Course Title: Environmental Laboratory-I			
Course code: UES 208	**No. of credits: 3**	**L-T-P: 4-14-54**	**Learning hours: 72**
Pre-requisite course code and title (if any):			
Department: Natural and Applied Sciences			
Course coordinator:		**Course instructor:**	
Contact details:			
Course type: Major		**Course offered in:** Semester 4	

Course Description

This course aims to provide the preliminary understanding of laboratory methods for analyzing water and soil samples. The course equips students with the skills to perform quantitative analyses of various physical, chemical, and biological parameters in water, soil, and microbiology research. Students will learn standard protocols used in environmental monitoring. Acting as a foundational course for advanced courses in subsequent semesters, it also offers students the chance to learn theoretical concepts and develop practical skills using contemporary tools and techniques necessary for environmental impact assessment.

Course objectives

The course aims to build the following basic understanding among students:

- The course is designed to develop sampling and analytical skills of the students which are required in environmental monitoring
- The students will be exposed to various standard protocols used in environmental monitoring

Course content

Module	Topic	L	T	P
1	**Introduction to Water Quality Analysis**			
	Introduction of environmental monitoring, pre-processing, collection, preservation and precaution during sampling, basic concept of quantitative techniques; Quality Assurance /Quality Control (QA/QC): precision, accuracy, Replicate Analyses, Split samples, Reference Samples, Standard samples, Spiked samples	4		
2	**Physical Water Quality parameters**			
	General understanding of alternation in the water quality through various physical water quality parameters, its causes and impact on environment and human health. Colorimetry: Importance of colour for aquatic, home and industrial uses; pH determination: Litmus paper test and Benchtop method, environmental significance of pH in water sample; solids: total, dissolved and suspended solids, settleable solids; Turbidimetry: importance and uses; turbidity measurement and its environmental significance; electrical conductivity		3	9
3	**General Water Quality parameters**			
	Study of sources and nature, environmental significance, methods of measurement of general water quality parameters. Acidity and Alkalinity: Titrimetric method for the determination of the carbonate, bicarbonate and hydroxide alkalinity; Determination of type and extent of acidity; Hardness: EDTA method for estimation of total hardness; Chlorides: Argentometric method		4	15
4	**Wastewater Quality Analysis**			
	Environmental significance of dissolved oxygen, collection of samples for determination of dissolved oxygen, methods of determination. Dissolved oxygen (DO): Winkler Procedure for dissolved oxygen (Azide Modification) and Membrane Electrode Method for Dissolved Oxygen (DO Meter);		3	16

	Biochemical Oxygen Demand (BOD): estimation of BOD_3/BOD_5; Chemical oxygen Demand (COD): Open reflux method			
5	**Biological Water Quality parameters**			
	Understanding of indicators of fecal contamination and the concept of indicator organisms; coliform bacteria count and its sampling: Membrane Filter Method, Multiple Tube Fermentation Method or Most Probable Number (MPN) method and its environmental relevance Bacterial and microscopical characteristics, common indicator bacteria; determination of total coliform and fecal coliform for drinking and wastewater samples		1	4
6	**Soil Analysis**			
	Understanding of soil characteristics by physio-chemical parameters and its importance for agricultural productivity Soil moisture & soil pH determination; Soil organic content determination (Walkley-Black method); N, P, K estimation; Electrical conductivity for the determination of dissolved salts in the soil		3	10
	Total	4	14	54

Evaluation criteria

- Test 1: Practical exam and records [at the end of the semester, full syllabus] -- 40%
- Test 2: Spotting and Assignment [at the end of the semester, full syllabus] -- 30%
- Test 3: Viva [at the end of the semester, full syllabus] -- 30%

Learning outcomes

Upon completion of the course, the students will be able to

- trained in analytical and conceptual skills required for environmental research (water and soil). [Test 1]
- correlate environmental impacts and field processes. [Test 2]
- gain the conceptual clarity, theoretical concept and practical session. [Test 3]

Pedagogical approach

- The course will be delivered through class lectures and real time data.
- The course includes majorly the practical analysis in the laboratory.
- The course will also include the guided project work and its presentation.

Reading materials

Required text

- APHA (1980) Standard Methods for the Examination of Water and Wastewater Published by American Public Health Association, 15th ed.

Suggested readings

- Radojevic, M., Bashkin, V. N. (2006). *Practical Environmental Analysis*. United Kingdom: Royal Society of Chemistry.
- Hounslow, A. (2018). *Water quality data: analysis and interpretation*. CRC press.
- *Laboratory Analytical Techniques Series (LATS)*, published by CPCB.
- Wagner, T. P., & Sanford, R. M. (2018). *Environmental science: Active learning laboratories and applied problem sets*. John Wiley & Sons.
  Wells, E., Brooks/Cole. (2009). *Lab Manual for Environmental Science*. United States: Brooks/Cole.

Websites

- Central Pollution Control Board (CPCB) website for real time data collection (https://cpcb.nic.in/index.php)
- India Water Resources Information System website for surface and subsurface water information (https://indiawris.gov.in/wris/#/home)

Journals

- Environmental Science and Pollution Research
- Environmental Management
- Environmental Pollution
- Environmental Science and Technology

Student Responsibilities

The students must be present in the practical class before starting of the practicals. The attendance during the practical analysis in laboratory is compulsory to learn the handling of glassware, chemicals, instruments etc.

Course Designed by:

- Dr. Chandrashekhar Azad Vishwakarma, Assistant Professor, Department of Natural and Applied Sciences, TERI School of Advanced Studies

Course Reviewers:

The course is reviewed by following reviewers:

- Dr. Prasant Singh, Professor, Department of Chemistry, D.A.V. (P.G) College, Dehradun, Uttarakhand
- Dr. Dinesh Mohan, Professor, School of Environmental Sciences, Jawaharlal Nehru University, New Delhi