



**Objective:** The Course aims to expose students to various applications of Chemistry and Microbiology in Environmental Engineering

**Credits Earned:** 4 Credits

**Course Outcomes:** After completion of this course, student will be able to:

1. Apply various concept of chemistry to solve the Environmental Problems
2. Correlate the organic matter with biodegradation.
3. Analyze and interpret various water quality parameters such as pH, TS, TDS, DO, BOD, COD, Sulphates, Nitrates, Fecal and Total Coliform Count etc etc

**Pre-requisite of course:** Basic understanding of the concepts learnt in Environmental Sciences I and II.

**Teaching and Examination Scheme**

Teaching Scheme (Hours)			Credits	Theory Marks			Tutorial/ Practical Marks		Total Marks
Theory	Tutorial	Practical		ESE (E)	Mid Sem (M)	Internal (I)	Viva (V)	Term work (TW)	
3	0	2	4	60	30	10	25	25	150

**Contents:**

Unit	Topics	Contact Hours
1	<b>General Chemical Concepts</b>  Concept of Quantitative and Qualitative Analysis, Molar and Normal Solutions, Atomic, molecular, formula and equivalent weights. Primary and Secondary Solutions and their standardization, Solubility Product and Common Ion effect.	6



2	<b>Sample Collection and Preservation</b>  Importance of proper sampling technique, Types of Sampling- Integrated, grab and representative samples. Sample Preservation for various water quality parameters.	4
3	<b>Water and Wastewater Analysis</b>  Determination of acidity, alkalinity, pH, Conductivity, Turbidity, TS, TSS, TDS, Hardness, chlorides, sulphates, Oil and Grease, Dissolved oxygen, Biochemical Oxygen Demand, Chemical Oxygen Demand, Nitrates, Nitrites, TKN, Phosphates and analysis of Heavy Metals.	30
4	<b>Environmental Microbiology</b>  Physical conditions required for growth of Bacteria/micro-organisms: Temperature, PH & oxygen. Growth and growth cycle of Bacteria, Pure culture & Methods of isolation, Introduction to control of microorganisms by physical and chemical agents. Soil microbiology, Microbial flora of soil and interaction among soil microorganisms. Microbiology of domestic water and wastewater,- Bacteriological evidence of pollution, Bacteriological examination of water- MPN & Presumptive test.	10
<b>Total Hours</b>		<b>50</b>

### List of Experiments

1. Preparation of primary and secondary standards solutions and its standardization
2. Determination of acidity of water and wastewater samples.
3. Determination of alkalinity of water and wastewater samples
4. Determination of pH and Conductivity.
5. Turbidity measurement using Nephelometer.
6. Determine Total solids (TS), Total suspended solids (TSS) and Total dissolved solids (TDS) for given water and wastewater samples.
7. Determine Total Hardness , Calcium Hardness and magnesium hardness from given water samples
8. Determine Chloride from given water and wastewater samples.
9. Determination of sulphates from water and wastewater.
10. Determination of DO from water and wastewater samples.
11. Determination of BOD from samples
12. Determination of COD of industrial wastewater.
13. Determination of oil and grease from wastewater samples.
14. Determination of Phosphates
15. Estimation of Nitrates and Nitrites
16. Estimation of Total Kjeldhal Nitrogen
17. Estimation of Total and Fecal Coliform count using MPN Test.



**Design based Problems (DP)/Open Ended Problem:**

1. Students will be given actual wastewater samples from industries or domestic wastewater sources to analyze for all the parameters.
2. The students will be made to analyze the water samples collected from their homes for basic parameters.

**Reference Books:**

1. Chemistry for Environmental Engineering by Clair N. Sawyer, Perry L. McCarty and Perkin
2. Quantitative Analysis by R.A. Day, Jr. and A.L. Underwood
3. Standard Methods for Water and Wastewater Analysis published by AWWA, American Public Health Association
4. Water & Waste Water Testing- A Laboratory Manual by R.P. Mathur
5. Guide Manual: Water and Wastewater Analysis - Central Pollution Control Board, India

**Suggested Theory distribution:**

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery and evaluation					
Remember	Understand	Apply	Analyze	Evaluate	Create
5%	15%	40%	30%	10%	-

**Instructional Method:**

- a. The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by white board, may also use any of tools such as collaborative learning, demonstration, role play, Quiz, brainstorming, MOOCs, Active Learning Assignments etc.
- b. The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.
- c. Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory.
- d. Students will use supplementary resources such as online videos, Virtual Laboratory NPTEL videos, e-courses.