Park J.E, and Park Preventive and social medicine.
4. Schilling R.S.E 1973. Occupational health practices, Buffer Worth, London,
5. Gurjar, B.R., Molina, L.T. & Ojha C.S.P. 2010. Air Pollution: Health and Environmental Impacts. CRC Press, Taylor & Francis.

3

**CORE PRACTICAL PAPER -3**

**Name of the course : B.Sc Environmental Management semester : IV**

**Name of the paper : core practical -3 credits : 3**

**Paper type : core Practical . Hours of practical : 3**

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**ENERGY AND ENVIRONMENT**

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**EXPERIMENTS**

* + 1. **Estimation of Total solids and Dissolved solids**

**2.Estimation of Turbidity**

**3.Estimation of chloride**

**4.Estimation of Dissolved Oxygen .**

**5.Estimation of Total Alkalinity .**

**6.Estimation of Total Hardness**

**7.Estimation of phosphate .**

**8.Pollution Indicators**

**9.Demonstration of pH and conductivity meter**

**10 .Demonstration of AAS .**

**11.Demonstration of Noise level meter.**

**12.Demonstration of Renewable Energy Sources .**

## CORE PAPER - 09

**Name of the Course: B.Sc Environmental Management Semester: V Name of the Paper: Waste Management and Recycling Credits: 5**

**Paper Type: Core Hours of Teaching: 6**

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## 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 - VermiComposting.

## 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 Meth - Neutralization, Oxidation Reduction Precipitation, Solidification, Stabilization, Incineration and Final Disposal. Hazardous Waste (management and handling) Rule 2016 .

## 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 2020.

## Course Outcomes

1. After studied Unit I, the students will be able to understand the different types of solid wastes and their sources and characteristics.
2. After studied Unit II the students will be able to recognize different types of waste collection, transport method and follow proper disposal method.
3. After studied Unit III, the students will be able to explain various waste recycling methods.
4. After studied Unit IV the students will be able to distinguish hazardous wastes and
5. After studied 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. US EPA. 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- andHandling-Rules-1989.pdf [3.ht](http://www.hp.gov.in/dhsrhp/pdf/Biomedical_waste.pdf)t[p:](http://www.hp.gov.in/dhsrhp/pdf/Biomedical_waste.pdf)/[/www.hp.gov.in/dhsrhp/pdf/Biomedical\_waste.pdf](http://www.hp.gov.in/dhsrhp/pdf/Biomedical_waste.pdf) [4.ht](http://www.cpeo.org/techtree/ttdescript/pyrols.html)t[p:](http://www.cpeo.org/techtree/ttdescript/pyrols.html)/[/www.cpeo.org/techtree/ttdescript/pyrols.html](http://www.cpeo.org/techtree/ttdescript/pyrols.html) [5.w](http://www.satavic.org/vermicomposting.html)ww[.satavic.org/vermicomposting.html](http://www.satavic.org/vermicomposting.html)

6.<http://web.mit.edu/urbanupgrading/urbanenvironment/sectors/solid-waste-landfills.html> [7.w](http://www.cement.org/waste/wt_apps_radioactive.asp)ww[.cement.org/waste/wt\_apps\_radioactive.asp](http://www.cement.org/waste/wt_apps_radioactive.asp)

8. [www.ipma.co.in/recycle.asp](http://www.ipma.co.in/recycle.asp)

## CORE PAPER - 10

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

**Name of the Paper: Environmental Safety, Health and management Credits: 5 Paper Type: Core Hours of Teaching: 6**

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**Environmental Safety, Health and management 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 - Anthracosis - 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) - Standards.

**Course Outcome**

1. After studied Unit I, the students will be able to understand the concept and scope of Environmental Health.
2. After studied Unit II, the students will be able to recognize different types of public health issues.
3. After studied Unit III, the students will be able to undemand occupational health hazards, and take steps to control measures.
4. After studied Unit IV, the students will be able to identify the suitable safety measures to prevent industrial occupational hazards.
5. After studied Unit V, the students will be able to utilize the environmental management system.

**Text Books**

* 1. Shaw, J. Chadwick (1998) Principles of Environmental Toxicology, Taylor& Francis Ltd.
  2. Annalee Yassi, Tord Kjellstr"om, Theo de Kok, Tee Guidotti (2001). Basic Environmental Health, Oxford University Press.

**Reference Books**

* + 1. Scoot, R, M, (1997) concepts of industrial hygine, lewis publisher, New York.
    2. Diberardins L.J., (1998). Hand Book of Occupational safety and health, john Willey, New York.
    3. Park J.E, and Park Preventive and social medicine.
    4. Schilling R.S.E (1973). Occupational health practices, Buffer Worth, London,
    5. Gurjar, B.R., Molina, L.T., Ojha C.S.P. (2010). Air Pollution: Health and Environmental Impacts. CRC Press, Taylor & Francis.
    6. Monroe T. Morgan (2003) Environmental Health, Third Edition, Thomson/Wadsworth Publishers.
    7. Koren, H. (2002). Handbook of Environmental Health and Safety - Principle and Practices, Fourth Edition, Lewis Publishers, CRC Press.

**E-Material**

1.https://dgfasli.gov.in/sites/default/files/service\_file/Nat-OSH-India-Draft%281%29.pdf [2.w](http://www.ehs.ucsb.edu/)ww[.ehs.ucsb.edu/](http://www.ehs.ucsb.edu/)

1. <http://safety.ucanr.edu/Safety_Notes/>
2. https://doresearch.stanford.edu/policies/research-policy-handbook/environmental-health- andsafety/health-and-safety-principles 5.https://www.cdc.gov/niosh/docs/98145/pdfs/98145.pdf?id=10.26616/NIOSHPUB98145 6.https://[www.gooduniversitiesguide.com.au/careers-guide/occupational-health-and-safety-](http://www.gooduniversitiesguide.com.au/careers-guide/occupational-health-and-safety-) officer

7.https://doresearch.stanford.edu/policies/research-policy-handbook/environmental-health- andsafety/health-and-safety-principles

## CORE PAPER - 11

**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 INSTRUMENTATION

**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- power point. Network- Internet, World Wide Web, Search Engines, E- mail. Applications 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 Voltera 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 operation 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 Text book of statistics, paramount publication, palani.
2. Vittal, R.R(1986) Business Mathematics and Statistics, Murugan Publications.
3. Sanjay saxena (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](http://www.stat.cmu.edu/~brian/701/notes/paper-structure.pdf) [2.w](http://www.cengage.com/resource_uploads/downloads/1133629601_397200.pdf)ww[.cengage.com/resource\_uploads/downloads/1133629601\_397200.pdf](http://www.cengage.com/resource_uploads/downloads/1133629601_397200.pdf)

3. https://[www.scribd.com/document/.../Statistical-Analysis-of-Data-with-report-writing](http://www.scribd.com/document/.../Statistical-Analysis-of-Data-with-report-writing)

## MAJOR ELECTIVE PAPER -01

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## Name of the course : B.Sc. Environmental Management semester : V

## Name of the paper : Principles of Sustainable Development

## and Management credits :3

## Paper type : Major Elective Hours of teaching : 6

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**PRINCIPLES OF SUSTAINABLE DEVELOPMENT AND MANAGEMENT UNIT – I**

Function of Management – Planning Organizing and Controlling, Systems approach to Management, Patterns of Analysis, Economic, Social Political and Ethical factors affecting Management practice.

## Unit – II

Steps in the Planning Process Management.By objectives, Programme Budgeting, Capital budgeting, Economic Analysis – Marginal Analysis, Benefit / Cost Analysis etc. Decision Analysis – Risk and Uncertainty decision tress, Strategy and Policy Analysis, Limitation of Planning.

## Unit – III

Organizational Structure, Formal and Informal Organization, Line and Staff relations, relations with the public , Principles of delegation, Performance appraisal motivation, Communication and leadership aspect, Theories of Organization.

## Unit – IV

Green buildings – History of Green buildings – Need and Relevance of Green buildings – Associated cost and benefits –Outlined examples of Green buildings – LEED certified building - Eco mark certification – Establishment of Eco mark in India, Its importance and implementation.

## Unit – V

Public transportation for Sustainable development – Green belts – Introduction to UNEP’s – Green Economy Initiative, inclusive Economic growth of the society – REDD+ initiative and cap and trade concept – Green banking – Setting environmental goals, resource mobilization use of Natural resource and Environmental indicators, Output budgeting, Monitoring and Evaluating Environmental Programme.

## REFERENCE

1. Sharma ,R.D.(1976), Organizational Management, Light and life publishers, New Delhi
2. Chakraborthy. S.K (1976) Management by objection Macmillan Co .of India Ltd, New Delhi
3. Varma and Agarwal, theory & practice of Management Forward Book Depot, New Delhi.
4. Anastas, P.T. & Warner, J.C. 1998. Green Chemistry: Theory & Practice. Oxford University Press.
5. Arceivala, S.L. 2014. Green Technologies: For a Better Future. Mc-Graw

**SKILL BASED SUBJECT**

**PAPER -3**

**Name of the course : B.Sc Environmental management semester : V**

**Name of paper :Forest conservation & management credits : 2**

**Paper type: skill based subject hours of teaching : 3**

**FOREST CONSERVATION AND MANAGEMENT**

**UNIT 1**

Forest-Types-Moist Deciduous-Dry Deciduous-Evergreen – Semi green- Grassland- Thorny Forest - mangrove forest -utilization of forest products-Timber, firewood, pulp, fodder and medicinal plants.

## UNIT II

Sacred groves-Values- Scared groves in Tamil Nadu - Shrines of symbols-Character of deities-festivals-Beliefs, Taboos associated with sacred groves-key stone species-ethical dilemma in sacred groves-conservation.

## UNIT III

Forest movement-and Peoples participation - Tribal community symbiotic relationship between tribal and Forest, community participation - Chipko movement, Apiko movement. India`s bishnoi community and their conservation practices.

## UNIT IV

Social forestry, Afforestation, Ecological significance of Forests, plant indicators, Forests as carbon sinks.

## UNIT V

Forest conservation-Protection from fire, Prevention of Fire, Protection from wild animals-Raise of awareness, through tourism, Role of government in forest conservation, Forest conservation ACT 1980.

## REFERENCE

1. Kormondy, E.J. 2005. Concepts of Ecology. Prentice hall of India Pvt Ltd. New Delhi
2. Calrke, G.L.1954. Elements ecology , John Wiley and Sons, New York.
3. Champman, R.N.1928. The Quantitative analysis of environmental factors Ecology 9:111-122
4. Champion H.G &seth, 1965 A revised Survey of the forest types of India, Manager of publishers New Delhi.
5. S. Karthikeyan and A.C. Thangavelou 2011. Journey through Sacred Grooves. Bio- Science Research Foundation, Pondicherry, India.

**CORE PRACTICAL PAPER -4**

# Name of the course : B.Sc . Environmental Management semester : V

# Name of the paper : Biostatistics & Instrumentation and

# Waste Management

# Paper type: core practical Hours of practical : 3

# BIOSTATISTICS & INSTRUMENTATION AND WASTE MANAGEMENT

# 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- land fill

# 5 .Characterization of land fill 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 Deviaion 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

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## COREPAPER-12

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

## Name of the Paper:Natural Hazard and Disaster Management Credits:4

**Paper Type: Core Hours Of Teaching:6**

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**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, Impacts on Environment- Control Measures- Tsunami- Cyclones - Landslides-Causes , Impacts on Environment- Preventive Measures.

**UNIT- II**

**ANTHROPOGENIC HAZARDS**

Anthropogenic Hazards- Impacts of Anthropogenic Activities – Rapid Urbanization –Injudious Ground water Extraction –Sand Mining From River Bank -Deforestation -Mangroves Destruction- Warfare- Chemical Weapons -Biological Weapons -Major Accidents From Industries-Lov 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-Applications of Geoinformatics in Hazard

,Risks And Vulnerability Assessment.

**UNIT- IV**

**DISASTER MANAGEMENT SYSTEM**

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

**UNIT- V**

**DISASTER MANAGEMENT IN INDIA**

Policy For Disaster Reduction –Disaster Management Act 2005 –National Guidelines and Plans on Disaster Management –National Disaster Management Authority (NDMA) –NIDM (National Institute of Disaster Management) – State Disaste Management Authorities-National Disaster Response force.

## Course Outcomes

1.The students will be able to differentiate vulnerability,risk & hazard. 2.To gainknowledge about the different types of Natural Disasters.

1. To impart knowledge on anthropogenic hazards & its impacton environment.
2. To know about the national & international agencies, NGOs for major role in disaster management.
3. Knowledge gained will enable the students to volunteer themselves in disaster management programs 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.HPublishing Corporation, NewDelhi.
3. Disaster Management:A Disaster Manager’s Hand book ,Carter ,N.W .(1992), Asian Development Bank ,Manila.

4.A Manual On Disaster Management, Diwan , P.(2010) ,Pentagon Earth, NewDelhi. 5.Early Warning Systems For Natural Disaster Reduction ,Zschau, Jand Kuppers

,N.(2003), Springer-Verlag ,Berlin , Heidelberg.

## Reference Books

1. Natural Hazards & Disaster Management-Vulnerability & mitigation, SinghR.B,(2006), Rawat Publications.
2. Disaster Planning: The Preservation of Life & Property ,Foster ,H.D,(1980)

,SpringerVerlay ,NewYork.

1. Disaster Management, SinghS.K,S.C .& SinghS (1998) Mittal Publications ,NewDelhi. 4.Natural Disaster Reduction ,Mishra G.K&Mathur G.C,(1993), Reliance Publishing House,

NewDelhi.

## E-Materials

* 1. https://[www.GIS.Development.net](http://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:4

**Paper Type :Core Hours of teaching : 5**

**------------------------------------------------------------------------------------------------------------ ENVIRONMENTAL IMPACT ASSESSMENT**

## Course Objectives:

1.To impart knowledge about Environmental Impact Assessment 2.To identify methods and parameters to be included to EIA 3.To learn about the methods and steps involved in EIA

4.To repot the EIA study report and post EIN 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 –Sitting 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 anddata collection-Environmental auditing.

## UNIT -III

**EIA METHODLOGIES**

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

## UNIT- IV

**ENVIRONMENTAL IMPACT STATEMENT**

Environmenta Impact Statement(EIS) and Environmental Management Plan(EMP) Environmental Management System Standards (ISO14000series). EIA Notification ,2006 and 2020 amendments. Eco-labeling schemes.

## UNIT- V

**EIA CASE STUDIES**

Case Studies for Major Developmental Projects :Hydro electric and Thermal PowerPlants

,Mining ,Highway Roads, Airport, Cement Industries.

## Course outcomes

1. After studied UnitI, the students will be able to explain the importance and principles of EIA

processes.

1. After studied UnitII, the students will be able to identify and list out the parameter to be evaluated fo rEIA.
2. After studied UnitIII,the students will be able to understand follow the methods of EIA . 4.After studied UnitIV, the students will be able to summarize the EIA report and

appropriate environmental management plan.

5.After studied UnitV,the students will be able to access and analyze EIA cases studies report of different developmental projects.

## Text Books

1.EIA Manual (2001) Ministry of Environment, Forest and Climate Change ,NewDelhi. 2.Barthwal ,R.R. (2012) EnvironmentalImpact Assessment,New Age Internationa

Publishers.

3.Khandeshwar, S.R.,Raman,N.S. ,Gajbhiye,A.R.(2019) Environmental Impact Assessment

,I.K.International Publishing HousePvt.Ltd.

## ReferenceBooks

1.Barrow, C.J.(2000)Social Impact Assessment: An Introduction.Oxford UniversityPress. 2.Glasson,J.,TheRivel,R.,Chadwick,A.(1994) Introduction to Environmental Impact

Assessment. London ,Research Press,UK.

3.Judith,P.(1999) Hand book of Environmental Impact Assessment.Black well Science. 4.Marriott,B.(1997) Environmental Impact Assessment:A Practical Guide .McGraw

.Hill,NewYork,USA.

1. Canter,L.W.(1997) Environmental Impact Assessment.McGraw-Hill, NewYork.
2. Peter Wathern(2015) Environmental Impact Assessment: Theory and Practice, Taylor &Francis, London.

## E-Materials

* 1. <http://environmentclearance.nic.in/> [2.ht](http://environmentclearance.nic.in/writereaddata/Draft_EIA_2020.pdf)t[p:](http://environmentclearance.nic.in/writereaddata/Draft_EIA_2020.pdf)/[/environmentclearance.nic.in/writereaddata/Draft\_EIA\_2020.pdf](http://environmentclearance.nic.in/writereaddata/Draft_EIA_2020.pdf) [3.w](http://www.fao.org/docrep/V8350E/v8350e06.htm)ww[.fao.org/docrep/V8350E/v8350e06.htm](http://www.fao.org/docrep/V8350E/v8350e06.htm) [4.ht](http://www.moef.nic.in/division/eia-manual)t[p:](http://www.moef.nic.in/division/eia-manual)/[/www.moef.nic.in/division/eia-manual](http://www.moef.nic.in/division/eia-manual) [5.ht](http://www.moef.nic.in/circulars)t[p:](http://www.moef.nic.in/circulars)/[/www.moef.nic.in/circulars](http://www.moef.nic.in/circulars)

6.https://[www.adb.org/documents/adb-environmental-assessment-guidelines](http://www.adb.org/documents/adb-environmental-assessment-guidelines) 7.https://[www.iaia.org/eia-index-of-websites.php](http://www.iaia.org/eia-index-of-websites.php) 8.https://[www.csaocean.com/services/environmental-impact-assessment-eia](http://www.csaocean.com/services/environmental-impact-assessment-eia)

9. https://[www.elaw.org/files/mining-eia-guidebook/Chapter2.pdf](http://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:4 Paper Type :Core Hours of Teaching:5**

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**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) Rules2000-The Biological Diversity Act, 2002-The National Green TribunalAct,2010-Solid Waste(Management and Handling) Rules, 2000 –Biomedical Waste (Management and Handling) Rules1998- Solid Waste Management Act2016.

**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 Rules2009; Coastal Regulation Zones(CRZ)Rules2011;E-waste Management and Handling Rules2011 ;Plastics Manufacture

,Saleand Usage Rules,2011

**UNIT-IV**

**ENVIRONMENTAL POLICY**

Definition –Benefits of developing an Environmental Policy- International Agreements-Montreal Protocol 1987 –Kyoto Protocol 1997- Copenhagen –Pairssummits Conventionon 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 (RioDeclaration,Agenda21) Scheme and Labelling of Environment Friendly Products-Indus Water Treaty- Ganges Water Treaty -Vienna Convention for the Protection of Ozone Layer1985.

## Course Outcomes:

1. To know about the constitution of India environmental legislation and Environmental ethics.
2. To impart knowledge on legislation for environmental protections.
3. To knowabout the National Green Tribunal Act and bio medical waste management rules.
4. To understand about the environmental policies and internationa lagreements. 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. JadhavH&BhosaleY.M,1995 ,Environmental Protection & Laws ,Himalayan Publications ,NewDelhi.
4. DiwanS&RosencranzA ,2002 ,Environmental Law and Policy in India ,Cases

,Materials & Statues ,Oxford University Press.

## Reference

1. Nandithakrishna,Environmental Laws of India-AIntroduction ,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 NewDelhi,2018.
3. Abraham,C.M,1999,Environmental juris prudence in India ,Kluwer Law International.

**E-Materials** 1.https://[www.sciencedirect.com](http://www.sciencedirect.com/) 2.https://[www.epd.gov.hk.](http://www.epd.gov.hk/)

3.https://[www.gsa.gov.](http://www.gsa.gov/) 4.https://[www.iced.cag.gov.in.](http://www.iced.cag.gov.in/)

1. https://[www.unece.org.](http://www.unece.org/)

# Elective Paper 02

**Name of the Course: B.Sc. Environmental Management Semester: III Name of the Paper: Climate Change and Current Issues Credits: 3 Paper Type: Elective Hours of Teaching:3**

**CLIMATE CHANGE AND CURRENT ISSUES**

**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: Collison and Co-alescence process and Ice- crystal or Bergeron process – Cloud seeding – Precipitation types.

**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 - 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.

**UNIT IV**

**Climate Classification, Measurement of Climate**

Classification of climate: Koppen's and Thornthwaite' scheme - The measurement of climate change: Tree rings, ice cores, ocean sediments, pollen records, Boreholes and other proxy measurements.

**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 – 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.

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2. <http://unfccc.int/>
3. https://[www.ipcc.ch](http://www.ipcc.ch/)
4. https://[www.co2.earth/](http://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: VI Name of the Paper: Environmental Toxicology Credits: 3 Paper Type: Elective Hours of Teaching: 3**

**ENVIRONMENTAL TOXICOLOGY**

**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 - LC50 LD50.

**UNIT II - Toxicity Testing**

Toxicity testing (i) laboratory animals, (ii) toxicity testing in animals, (iii) toxicological field studies, Concepts of Bioassay, Types and characteristics - 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 – Bio accumulation and Bio magnifications - mechanisms of toxicity. - food toxicity, genotoxicity, Molecular neurotoxicity.

**UNIT V - Pesticide toxicology**

Bioaccumulation and Bio magnifications of toxic materials in food chain, Types, mechanism and Toxicology of major pesticides - Environmental impacts of pesticides, biotransformation, bio monitoring, concept of bio indicator groups and examples.

**Reference Books**

* 1. Alberts B, Bray D, Hopkin K et al. (2009) Essential Cell Biology, 3rd edition,
  2. Alberts B, Johmson A, Lewis J, Raff M, Roberts K and Walter P (2002) Molecular Biology of the Cell, Garland Science, New York.
  3. Buchanan BB, Gruissem W and Jones RL (2002) Biochemistry and Molecular Biology of Plants, ASPB, USA.
  4. Cooper GM and Hausman RE (2013) The Cell: A Molecular Approach, 6th edition, Sinauer Associates, Sunderland, MA, USA.
  5. David L. Nelson, Michael M. Cox (2004) Lehninger Principles of Biochemistry (1970) by Albert L. Lehninger Published April 23rd 2004 by W. H. Freeman (first published).
  6. Gerald Karp (2002) Cell and Molecular Biology: Concepts and Experiments, 7th edition.

## SKILL BASED SUBJECT PAPER – 4

## Name of the course: B.Sc Environmental management semester : VI

## Name of the paper: Environmental Biotechnology and Herbal science Credits: 2

## Paper type: skill based Hours of teaching : 3

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**ENVIRONMENTAL BIOTECHNOLOGY AND HERBAL SCIENCE**

**UNIT I**

Environmental Biotechnology: Basic Concept, Aim and Scope – Pollution Monitoring – Biotechnological Methods – Biosensors – Biological Treatment of Waste Water.

## UNIT II

Agricultural Biotechnology – Micro Propagation – Techniques – Application – Bio Fertilizers – Mass Cultivation Techniques of Rhizobium, Azolla and Phospho bacteria – Bio-Pesticides – Petroleum Plants.

## UNIT III

Mushrooms Technology – Nutritive Value of Edible Mushrooms – Medicinal Value of Mushrooms – Advantages of Mushrooms Cultivation – Cultivation of Oyster Mushrooms.

## UNIT IV

Herbal Science – Traditional System of Medicine – Siddha – Ayurveda – Homeopathy – Common Medicinal Plants – Zingiber officinale– Aloe vera – Ocimum sanctum – Asafoetida – Honey.

## UNIT V

Conservation Methods for Herbal Plants – Insitu and Ex-situ Conservation – Herbal Farms – Biotechnology in Conservation of Medicinal Plants – Adulteration of Herbal Products – Reason – Types – Disadvantages.

## REFERENCE

1. N. Arumugam, V. Kumaresan, Applied Plant Biotechnoloy. 2016, Saras Publication, Nagarcoil.
2. V.Kumaresan, Herbal Biotechnology & Pharmacography, 2015, Saras Publication, Nagarcoil.
3. Gupta B.K. Elements of Biotechnology, 1997, Tata McCraw Hill Pub. New Delhi.
4. Scagg, A.H. 2005. Environmental Biotechnology. Oxford University Press.
5. Wainwright, M. 1999. An Introduction to Environmental Biotechnology. Springer.