# KISAN POST GRADUATE COLLEGE, BAHRAICH (UP) 271801
(Autonomous)

## Proposed Structure of Syllabus for the
## PROGRAM: Bachelor of Science

## SUBJECT: ENVIRONMENTAL SCIENCE

| Syllabus developed/ Proposed by: - | | | | |
|---|---|---|---|---|
| **S. No.** | **Name** | **Designation** | **Department** | **College/ University** |
| 1. | Dr. Sumit Srivastava | Coordinator | Department of Environmental Science | Kisan P. G. College Bahraich, U.P. |
| 2. | Prof. (Dr.) Siddharth Shukla | University Nominee | Department of Environmental Science | Dr. Rammanohar Lohia Avadh, University, Ayodhya-224001, |
| 3. | Prof. (Dr.) B. D. Tripathi | Subject Expert | Department of Environmental Science | B. H. U. Varanasi |
| 4. | Prof.(Dr.) Pooja Singh | Subject Expert | Department of Botany | D. D. U. Gorakhpur University, Gorakhpur |
| 5. | Prof. (Dr.) Jaswant Singh | Invited Member | Department of Environmental Science | Dr. Rammanohar Lohia Avadh, University, Ayodhya-224001, |
| 6. | Miss. Lavi Jaisawal | Invited Member | Department of Zoology | B. D. K. College, Agra |

| Year & Semester wise Title of UG Program | | | | | | |
|---|---|---|---|---|---|---|
| **Year** | **Semester** | **Paper** | **Course Code** | **Paper Title** | **Credits** | **Teaching Hour** |
| **CERTIFICATE IN FUNDAMENTALS OF ENVIRONMENTAL SCIENCE** | | | | | | |
| **FIRST YEAR** | **I** | Theory Paper-1 | B150101T | Fundamentals of Environmental Science | 4 | 60 |
| | | Practical Paper | B150102P | Practical on Environmental | 2 | 60 |
| | **II** | Theory Paper-1 | B150201T | Environmental Biology | 4 | 60 |
| | | Practical Paper | B150202T | Practical on Environmental Biology | 2 | 60 |
| **DIPLOMA IN ENVIRONMENTAL SCIENCES** | | | | | | |
| **SECOND YEAR** | **III** | Theory Paper-1 | B150301T | Biodiversity and its Conservation | 4 | 60 |
| | | Practical Paper | B150302P | Practical on understanding Biodiversity | 2 | 60 |
| | **IV** | Theory Paper-1 | B150401T | Environmental Pollution & Management | 4 | 60 |
| | | Practical Paper | B150402P | Practical on Environmental Pollution | 2 | 60 |
| **DEGREE IN BACHLOR OF SCIENCE** | | | | | | |
| **THIRD YEAR** | **V** | Theory Paper-1 | B150501T | Natural Resources and its Management | 4 | 60 |
| | | Theory Paper-2 | B150502T | Environmental Microbiology and Biotechnology | 4 | 60 |
| | | Practical Paper | B150503P | Practical on Natural Resources and Microbial Biotechnology | 2 | 60 |
| | **VI** | Theory Paper-1 | B150601T | Environmental Legislation and Impact Assessment | 4 | 60 |
| | | Theory Paper-2 | B150602T | Environmental Priorities and Research tools | 4 | 60 |
| | | Practical Paper | B150603P | Practical on EIA, Biostatistics and Computer Application | 2 | 60 |

| Program Outcomes (POs) | | |
|---|---|---|
| **PO1:-** | The students could get employment opportunities in Central Pollution Control Board (CPCB) and State Pollution Control Board (SPCB), Research Institutions, Colleges, Universities and Non-governmental organizations. | |
| **PO2:-** | After successful completion of the course, the students could get job opportunities in urban and rural environmental mitigation and awareness programs funded by National, International and Regional agencies | |
| **PO3:-** | The students could get employment perspectives in R & D laboratories of waste water treatment plants, metal, chemical and textile effluent treatment plants, municipal solid waste management units and waste management in biomedical industries and hospitals. | |
| **PO4:-** | The students could find employment opportunities in agro industries, forest departments, water harvesting and watershed management sectors, bio resource utilization and biodiversity conservation organizations, food and feed Industries, environment friendly and integrated livestock management sectors. | |
| **PO5:-** | Students also having the immense opportunities to pursue higher studies in various research fields such as environmental pollution, waste management and bioremediation, environmental microbiology, waste water treatment, recycle, reuse and management, sustainable environmental food security, bio-resource utilization and biodiversity conservation, functional and ecosystem ecology, environmental toxicology, agro-waste ecosystem, occupational health and industrial safety, environment analytical techniques, environmental impact assessment, remote sensing and geographical information system, environmental biotechnology, carbon sequestration, natural disaster management and mitigation, climate change, resources utilization, restoration of different ecosystems, renewable and green energy and environmental law, policies and auditing. | |
| **PROGRAM SPECIFIC OUTCOMES (PSOs)** | | |
| **First Year** | Certificate in Environment Understanding | The aim is to build conceptual understanding of students by exposing them<br>- To the basic principles behind various environmental processes.<br>- To introduce students to the basic concepts of ecology its different branches, scope and ecosystem dynamics along with the various ecosystem functions. They also be able to understand the good laboratory practices, meteorological parameters and to know the strategies for sustainable management and carrying capacity. |
| **Second Year** | Diploma in Natural Resources and Microbial Biotechnology | To enrich the knowledge on biodiversity its value and various approach for conservations. Make students aware of biodiversity of India, biogeographic zones and role of local communities and traditional knowledge in conservation. Educate the students on source, classification, and impact of air, water and soil pollution & will also recognize the various control measures of pollution problems. Understand the solid waste pollution, noise pollution, radioactive and thermal pollution and related consequences. In addition also get the knowledge of sustainable management of wastes. |
| **Third Year** | Degree in Bachelor of Science | To develop the understanding on natural resources and their significance and to know the strategies for sustainable management. Understand the basic principles and application of remote sensing and GIS techniques. Impart knowledge on microbial diversity and recent advancement methods in the analysis of microbial diversity. Provide in-depth knowledge of role of beneficial and pathogenic microorganisms in environment.<br>Understand the application of microbes for production of different ecofriendly products. Impart knowledge in molecular biotechnology and its applications in Environmental management and conservation. Make students aware about Bioethics, biosafety and IPR.<br>Understand the basic laws, act, treaty, public policies and PIL. Environment provisions in constitution, power and functions of government agencies for pollution control. To introduce students to the general environmental awareness, current environmental priorities in India and basic of statistics and instrumentations. |

| PROGRAMME:- CERTIFICATE | YEAR:- FIRST | SEMESTER:- FIRST |
|---|---|---|
| PAPER - 1:- THEORY | SUBJECT:- ENVIRONMENTAL SCIENCE | |
| COURSE CODE:- B150101T | COURSE TITLE:- FUNDAMENTAL OF ENVIRONMENTAL SCIENCE | |

**Course Outcome:-**After completing the course the student will be able to:

**CO1:-** Learn fundamental concept of environmental science and develop understanding about environmental education, justice and environmentalism.

**CO2:-** Gain knowledge about origin of life and related theories

**CO3:-** Able to understand the relationship between man and environment.

**CO4:-** Understand the structure and composition of different sphere of earth.

**CO5:-** Also able to understand the different meteorological parameters.

| Credits:- 4 | Core/Elective: Core |
|---|---|
| Max. Marks:- 25+75 | Min. Passing Mark:- As per norms |

**Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0**

| Unit | Topics | No. of Lectures |
|---|---|---|
| I | **Concept of Environment:** Bhartiya Gyan Parampara aur bhartiya Vaigyanik; Definition, Principles and Scope of Environmental Science; Moral and Aesthetic Nature of Environmental Science; Objectives and Historic roots of the subject; Need for Public Awareness. | 14 |
| II | **Environmental Education:** Goals of environmental education; Environmental Literacy, Environmental Careers, Environmental Justice, Individual Organisms, Environmentalism, Environmental Education at Primary, Secondary level. | 12 |
| III | **Evolution:** Origin of life and speciation, Darwinism and modern synthetic theory of evolution, Natural Selection; Biochemical basis of origin of life; Hardy Weinberg Equilibrium; genetic drift. | 10 |
| IV | **Man and Environment:** Man-Environment relationships; Impacts of human activity on environment (Agriculture, transportation, mining, urbanization, industrialization); Environmental Degradation and Conservation Issues, Modern concept of environmental conservation, Sustainability and Carrying Capacity. | 14 |
| V | **Meteorology:** Structure and composition of atmosphere, hydrosphere, lithosphere and biosphere; Meteorological Parameters- Pressure, Temperature, Precipitation, Humidity, Wind Speed and Direction, Wind Rose, Inversion. | 10 |

**Suggested readings (Books)**

- A text Book of Environment Studies, Asthana, D. K. and Asthana, M. 2006, S. Chand & Co.
- Environmental Encyclopedia, Jaico Publ. House, Mumabai, 1196p
- Atmosphere, Weather and Climate, Barry, R. G. 2003, Routledge Press, UK.
- Environmental Science: S. C. Santra, New Central Book Agency.

**Suggestive Digital Platforms / Web Links**

- Environmental Science, Dr. Y. K. Singh https://www.hzu.edu.in/bed/E%20V%20S.pdf
- Textbook for Environmental Studies, Erach Bharucha, https://www.ugc.ac.in/oldpdf/modelcurriculum/env.pdf
- Fundamentals of Environmental Studies, https://www.jkcprl.ac.in/download/11567250727.pdf
- Environmental Science, Tom Theis and Jonathan Tomkin, OpenStax CNX, National Digital Library of India. http://ndl.iitkgp.ac.in/document/N2tzeE1aWWpUMm04b2l1VVZEdSsvK09RckF
- lSkE0OWI3b1Flb 2ZTNHFxST0
- Environmental Science, CEC EduSat, National Digital Library of India.
- http://ndl.iitkgp.ac.in/document/Rm5qb3lqRngwWDZ2TnI6UXl4VU9YRFhzeDdqSlZMSUQrQXQv
- WmF6TVBCVHdtUE1SekxkNDNNaDJIN1JVZHhhZm9NRytoRWgyTXpwRE0yUFBTK202S2c9PQ

**This course can be opted as an Elective by the students of following subjects:-** Open to All

**Suggested Continuous Internal Evaluation (CIE) Methods**

| S. No. | Assessment Type | Max. Marks |
|---|---|---|
| 1. | Test | 15 |
| 2. | Assignment & Presentation | 5 |
| 3. | Class Interaction/Attendance | 5 |

**Course Prerequisites**:- Biology in 12th

**Suggested Equivalent Online Courses**:- None

**Further Suggestions:-** None

**Any Remarks/ Suggestion**:- None

| PROGRAMME:- CERTIFICATE | YEAR:- FIRST | SEMESTER:- FIRST |
|---|---|---|
| PAPER - 2:- PRACTICAL | SUBJECT:- ENVIRONMENTAL SCIENCE | |
| COURSE CODE:- B150102P | COURSE TITLE:- FUNDAMENTAL OF ENVIRONMENTAL SCIENCE | |

**Course Outcome:-**After completing the course the student will be able to:

- Understand the Good Laboratory Practices including Dos & DON'Ts in the laboratory.
- Learn interaction of human with environment**.**
- Develop understanding about local environmental problems and able to find remedy.
- Gain knowledge about different meteorological parameters.

| Credits:- 2 | Core/Elective: Core |
|---|---|
| Max. Marks:- 25+75 | Min. Passing Mark:- As per norms |

**Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-4**

**Lab Experiments List:-**

**1**. Good Lab Practices (GLP).

- Instructions
- DOs and DON'Ts in the Laboratory
- General Information
- Introduction

**2**. Study of effects of human interaction with natural environment.

**3**. Describe the environmental problem of your locality and suggest a remedy.

**4.** Choose five common species of Trees / plants from your NEIGHBORHOOD and list their common names. Describe each plant in terms of its height and leaves.

**5.** To record the following parameters of weather monitoring station:

- Atmospheric Pressure
- Rainfall
- Outdoor, indoor temperature
- Wind speed and Direction
- E. Humidity & draw point.

**Online Virtual Lab Experiment List / Link**

**1**. Good Lab Practices, https://youtu.be/YXl6MLvcGic; https://youtu.be/TADfGsai3Ro.
**2.** Indian Meteorological Department, Weather, https://mausam.imd.gov.in/imd_latest/weather_video/video.php.
**3.** Atmospheric Pressure, https://youtu.be/r7ZfzJ-yP3U; https://youtu.be/JQp63iUYSgU.
**4.** Anemometer, https://youtu.be/cWzGDEDVEgY; https://youtu.be/J5Eh6EU18Us; https://youtu.be/n5deIWQigrk.
**5**. Rain gauge, https://youtu.be/y6tyAy_MRv0; https://youtu.be/IU9CsbAkRbc.

**Suggested Continuous Internal Evaluation (CIE) Methods**

| S. No. | Assessment Type | Max. Marks |
|---|---|---|
| 1. | Tour | 10 |
| 2. | Local field excursion | 5 |
| 3. | Activities related to Environment Awareness | 10 |

| PROGRAMME:- CERTIFICATE | YEAR:- FIRST | SEMESTER:- SECOND |
|---|---|---|
| PAPER - 1:- THEORY | SUBJECT:- ENVIRONMENTAL SCIENCE | |
| COURSE CODE:- B150201T | COURSE TITLE:- ENVIRONMENTAL BIOLOGY | |

**Course Outcome:-**After completing the course the student will be able to:

- Learn basic elements of ecology and environmental factors.
- Developing understanding about ecosystem dynamics.
- Understand the different functions played by ecosystem.
- Learn the positive and negative interaction of the organism.
- Develop conceptual skills about biogeochemical cycles

| Credits:- 4 | Core/Elective: Core |
|---|---|
| Max. Marks:- 25+75 | Min. Passing Mark:- As per norms |

**Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0**

| Unit | Topics | No. of Lectures |
|---|---|---|
| I | **Ecology:** Introduction of Ecology (Definition, History, Branches and Scope). Basicprinciples of Environment and Ecology; Environmental factors (Abiotic and biotic)their importance and role. | 10 |
| II | **Ecosystem:** Components, structure and function of ecosystem; Major ecosystems(terrestrial, aquatic, and marine); Trophic Levels, food chain and food webs; Energyflow in Ecological systems; Ecological Pyramids, Productivity. | 10 |
| III | **Autecology:** Population Characteristics- Dispersion, Density, Natality, Mortality, AgeStructure, Population Growth; Human population & growth; Ecological niche andhabitat; Positive and Negative Interactions of Populations. | 14 |
| IV | **Synecology:** Community Structure, Growth Forms; Methods of Plant Community Analysis; Concept of Keystone Species, Ecotone, Ecotypes, Ecophene, ecologicalindicators; Ecological Succession. | 12 |
| V | **Biogeochemical Cycles:** Hydrological, Gaseous and Sedimentary Cycle- Carbon,Oxygen, Nitrogen, Phosphorus and Sulphur Cycles; Major biome of the world. | 14 |

**Suggested readings (Books)**

- Ecology and Environment: P.D. Sharma., Rastogi Publication.
- Fundamental of Ecology: E. P. Odum,W. B. Sauders Company, USA
- Ecology, 2nd Edition by Paul Colinvaux, Wiley.
  Ecology: Theories and Applications (4th Edition) by Peter Stiling; Prentice Hall.
- Text Book of Environmental Studies, Erach Bharucha, Orient longman Pvt. Ltd., Ernakulam.

**Suggestive Digital Platforms / Web Links**

- Principle of Ecology, UGC-MOOCs SWAYAM.
  https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_ug/156
- Environmental Science, Dr. Y. K. Singh,
  https://www.hzu.edu.in/bed/E%20V%20S.pdf
- Textbook for Environmental Studies, Erach Bharucha,
  https://www.ugc.ac.in/oldpdf/modelcurriculum/env.pdf
- Ecology, UGC-MOOCs SWAYAM.
  https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_ug/205
- 5. Environment and Elements of Ecology, UGC-MOOCs SWAYAM.
  https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_ug/228

**This course can be opted as an Elective by the students of following subjects:-** Open to All

**Suggested Continuous Internal Evaluation (CIE) Methods**

| S. No. | Assessment Type | Max. Marks |
|---|---|---|
| 1. | Test | 15 |
| 2. | Assignment & Presentation | 5 |
| 3. | Class Interaction/Attendance | 5 |

**Course Prerequisites**:- Biology in 12th

**Suggested Equivalent Online Courses**:- None

**Further Suggestions:-** None

**Any Remarks/ Suggestion**:- None

| PROGRAMME:- CERTIFICATE | YEAR:- FIRST | SEMESTER:- SECOND |
|---|---|---|
| PAPER - 2:- PRACTICAL | SUBJECT:- ENVIRONMENTAL SCIENCE | |
| COURSE CODE:- B150202P | COURSE TITLE:- PRACTICAL ON ENVIRONMENTAL BIOLOGY | |

**Course Outcome:-** After completing the course the student will be able to:
**CO1: -**Survey skill of vegetation, insects and other animals.
**CO2:-** Learn sampling techniques for water and soil samples.
**CO3:-** Understand to set up an aquarium.
**CO4:-** Practical skills for analyzing the quadrate study of grassland vegetation.

| **Credits:-** 2 | **Core/Elective:** Core |
|---|---|
| **Max. Marks:-** 25+75 | **Min. Passing Mark:-** As per norms |

**Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-4**

**Lab Experiments List:-**

1. Survey of vegetation, birds, insects and other animals in an area.
2. To study the quality of a sample of water collected or provided.
3. To determine Texture of various soil samples.
4. To set up an aquarium.
5. To determine the following parameters of grassland vegetation:
   - Minimum size and number of quadrate.
   - Density of plant species.

**Online Virtual Lab Experiment List / Link**

1. Soil Texture and Structure, SWAYAM, https://youtu.be/ual5loY8kFg.
2. Soil texture determination method, Institute of Soil Science, https://youtu.be/EcyqKRIn1pk.
3. AMRITA, OLABS, Study of plant population density by quadrat method. http://amrita.olabs.edu.in/?sub=79&brch=18&sim=239&cnt=2Quadrate study, https://youtu.be/SL9PPwb20yY.
4. Study of Water Samples, https://youtu.be/5AD-o6Q8uYs

**Suggested Continuous Internal Evaluation (CIE) Methods**

| S. No. | Assessment Type | Max. Marks |
|---|---|---|
| 1. | Tour | 10 |
| 2. | Local field excursion | 5 |
| 3. | Activities related to Environment Awareness | 10 |

| PROGRAMME:- DIPLOMA | YEAR:- SECOND | SEMESTER:- THIRD |
|---|---|---|
| SUBJECT:- ENVIRONMENTAL SCIENCE | | |
| COURSE CODE:- B150301T | COURSE TITLE:- BIODIVERSITY AND ITS CONSERVATION | |

**Course Outcome:-** After completing the course the student will be able to:

**CO1: -** Gain knowledge on biodiversity its value and various approach for conservations.

**CO2:-** Biodiversity of India and role of local communities and traditional knowledge in conservation.

**CO3:-** Develop knowledge about biodiversity identification and IUCN.

**CO4:-** Understand the various conservation process.

**CO5:-** Learn wildlife its importance, threat and management.

| Credits:- 4 | Core/Elective: Core |
|---|---|
| Max. Marks:- 25+75 | Min. Passing Mark:- As per norms |

**Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0**

| Unit | Topics | No. of Lectures |
|---|---|---|
| I | **Biodiversity:** Basic concepts and importance; Types (Species diversity, Genetic diversity, Ecosystem diversity); Measurement of Biological Diversity; Biological and Phylogenetic Species Concept; Basic Concept of Species and Speciation. | 10 |
| II | **Identification:** Concept and basis of identification of Biodiversity Hotspots; hotspots in India. Factors for Decline of Biological Diversity, Concept of Extinction, Threatened and Endangered Species; IUCN categorization. | 12 |
| III | **Conservation:** Approaches for Conservation of Biological Diversity: In-situ conservation, Ex-situ conservation; Role of local communities and traditional knowledge in conservation; Biodiversity convention; International and national efforts to conserve biodiversity. | 14 |
| IV | **Biodiversity of India:** India as a mega diversity nation; Biogeographic zones of country; Forest Types and Forest Cover in India; National parks, Sanctuaries, and Sacred groves in India; important conservation projects; Concepts of gene pool,Bio piracy and bio-prospecting. | 14 |
| V | **Wildlife:** General introduction; Definition, Importance; Reason for wildlife Depletion; Wildlife Management; Protection of Wild Flora, Fauna and Natural Habitats. | 10 |

**Suggested readings (Books)**

- The Biodiversity of India, Bharucha Erach, Mapin Publishing Pvt. Ltd.
- Ecology and Environment: P.D. Sharma., Rastogi Publication.
- Biodiversity: An Introduction, Gaston, K. J. & Spicer, J. I., Blackwell Science, Londan, UK.
- Global Biodiversity: Status of the Earth's Living Resources, World conservation Monitoring Centre, Groombridge, B., UNEP, Cambridge.
- Biodiversity: a beginner's guide, john I. spicer, Oneworld Publications.
- Environmental Science: S. C. Santra, New Central Book Agency.

**Suggestive Digital Platforms / Web Links**

1. Environmental Science, Dr. Y. K. Singh, https://www.hzu.edu.in/bed/E%20V%20S.pdf
2. Textbook for Environmental Studies, Erach Bharucha, https://www.ugc.ac.in/oldpdf/modelcurriculum/env.pdf
3. Environmental Science, NPTEL, National Digital Library of India. http://ndl.iitkgp.ac.in/document/Z2JzN0ZmU2VhdW5kODBJdWRCTmg3SWtiUVViMTRSV1FQclhWQ2xCTTExM2dMSmZ0N1BHeC94cWFUUUZ6Ti9lbw
4. Ecology, UGC-MOOCs SWAYAM. https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_ug/205
5. The Convention on Biological Diversity, https://www.cbd.int/convention/

**This course can be opted as an Elective by the students of following subjects:-** Open to All

**Suggested Continuous Internal Evaluation (CIE) Methods**

| S. No. | Assessment Type | Max. Marks |
|---|---|---|
| 1. | Test | 15 |
| 2. | Assignment & Presentation | 5 |
| 3. | Class Interaction/Attendance | 5 |

**Course Prerequisites**:- Biology in 12th + I & II Semester

**Suggested Equivalent Online Courses**:- None

**Further Suggestions:-** None

**Any Remarks/ Suggestion**:- None

| PROGRAMME:- CERTIFICATE | YEAR:- FIRST | SEMESTER:- THIRD |
|---|---|---|
| PAPER - 2:- PRACTICAL | SUBJECT:- ENVIRONMENTAL SCIENCE | |
| COURSE CODE:- B150302P | COURSE TITLE:- PRACTICAL ON UNDERSTANDING BIODIVERSITY | |

**Course Outcome:-**After completing the course the student will be able to:
**CO1: -** Learn to prepare the field report and herbarium sheet.
**CO2:-** Practical skills about analyses of primary productivity.
**CO3:-**Practical skills about analyses of chlorophyll content.
**CO4:-** Gain knowledge on analysis and interpretation of different physical properties of soil.

| Credits:- 2 | Core/Elective: Core |
|---|---|
| Max. Marks:- 25+75 | Min. Passing Mark:- As per norms |

**Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-4**

**Lab Experiments List:-**

1. Preparation of field report based on the survey of local flora (herbarium sheet).
2. To determine the primary productivity by light and dark bottle method.
3. To determine chlorophyll content of the given plant material.
4. To study pore space, water holding capacity and bulk density of soil.
5. Qualitative analysis of soil organic carbon, Soil pH.

**Online Virtual Lab Experiment List / Link**

1. Study of soil pH, https://youtu.be/ViWCoeFwH9M.
2. Preparation of herbarium sheets, https://youtu.be/CK4vepuWzrM.
3. Herbarium - CSIR-NBRI, https://youtu.be/6tJdvDzPzR8.
4. Primary productivity, https://youtu.be/9LpMskfUgz0.
5. Light-Dark bottle method, https://youtu.be/i5Tit4BgfIE.
6. AMRITA, OLABS, Study of Physical Properties of Soil. http://amrita.olabs.edu.in/?sub=79&brch=18&sim=235&cnt=1

**Suggested Continuous Internal Evaluation (CIE) Methods**

| S. No. | Assessment Type | Max. Marks |
|---|---|---|
| 1. | Tour | 10 |
| 2. | Local field excursion | 5 |
| 3. | Activities related to Environment Awareness | 10 |

| PROGRAMME:- DIPLOMA | YEAR:- SECOND | SEMESTER:- FOURTH |
|---|---|---|
| PAPER - 1:- THEORY | SUBJECT:- ENVIRONMENTAL SCIENCE | |
| COURSE CODE:- : B150401T | COURSE TITLE:- ENVIRONMENTAL POLLUTION & MANAGEMENT | |

**Course Outcome:-**After completing the course the student will be able to:

**CO1: -** Understand the basic concept of pollution and its effect on environment.

**CO2:-** Develop understanding about history, sources, types and effect of air, water and soil pollution.

**CO3:-** Gain skills on various control measures of pollution problems.

**CO4:-** Understand the solid waste pollution, noise pollution, radioactive and thermal pollution.

**CO5:-** Gain knowledge about sustainable management of different wastes.

| Credits:- 4 | Core/Elective: Core |
|---|---|
| Max. Marks:- 25+75 | Min. Passing Mark:- As per norms |

**Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0**

| Unit | Topics | No. of Lectures |
|---|---|---|
| I | **Environmental Pollution:** Introduction; Roots of Our Environmental Problems; Pollution and Pollutants; Principal Pollutants; Classification of Pollutants; Cost of Pollutants; Types of Environmental Pollution; Pollution and Environmental Ethics. | 10 |
| II | **Air pollution:** History, Sources, Types, Effects and Control of air Pollutants (Particulate Matter, Oxides of COx, NOx, SOx); Factors affecting distribution of air pollution; Photo Chemical Smog; Monitoring of air quality; Greenhouse effect, Ozone depletion, and Acid Rain; National Air Quality Monitoring Program; AQI. | 14 |
| III | **Water Pollution:** Types and sources of Water Pollutions; impact on humans, plants and animals; Water Quality Parameters- DO, BOD, COD, Acidity, Alkalinity, Salinity, Hardness; Drinking Water Quality Standards; Water Treatment- Adsorption, Flocculation, Ion Exchange and Reverse Osmosis Methods; Eutrophication, Algal bloom. | 14 |
| IV | **Soil Pollution:** Physico-Chemical and Biological Properties of Soil (structure, texture, inorganic, organic); Soil Pollution sources and control measures; Metal and Pesticides; **Solid Waste Pollution:** Municipal solid waste, Biomedical Waste, Hazardous Waste; Container Systems; Solid Waste management: Concept of 3R;Composting and Vermicomposting. | 12 |
| V | **Noise Pollution:** Source of noise, Noise exposure level, Effect of noise, Noise Pollution Control; **Radioactive Pollution:** Types of radiations, Sources of radiations, Biological effects of radiations; **Thermal pollution:** Cause, Effect and Control**; E-Waste.** | 10 |

**Suggested readings (Books)**


- A text book of environmental chemistry and pollution control, Dara, S. S., S. Chand &Company Ltd, New Delhi.
- Environmental Pollution, Khitoliya, R. K., S. Chand and Company, New Delhi.
- Air Pollution, Rao. M. N. and Rao, H. V. N., Tata McGraw -Hill Publishing Company, New Delhi.
- Environmental Pollution and Control, 4th edition, J. Jeffrey Peirce, Ruth E Weiner, E AarneVesilind, Boston Oxford Johannesburg Melbourne New Delhi Singapore.
- Principles of Environmental Chemistry, 3rd edition, J. E. Girard, Jones & Bartlett Learning,Company, Burlington.
- The Science of Environmental Pollution, 3rd edition, Frank R. Spellman, CRC Press, Taylor &Francis Group.


**Suggestive Digital Platforms / Web Links**

1. Environmental Science, Tom Theis and Jonathan Tomkin, OpenStax CNX, National Digital Library of India. http://ndl.iitkgp.ac.in/document/N2tzeE1aWWpUMm04b2l1VVZEdSsvK09RckFlS kE0OWI3b1Flb2ZTNHFxST0
2. Environmental Science, NPTEL, National Digital Library of India. http://ndl.iitkgp.ac.in/documentZ2JzN0ZmU2VhdW5kODBJdWRCTmg3SWtiUVViMTRSV1FQclhWQ2xCTTExM2dMSmZ0N1BHeC 94cWFUUUZ6Ti9lbw
3. Environmental Science, Dr. Y. K. Singh, https://www.hzu.edu.in/bed/E%20V%20S.pdf
4. Environmental Pollution, UGC-MOOCs SWAYAM. https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_ug/205
5. Textbook for Environmental Studies, Erach Bharucha, https://www.ugc.ac.in/oldpdf/modelcurriculum/env.pdf

**This course can be opted as an Elective by the students of following subjects:-** Open to All

**Suggested Continuous Internal Evaluation (CIE) Methods**

| S. No. | Assessment Type | Max. Marks |
|---|---|---|
| 1. | Test | 15 |
| 2. | Assignment & Presentation | 5 |
| 3. | Class Interaction/Attendance | 5 |

**Course Prerequisites**:- Biology in 12th + I & II Semester

**Suggested Equivalent Online Courses**:- None

**Further Suggestions:-** None

**Any Remarks/ Suggestion**:- None

| PROGRAMME:- CERTIFICATE | YEAR:- SECOND | SEMESTER:- FOURTH |
|---|---|---|
| PAPER - 2:- PRACTICAL | SUBJECT:- ENVIRONMENTAL SCIENCE | |
| COURSE CODE:-B150402P | COURSE TITLE:- PRACTICAL ON ENVIRONMENTAL POLLUTION | |

**Course Outcome:-**After completing the course the student will be able to:
**CO1: -** Practical knowledge for the determination of different water parameters.
**CO2:-** Practical know how for the analyses of different air pollutants.
**CO3:-**Gain knowledge on segregation and components of waste.
**CO4:-** Learn measurement of noise level of different areas.

| Credits:- 2 | Core/Elective: Core |
|---|---|
| Max. Marks:- 25+75 | Min. Passing Mark:- As per norms |

**Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-4**

**Lab Experiments List:-**

1. Determination following Water parameter:
   i. DO
   ii. BOD
   iii. Alkalinity
   iv. TDS
   v. Turbidity
2. Determination following air pollutants:
   i. RSPM
   ii. SPM
3. To estimate the amount dust (particulate matter) deposition on the leaves of roadside plants.
4. To segregate domestic waste into bio-degradable and non-biodegradable components.
5. Determination the Noise levels of residential, institutional and industrial area.

**Online Virtual Lab Experiment List / Link**

1. AMRITA, OLABS, Study of pollutants in Air. http://amrita.olabs.edu.in/?sub=79&brch=18&sim=240&cnt=1.
2. AMRITA, OLABS, Studies on Turbidity, pH and Microbial Presence in Water. http://amrita.olabs.edu.in/?sub=79&brch=18&sim=229&cnt=1.
3. PM - Particulate Matter, https://youtu.be/ZUsNCq8acYM.
4. Monitoring methods for Air – PM, https://youtu.be/-uZURNKE4z8.
5. Noise pollution measurement by sound level meter, https://youtu.be/j4sq4CmGV5o.

**Suggested Continuous Internal Evaluation (CIE) Methods**

| S. No. | Assessment Type | Max. Marks |
|---|---|---|
| 1. | Tour | 10 |
| 2. | Local field excursion | 5 |
| 3. | Activities related to Environment Awareness | 10 |

| PROGRAMME:- DEGREE | YEAR:- THIRD | SEMESTER:- FIFTH |
|---|---|---|
| PAPER - 1:- THEORY | SUBJECT:- ENVIRONMENTAL SCIENCE | |
| COURSE CODE:- : B150501T | COURSE TITLE:- NATURAL RESOURCES AND ITS MANAGEMENT | |

**Course Outcome:-**After completing the course the student will be able to:
**CO1: -** Develop the understanding on natural resources and their significance.
**CO2:-** Able to know the strategies for sustainable management.
**CO3:-** Understand the basic principles and application of remote sensing and GIS techniques.
**CO4:-** Gain skills on renewable energy resources and bio-energy options.
**CO5:-** Understand the present scenario of states on different environmental issues related to mining.

| Credits:- 4 | Core/Elective: Core |
|---|---|
| Max. Marks:- 25+75 | Min. Passing Mark:- As per norms |

**Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0**

| Unit | Topics | No. of Lectures |
|---|---|---|
| I | **Natural Resources:** Concept and types of natural resources; classification of natural resources; Factors influencing resource availability, distribution and uses; Interrelationships among different types of natural resources. | 10 |
| II | **Land Resource:** Soil types, profile and composition; degradation of land and agricultural lands; impacts of land use on environment; Soil Management: Soil erosion and Conservation, Desertification; Soil reclamation.<br>**Water Resources:** Surface and Ground Water- distribution and supply; Causes of water resource depletion; water resource management- Ground water recharging, rain water harvesting; Watershed management; Wetlands: definition, importance and classification. | 14 |
| III | **Forest Resource:** Types and extent of forests in India; forest fragmentation; Importance of Forest; Exploitation of Forest resources; Deforestation; Forest Management; National forest policy; Carbon Sequestration.<br>**Agriculture Resources:** Types of Agriculture; Basic Resources of Agriculture; Major Crop of India; Agriculture and Environment; Effect of Modern Agriculture; Fertilizer Pesticides Problems; Agroforestry; Social Forestry. | 12 |
| IV | **Energy Resource:** Concept of Conventional and Non-Conventional Energy Resources; Fossil fuels; Hydro-power; Tidal Energy; Ocean Thermal Energy Conversion; Wind Power; Geothermal Energy; Solar Energy.<br>**Bioenergy:** Methods to produce energy from biomass; Biogas Plant; Nuclear energy;Hydrogen as an alternative Fuel; Energy use pattern in India; Emissions of $CO_2$ indeveloped and developing countries including India. | 14 |
| V | **Mineral Resources:** Types, distribution and reserves of mineral resources; use andexploitation; environmental effects of mining; **Case Studies-** Mining in Aravali Hills;Bundelkhand Region; Sand mining in UP; **Remote Sensing and GIS:** Basic Principles and Application. | 10 |

**Suggested readings (Books)**

- Ecology and Environment: P.D. Sharma., Rastogi Publication.
- Ecology of Natural Resources, Ramade, F., John Wiley & Sons Ltd.
- Singh, J.S., Singh, S.P. and Gupta, R.S., Ecology, Environment and Resource Conservation,Anamaya Publishers, New Delhi.
- Text Book of Environmental Studies, Erach Bharucha, Orient longman Pvt. Ltd., Ernakulam.
- Encyclopedia of Indian Natural History, Hawkins R.E., Bombay Natural History Society,Bombay.
- Fundamental of Remote sensing, Joseph, G., 2018, University Press (India) Private Ltd,Hyderabad.

**Suggestive Digital Platforms / Web Links**

1. Environmental Science, Dr. Y. K. Singh, https://www.hzu.edu.in/bed/E%20V%20S.pdf
2. Resources and Environment, UGC-MOOCs SWAYAM. https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_ug/172
3. Environmental Science, CEC EduSat, National Digital Library of India. http://ndl.iitkgp.ac.in/document/Rm5qb3lqRngwWDZ2Tnl6UXl4VU9YRFhzeDdqSlZMSUQrQX QvWmF6TVBCVHdtUE1SekxkNDNNaDJIN1JVZHhhZm9NRytoRWgyTXpwRE0yUFBTK202S2c9PQ
4. Textbook for Environmental Studies, Erach Bharucha, https://www.ugc.ac.in/oldpdf/modelcurriculum/env.pdf

**This course can be opted as an Elective by the students of following subjects:-** Open to All

**Suggested Continuous Internal Evaluation (CIE) Methods**

| S. No. | Assessment Type | Max. Marks |
|---|---|---|
| 1. | Test | 15 |
| 2. | Assignment & Presentation | 5 |
| 3. | Class Interaction/Attendance | 5 |

**Course Prerequisites**:- Biology in 12th + I, II, III & IV- Semester

**Suggested Equivalent Online Courses**:- None

**Further Suggestions:-** None

**Any Remarks/ Suggestion**:- None

| PROGRAMME:- DEGREE | YEAR:- THIRD | SEMESTER:- FIFTH |
|---|---|---|
| PAPER - 2:- THEORY | SUBJECT:- ENVIRONMENTAL SCIENCE | |
| COURSE CODE:- : B150502T | COURSE TITLE:- ENVIRONMENTAL MICROBIOLOGY AND BIOTECHNOLOGY | |

**Course Outcome:-**After completing the course the student will be able to:
**CO1: -** Impart knowledge on microbial diversity and recent advancement.
**CO2:-** Gain in-depth knowledge of role of beneficial and pathogenic microorganisms in environment.
**CO3:-** Understand the application of microbes for production of different eco-friendly products.
**CO4:-** Understand molecular biotechnology and its applications in Environmental management.
**CO5:-** Learn about Bioethics, biosafety and IPR.

| Credits:- 4 | Core/Elective: Core |
|---|---|
| Max. Marks:- 25+75 | Min. Passing Mark:- As per norms |

**Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0**

| Unit | Topics | No. of Lectures |
|---|---|---|
| I | **Environmental Microbiology 1:** Concept and scope; distribution of microbes innature-soil/air/water; Cultivation of microorganism; Extreme EnvironmentAdaptation– Archae Bacteria, Acidophilic, Alkalophilic, Thermophilic, Barophilic,Osmophilic and Radiodurant Microbes. | 10 |
| II | **Environmental Microbiology 2:** Importance of microbes in the environment;Microbial pathogens and Parasites and their effects on Human, Animal and Planthealth, Indicator microorganisms in air, water and soil Environment; Biologicaltreatment of waste water; Bioremediation. | 14 |
| III | **Food microbiology:** Spoilage and Preservation of foods; Fermented food; foodpoisoning; Microbiology of milk;<br>**Industrial Microbiology**: Industrial use of bacteria, fungi, yeast, biogas production,vaccine production; Role of microbes in production of biopolymers and biodegradable plastics. | 14 |
| IV | **Biotechnology:** Scope and Importance of Biotechnology; Development of geneticallyengineered microorganisms (GEMs); Biotechnology and its application-, Biofertilizer,Vermiculture Technology, Microbial enhanced oil recovery (MEOR), Biomining,Biosensors. | 12 |
| V | **Bioethics, Biosafety and IPR**: Ethics of Genetically modified (GM) plants, animals,microbes; GM food and Biowarfare; Biosafety guidelines in India; IntellectualProperty Right. | 10 |

**Suggested readings (Books)**

- Environmental Microbiology, Pepper, I. L., Gerba, C. P. and Gentry, T. J., 3rd edition, AcademiaPress, Elsevier.
- Textbook of Environmental Microbiology, Mohapatra, P. K., I.K. International (P) Ltd.
- Basic Biotechnology, Ratledge, C. and Kristiansen, B., 2nd edition, Cambridge University Press.
- Environmental Biotechnology, Theory and Application, Gareth M. Evans and Judith C. Furlong.John Wiley & Sons.
- Bioethics and Biosafety in Biotechnology, Sree Krishna. V., New Age International Publishers.

**Suggestive Digital Platforms / Web Links**

1. Introductory Microbiology, UGC-MOOCs SWAYAM. https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_ug/74
2. Industrial Microbiology and Immunology, UGC-MOOCs SWAYAM. https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_ug/69
3. Environmental, Food & Dairy Microbiology, UGC-MOOCs SWAYAM. https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_ug/77
4. Food Microbiology-1, UGC-MOOCs SWAYAM. https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_ug/132
5. Plant Biochemistry and Plant Biotechnology, UGC-MOOCs SWAYAM. https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_ug/54
6. Food Microbiology, UGC-MOOCs SWAYAM. https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_ug/62

**This course can be opted as an Elective by the students of following subjects:-** Open to All

**Suggested Continuous Internal Evaluation (CIE) Methods**

| S. No. | Assessment Type | Max. Marks |
|---|---|---|
| 1. | Test | 15 |
| 2. | Assignment & Presentation | 5 |
| 3. | Class Interaction/Attendance | 5 |

**Course Prerequisites**:- Biology in 12th + I, II, III & IV - Semester

**Suggested Equivalent Online Courses**:- None

**Further Suggestions:-** None

**Any Remarks/ Suggestion**:- None

| PROGRAMME:- DEGREE | YEAR:- FIRST | SEMESTER:- FIFTH |
|---|---|---|
| PAPER - 3:- PRACTICAL | SUBJECT:- ENVIRONMENTAL SCIENCE | |
| COURSE CODE:- : B150503P | COURSE TITLE:- : PRACTICAL ON NATURAL RESOURCES AND MICROBIOLOGY | |

**Course Outcome:-**After completing the course the student will be able to:
**CO1: -** Understand the morphological and anatomical adaptations of different plants species.
**CO2:-** Learn to identify the rocks and minerals.
**CO3:-**Gain practical skills of microbiology techniques and able to isolate the bacteria from different environmental matrices.
**CO4:-** Develop understanding about the heavy metals and their presence identification.

| Credits:- 2 | Core/Elective: Core |
|---|---|
| Max. Marks:- 25+75 | Min. Passing Mark:- As per norms |

**Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-4**

**Lab Experiments List:-**

1. To study the morphological and anatomical adaptions of the given hydrophytes.
2. To study the morphological and anatomical adaptions of the given xerophytes.
3. To study the morphological and anatomical adaptions of the given mesophytes.
4. Identification of rocks and minerals on the basis of physical characters.
5. Demonstration of Pouring, Streaking and Spreading techniques.
6. Isolation of bacteria from following matrices:
   a) Air
   b) Water
   c) Soil
   d) Vegetables
   e) Curd
7. To analyse the given water sample for the presence of heavy metals by rapid field test.
8. To analyse the given soil sample for the presence of heavy metals by rapid field test.

**Online Virtual Lab Experiment List / Link**

1. Bacteriological Culture Methods, https://youtu.be/ILg2HkmO_go.
2. Limit test for Heavy Metals, https://youtu.be/-3N2c48ZJZ8.
3. Identification of minerals and rock samples, NPTEL, https://youtu.be/Gr9VZp3eLOA.
4. AMRITA, OLABS, Characteristics of Dicot and Monocot Stem and Root, http://amrita.olabs.edu.in/?sub=79&brch=17&sim=192&cnt=1.
5. Introduction to Microbiology Culture Techniques, https://youtu.be/Et1v8EQP10U.

**Suggested Continuous Internal Evaluation (CIE) Methods**

| S. No. | Assessment Type | Max. Marks |
|---|---|---|
| 1. | Tour | 10 |
| 2. | Local field excursion | 5 |
| 3. | Activities related to Environment Awareness | 10 |

| PROGRAMME:- DEGREE | YEAR:- THIRD | SEMESTER:- SIX |
|---|---|---|
| PAPER - 1:- THEORY | SUBJECT:- ENVIRONMENTAL SCIENCE | |
| COURSE CODE:- : B150601T | COURSE TITLE: -ENVIRONMENTAL LEGISLATION AND IMPACT ASSESSMENT | |

**Course Outcome:-**After completing the course the student will be able to:
**CO1:** - Understand the basic laws, act, treaty related to environment and gain knowledge on public policies and PIL.
**CO2:-** Understand the Environment provisions in constitution
**CO3:-** Able to know the power and functions of government agencies for pollution control.
**CO4:-** Learn the national action plan for sustainable environment.
**CO5:-** Develop understanding about environmental impact assessment and auditing.

| Credits:- 4 | Core/Elective: Core |
|---|---|
| Max. Marks:- 25+75 | Min. Passing Mark:- As per norms |

**Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0**

| Unit | Topics | No. of Lectures |
|---|---|---|
| I | **Environmental Laws:** National Environmental Policy Statement on abetment ofpollution legislation; The Air (Prevention and Control) Act, 1981; The Air (Preventionand Control) Rules, 1982; The Water (Prevention and Control) Act, 1974; The Water(Prevention and Control) Rules, 1975; The Environmental (Protection) Act, 1986; TheForest Conservation Act, 1980; The Wildlife Protection Act, 1972; Biodiversity Act,2002. | 14 |
| II | **Organizations and Conventions:** National and International Organizations dealingwith Environmental Issues; Famous Environmental Conventions; Role of Governmentand NGO's in environmental protection; Women participation;Ecological footprint, Carbon Footprint, Carbon Trading, Carbon Diet, Carbon Credits | 14 |
| III | **National Action Plan:** National Action Plan on Climate Change- Eight Nationalmissions– Solar Mission, Mission for Enhanced Energy Efficiency, Mission onSustainable Habitat, Water Mission, Mission for Sustaining the Himalayan Ecosystem,Mission for a 'Green India', Mission for Sustainable Agriculture, Mission on StrategicKnowledge for Climate Change). | 10 |
| IV | **EIA:** Aims and objectives of Environmental Impact Assessment; EIS; EMP;Environmental Clearance; Impact Assessment Methodologies; EIA Notification –2006 and amendments; Public Participation; Status of EIA in India-Current trends and strategies. | 12 |
| V | **Environmental Audit:** Life-cycle analysis; cost-benefit analysis; Guidelines forEnvironmental Audit; Environmental Management System Standards (ISO 14000series); Eco-labeling schemes, Eco-tourism. | 10 |

**Suggested readings (Books)**

- Handbook of Environmental Laws, Rules Guidelines, Compliances and Stadards, Vol I and II,Trivedi R.K., Enviro Media.
- Environmental Protection and Laws, Jadhav, H & Bhosale, V.M., Himalaya Pub. House, Delhi.
- Text Book on Environmental Impact Assessment, Barthwal, R. R., New Age InternationalPrivate Limited.
- Environmental Impact Assessment, Canter, L.W., McGraw Hill, New York.
- Environmental Audit, Shrivastava, A. K., New Delhi, India.

**Suggestive Digital Platforms / Web Links**

- Environment, UGC-MOOCs SWAYAM.
  https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_ug/228
- Environmental Science, Tom Theis and Jonathan Tomkin, OpenStax CNX, National DigitalLibrary of India.
  http://ndl.iitkgp.ac.in/document/N2tzeE1aWWpUMm04b2l1VVZEdSsvK09RckFlSkE0OWI3b1Flb2ZTNHFxST0
- Population, Environment and Development, UGC-MOOCs SWAYAM.
  https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_ug/167
- Environmental Science, CEC EduSat, National Digital Library of India.
  http://ndl.iitkgp.ac.in/document/Rm5qb3lqRngwWDZ2Tnl6UXl4VU9YRFhzeDdqSlZMSUQrQX
  QvWmF6TVBCVHdtUE1SekxkNDNNaDJIN1JVZHhhZm9NRytoRWgyTXpwRE0yUFBTK202
  S2c9PQEnvironmental law, UGC-MOOCs SWAYAM.
  https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_pg/843
- The legal and regulatory framework for Environmental protection in India, MoEF.
  http://moef.gov.in/wp-content/uploads/wssd/doc2/ch2.html
- Environmental Impact Assessment, Ministry of Environment & Forests.
  http://moef.gov.in/wp-content/uploads/report/0607/chap03.pdf; http://moef.gov.in/wpcontent/uploads/2018/04/Introducation.pdf

**This course can be opted as an Elective by the students of following subjects:-** Open to All

**Suggested Continuous Internal Evaluation (CIE) Methods**

| S. No. | Assessment Type | Max. Marks |
|---|---|---|
| 1. | Test | 15 |
| 2. | Assignment & Presentation | 5 |
| 3. | Class Interaction/Attendance | 5 |

**Course Prerequisites**:- Biology in 12th + I, II, III IV&V- Semester
**Suggested Equivalent Online Courses**:- None
**Further Suggestions:-** None
**Any Remarks/ Suggestion**:- None

| PROGRAMME:- DEGREE | YEAR:- THIRD | SEMESTER:- SIX |
|---|---|---|
| PAPER - 2:- THEORY | SUBJECT:- ENVIRONMENTAL SCIENCE | |

| COURSE CODE:- : B150602T | COURSE TITLE: - ENVIRONMENTAL PRIORITIES AND RESEARCH TOOLS |
|---|---|

**Course Outcome:-**After completing the course the student will be able to:
**CO1: -** Learn about general national environmental movements.
**CO2:-** Able to understand the environmental priorities in India.
**CO3:-** Develop understanding about different environmental disasters and their management.
**CO4:-** Gain knowledge on basic of statistics and instrumentation.

| Credits:- 4 | Core/Elective: Core |
|---|---|
| Max. Marks:- 25+75 | Min. Passing Mark:- As per norms |

**Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0**

| Unit | Topics | No. of Lectures |
|---|---|---|
| I | **National Environmental movement:** Silent valley movement, Chipko movement,Narmada movement, Green Revolution, Appiko movement, Tehri Dam movement;Namami Gange and Yamuna Action Plan; International Solar Alliance. | 12 |
| II | **Environmental Priorities in India:** Sustainable Development; Urban and Ruralplanning, Power generation; Human Population Explosion; Environment and humanhealth; Sanitation and health education; Role of information technology inenvironment and human health. | 10 |
| III | **Environmental Disaster & Toxicology:** Natural hazards; earthquake, flood, cyclones,landslides, desertification and fire; Resettlement and rehabilitation process;NDRF/SDRF; NDMA; Introduction and nature of toxicity (acute and chronic), Dose andtime response relationship, Teratogenicity, Carcinogenicity and mutagenicity. | 14 |
| IV | **Biostatistics:** Introduction and historical perspective; definition; characteristics andapplication of biostatistics; statistical terms and symbols; mean, mode and median;variance and standard deviation. | 14 |
| V | **Instrumentation:** Introduction to Techniques, Basic principles, and applicationsCentrifuge; colorimetric, volumetric, titration, Conductometry; Nephelometry;Gravimetry; Microscopy; Ultraviolet-visible (UV- VIS) Spectroscopy. | 12 |

**Suggested readings (Books)**

- Ecology and Environment: P.D. Sharma., Rastogi Publication.
- Disaster Management, Singh, S. and Singh, J., Pravalika Publications, Allahabad.
- Elements of Biostatistics, Prasad. S., Rastogi Publications, Meerut.
- Vogel's Text Book of Quantitative Inorganic Analysis, Barnes, J.D. J., Denney, R.C., Jeffery, G.H.and Mendham, J., 6th Edition, Pearson Education Ltd., U.K.
- Instrumental Methods of Chemical Analysis, Sharma, B.K. (2005), Goel Publishing House,Meerut, India.
- Instrumental methods of analysis, Malathi, S., Patil, P. M., Kumar, S. (2020). Thakurpublications (pvt.) Ltd, Lucknow, India

**Suggestive Digital Platforms / Web Links**

- Environmental Movements in India, Patna University. https://www.patnauniversity.ac.in/econtent/social_sciences/history/MAHistory4.pdf
- Environment and Ecological Movement. https://rajdhanicollege.ac.in/admin/ckeditor /ckfinder/userfiles/files/environment%20and%20ecological%20movement.pdf
- Environmental Movements in India: An Overview. https://www.arsdcollege.ac.in/wpcontent/uploads/2020/04/Environment-Movement-in-India_HRGE-BA-II.pdf
- Biostatistics and Mathematical Biology, UGC-MOOCs SWAYAM. https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_ug/298
- Basic biostatistics, UGC-MOOCs SWAYAM. https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_pg/530
- Urban Disaster Risk Mitigation and Climate Resilient Development, UGC-MOOCs SWAYAM. https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_ug/289

**This course can be opted as an Elective by the students of following subjects:-** Open to All

**Suggested Continuous Internal Evaluation (CIE) Methods**

| S. No. | Assessment Type | Max. Marks |
|---|---|---|
| 1. | Test | 15 |
| 2. | Assignment & Presentation | 5 |
| 3. | Class Interaction/Attendance | 5 |

**Course Prerequisites**:- Biology in 12th + I, II, III IV&V- Semester

**Suggested Equivalent Online Courses**:- None

**Further Suggestions:-** None

**Any Remarks/ Suggestion**:- None

| PROGRAMME:- DEGREE | YEAR:- THIRD | SEMESTER:- SIX |
|---|---|---|
| PAPER - 3:- PRACTICAL | SUBJECT:- ENVIRONMENTAL SCIENCE | |
| COURSE CODE:- : B150603P | COURSE TITLE:- : PRACTICAL ON EIA AND STATISTICS | |

**Course Outcome:-**After completing the course the student will be able to:
**CO1: -** Practical skills on different sophisticated instrument.
**CO2:-** Develop understanding over different statistical calculations.
**CO3:-**Learn to perform the environmental audit in terms of energy consumptions.
**CO4:-** Understand to do EIA study for some projects.
**CO5:-** Gain field knowledge functioning of water treatment and sewage treatment plant.

| Credits:- 2 | Core/Elective: Core |
|---|---|
| Max. Marks:- 25+75 | Min. Passing Mark:- As per norms |

**Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-4**

**Lab Experiments List:-**

1.Find out the concentration of unknown solution by spectrophotometer.
2. To determine the concentration of iron in water sample by spectrophotometric method.
3. Calculation of mean, mode and median from data.
4. Calculation of standard deviation from data.
5. Calculation of variance from data.
6. To make an audit of the electrical energy consumption by various household appliances.
7. Hypothetical EIA of following:
   i. Urbanization
   ii. Tourism
   iii. Sugar mills
8. Visit and report to study the functioning of water treatment/ Sewage treatment plant

**Online Virtual Lab Experiment List / Link**

1. Introduction to Biostatistics, NPTEL, https://youtu.be/Vz5jztR6QFM?list=PLoNoar1DlEikWKiRSwtu2g-zAS_NdHeVo.
2. Demonstration of Spectrophotometer, https://youtu.be/FdlGcwZB6Is.
3. UV - Visible Spectrophotometer, https://youtu.be/tbUx-RaZS7M.
4. Spectrophotometer working principle, https://youtu.be/oNl4vKCdp3Y.
5. Water Treatment Plants, https://youtu.be/0_ZcCqqpS2o.
6. Sewage Treatment Plant, https://youtu.be/OCYBk15_3II; https://youtu.be/VPLa31dvoxQ.

**Suggested Continuous Internal Evaluation (CIE) Methods**

| S. No. | Assessment Type | Max. Marks |
|---|---|---|
| 1. | Tour | 10 |
| 2. | Local field excursion | 5 |
| 3. | Activities related to Environment Awareness | 10 |