



**SYLLABUS & PROGRAMME  
STRUCTURE OF FOUR YEARS  
UNDERGRADUATE PROGRAMME**

**Environmental Science**

**( Minor )**

**Semester - II**

**( Under National Education Policy – 2020 )**

**(Effective from the Academic Session 2023-2024)**

**MAHARAJA BIR BIKRAM UNIVERSITY  
AGARTALA, TRIPURA: 799004**



# ENVIRONMENTAL SCIENCE (MINOR)

## Second Semester, Paper: 2A

**Course II: Analytical Techniques, Environmental Statistics and Environmental Economics**

### COURSE OBJECTIVES:

1. To study Analytical techniques related to the subject.
2. To learn about Environmental Statistics.
3. To study Environmental Chemistry.
4. To study Environmental Economics.

**COURSE CODE: ENVS102M**

**COURSE OUTCOME:** After successful completion of the course, the students will develop following attribute.

COURSE OUTCOME		ATTRIBUTES
CO1		At the end of the course, students will be able to understand about Different Analytical Techniques along with different Statistical Methods applied in Environmental Science.
CO2		They will know about Environmental Chemistry of Air, Water, Soil etc.
CO3		They will study Environmental Economics in the present context.
<b>Unit wise detail content</b>		
<b>Unit 1</b>	<b>Number of Lecture-20</b>	<b>Title of Unit: Analytical Techniques</b>
<p>Introduction to Environmental Sampling and Analysis, Sample Collection and Preservation Techniques, Principles of Analytical Chemistry in Environmental Analysis.</p> <p><i>Electrochemical Techniques:</i> Potentiometry, Voltammetry, Conductometry, Titrimetry.</p> <p><i>Photometry:</i> Flame photometry, Colorimetry.</p> <p><i>Spectroscopic Techniques:</i> UV-Visible Spectroscopy, Atomic Absorption Spectroscopy (AAS).</p> <p><i>Chromatographic Techniques:</i> Gas Chromatography (GC), Liquid Chromatography (LC), High-Performance Liquid Chromatography (HPLC).</p> <p><i>Microscopic Techniques:</i> Light Microscope, resolution and magnification. Phase contrast microscopy, Dark field microscopy, Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), X-ray diffraction.</p> <p><i>Applications of Analytical Techniques in Environmental Monitoring:</i> Water Quality Analysis, Air Quality Monitoring, Soil Contamination Assessment, Analysis of Organic Pollutants, Heavy Metals, Pesticides, etc.</p>		



<b>Unit 2</b>	<b>Number of Lecture-20</b>	<b>Title of Unit: Environmental Statistics</b>
Introduction to Environmental Statistics. Measures of Central Tendency (Mean, Median, Mode), Standard Deviation, Standard Error. Probability distribution in Environmental science. Statistical Inference and Hypothesis Testing in Environmental Studies, t-test, Least Significance Difference, Regression Analysis in Environmental Research, Analysis of Variance (ANOVA) in Environmental Experiments.		
<b>Unit 3</b>	<b>Number of Lecture-20</b>	<b>Title of Unit: Atmospheric Processes</b>
Introduction to Atmosphere and Climate Systems, Greenhouse Effect and Global Warming, Earth's Energy Budget and Climate Forcing, Climate Models and Predictions, Climate Change Impacts on Weather Patterns, Ocean-Atmosphere Interactions and Climate Variability, Anthropogenic Causes of Climate Change, Carbon Cycle and Greenhouse Gas Emissions, Effects of Climate Change on Ecosystems and Biodiversity, Extreme Weather Events and Climate Change, Mitigation Strategies.		
<b>Unit 4</b>	<b>Number of Lecture-20</b>	<b>Title of Unit: Environmental Literacy &amp; Law</b>
National and International Conventions: Earth Summit 1992, United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol, Convention on Biological Diversity, United Nations Convention to Combat Desertification (UNCCD), Vienna Convention on the Protection of the Ozone Layer, Convention on Migratory Species (CMS), International Union for Conservation of Nature (IUCN), Convention on International Trade of Endangered Species of Wild Flora and Fauna (CITES), Ramsar Convention on Wetlands, Basel Convention on Transboundary Movement of Hazardous Substances.		
Environmental protection Act, 1986, The Water(Prevention and Control of pollution) Act, 1974, The Air (Prevention and Control of pollution) Act, 1981, The forest Conservation Act, 1980, Biological Diversity Act, 2002, Green Tribunal Act, 2010. National Forest policy, Traditional Forest Dwellers (Recognition of Forest Right) Act.		

#### **Suggested Readings:**

#### **Analytical Techniques:**

- 1) Principles of Instrumental Analysis by Douglas A. Skoog, F. James Holler, and Stanley R. Crouch.
- 2) Analytical Chemistry: An Introduction by Douglas A. Skoog, Donald M. West, and F. James Holler.
- 3) Environmental Analytical Chemistry by W. R. Seitz.
- 4) Analytical Chemistry for Technicians by John Kenkel.
- 5) Modern Analytical Chemistry by David Harvey.
- 6) Chemical Analysis: Modern Instrumentation Methods and Techniques by Francis Rouessac and Annick Rouessac.
- 7) Environmental Sampling and Analysis: A Practical Guide by Chowdhury and Dhar.
- 8) Handbook of Environmental Analysis: Chemical Pollutants in Air, Water, Soil, and Solid Wastes by Pradyot Patnaik.

#### **Environmental Statistics:**

- 1) Statistics for Environmental Science and Management by Bryan F.J. Manly.
- 2) Applied Statistics for Environmental Science with R by Steven P. Millard and Mark J. Branch.
- 3) Environmental Statistics: Methods and Applications by Vic Barnett and Philip C. Neville.
- 4) Environmental and Ecological Statistics with R by Song S. Qian.



- 5) Statistics for Environmental Engineers by Thomas M. Missimer.
- 6) Introduction to Environmental Statistics by Wayne R. Ott and Stuart A. Allen.
- 7) Practical Environmental Statistics and Data Analysis by Francesca M. Kerton.
- 8) Statistical Methods for Environmental Epidemiology with R: A Case Study Approach by Roger D. Peng.
- 9) Environmental Statistics: Methods and Applications by Vic Barnett.
- 10) Environmental Statistics and Data Analysis by G.P. Patil and C.R. Rao.

#### **Environmental Chemistry:**

- 1) Environmental Chemistry by Stanley E. Manahan.
- 2) Environmental Chemistry by Colin Baird and Michael Cann.
- 3) Principles of Environmental Chemistry by James E. Girard.
- 4) Chemistry of the Environment by Thomas G. Spiro and William M. Stigliani.
- 5) Environmental Chemistry by Julian E. Andrews and Peter Brimblecombe.
- 6) Introduction to Environmental Chemistry by Julian E. Andrews and Peter Brimblecombe.
- 7) Environmental Chemistry: A Global Perspective by Gary W. VanLoon and Stephen J. Duffy.
- 8) Environmental Chemistry: Fundamentals by Jorge G. Ibanez and Marjan van Aubel.
- 9) Environmental Chemistry: A Modular Approach by Ian D. Pulford and R. D. Handy.
- 10) Environmental Chemistry: An Analytical Approach by Howard M. Stoker.

### **COURSE: ENVIRONMENTAL SCIENCE**

#### **Paper- 2B (Practical)**

#### **COURSE CODE: ENSG 102M**

#### **Second Semester**

**COURSE OUTCOME:** After successful completion of the course, the students will develop following attribute.

<b>COURSE OUTCOME</b>	<b>ATTRIBUTES</b>
CO1	Students will be able to learn Analytical Techniques, Environmental statistics, Sampling design exercise, Hypothesis testing, Data visualization project, Environmental Chemistry
CO2	They will also be able to understand Environmental policy simulation, valuation of ecosystem services, Environmental Impact Assessment etc.
<b>Detail content of Practical</b>	
<ol style="list-style-type: none"> <li>1) Introduction to various laboratory Glasswares &amp; Plasticwares.</li> <li>2) Preparation and standardization of acid and alkali of different strength.</li> <li>3) Quantification of Nutrients (e.g., Nitrate, Phosphate) in Water Samples using UV-Visible Spectroscopy.</li> <li>4) Measures of pH and conductivity of water samples.</li> <li>5) Measurement of Sodium, Potassium using Flame photo meter.</li> <li>6) Determination of SPM in atmosphere.</li> <li>7) Analysis of Climate Data: Analyze historical weather data (temperature, precipitation) using statistical techniques such as time series analysis and regression to identify trends and patterns.</li> <li>8) Hythergraph, climograph, Measurement of Wind velocity, light intensity, precipitation.</li> <li>9) Sampling Design Exercise: Design a sampling plan for assessing water quality in a local river, considering factors like spatial variability and budget constraints.</li> <li>10) Hypothesis Testing: Conduct a hypothesis test to assess whether there is a significant difference in pollutant concentrations between two different industrial zones.</li> <li>11) Preparation of model on effect of global warming, Environmental degradation and pollution.</li> </ol>	



## **Suggested Readings:**

### **Analytical Techniques:**

- 1) Practical Environmental Analysis by M. Radojevic and V. N. Bashkin.
- 2) Handbook of Analytical Techniques in Concrete Science and Technology: Principles, Techniques, and Applications edited by V.S. Ramachandran.
- 3) Practical Guide to Environmental Chemistry, Microbiology and Ecotoxicology by Frank R. Spellman.
- 4) Environmental Analytical Chemistry by W. R. Seitz.
- 5) Practical Environmental Analysis by Francesca M. Kerton.

### **Environmental Statistics:**

- 1) Statistics for Environmental Engineers by Thomas M. Missimer.
- 2) Environmental Statistics: Methods and Applications by Vic Barnett.
- 3) Environmental Statistics: Methods and Applications by Bryan F.J. Manly.
- 4) Applied Statistics for Environmental Science with R by Steven P. Millard and Mark J. Branch.
- 5) Practical Environmental Statistics and Data Analysis by Francesca M. Kerton.

### **Environmental Chemistry:**

- 1) Practical Environmental Chemistry: Microscale Investigations and Laboratory Analysis by Paul Kelter, David B. Manahan, and Michael Cross.
- 2) Introduction to Environmental Chemistry by Julian E. Andrews and Peter Brimblecombe
- 3) Practical Environmental Analysis by Francesca M. Kerton.
- 4) Principles and Applications in Environmental Chemistry: A Practical Guide by Rene P. Schwarzenbach, Philip M. Gschwend, and Dieter M. Imboden.
- 5) Experimental Methods in Environmental Chemistry: A Laboratory Manual by Janusz Pawliszyn and Dariusz G. Adamczyk..