

### 1. Course Objectives

The course will introduce students and researchers to various environmental issues related to water, soil, air, and waste management. It is aligned with sustainable development goals (SDGs), especially those concerning clean water and sanitation, as well as the environment. Participants will learn about both conventional and advanced treatment techniques for water and wastewater, air, and different soil remediation methods. The lab component of the course will provide hands-on experience with various tests, including pH, conductivity, acidity, alkalinity, and total coliforms, enabling analysis of the physical, chemical, and bacteriological properties of water. This course will be beneficial for students in the E4 Life Ph.D. program and interdisciplinary Ph.D. programs in Chemistry, Environment, Biotechnology, and Chemical Engineering, especially those interested in working in the field of environmental resource management for a sustainable future.

### 2. Course Outcomes

**CO1:** Understand the theories, principles, and procedures about pollution, environmental science, and management

**CO2:** Identify the contaminants in different environmental domains along with the methods used for their management and cleanup.

**CO3:** Conduct laboratory experiments to examine drinking water quality and wastewater treatment

**CO4:** Analyse the surface water/ groundwater quality in a community and propose a remediation strategy as a group project

### 3. Course Delivery

PowerPoint presentations, writing pad with a laptop, hands-on-training in the Water Laboratory, peer-to-peer interactions

### 4. Syllabus

#### Unit 1: [10 hrs]

**Water:** Sources; need for providing safe drinking water; Water quality studies- Sampling techniques- Sampling devices- Sample preservation Drinking water quality standards; water quality index; Water conservation techniques- rainwater harvesting, groundwater recharge, Waterborne diseases- causes and symptoms, Microbial indicators of water quality, The Water (Prevention and Control) Act

**Water Treatment** - definition, types and sources of pollutants, impacts; Management - need, site selection for water treatment, the concept of unit operations and processes for drinking water- screening, aeration, sedimentation, coagulation, flocculation, filtration, disinfection

**Unit 2: [7 hrs]**

**Wastewater:** Sources, Physical – Chemical and biological characteristics of wastewater; Effluent discharge standards, Eutrophication

**Liquid Waste Management** - Primary treatment processes - screening, grit removal, equalization tank-sedimentation tanks; Secondary treatment processes- Biological treatment of wastewater; Aerobic and anaerobic processes; suspended and attached growth systems; Tertiary Treatment Processes- Need; Nutrient removal; Advanced tertiary treatment methods

**Unit 3: [6 hrs]**

**Solid Waste:** Sources, types, properties, and impacts; Methods for treatment of solid waste; Concept of three R's (Reduce, Reuse, Recycle) and their importance; Concept of Zero waste and Zero liquid; Solid Waste Management Rules

**Solid Waste Management-** Thermal processes – Incineration, Pyrolysis, Refuse Derived Fuel; Biological processes – Anaerobic digestion, Aerobic treatment- Composting, types of composting; Disposal techniques: Landfills –operation and management

**Unit 4: [6 hrs]**

**Soil-** Sources, types of pollutants and impacts, Soil Quality Analysis: Moisture- pH- Organic Matter-Organic Carbon-Chloride content in Soil

**Soil Pollution and Management-** Soil remediation techniques- Solidification, Stabilization, Soil Vapour Extraction, Soil Washing, Bioremediation, Phytoremediation

**Unit 5: [6hrs]**

**Air-** Definition, Sources, types of air pollutants; Major air pollution episodes and their impacts; Health and Environmental Impacts of Air Pollution, Factors influencing air pollution

**Air Pollution Control:** Sampling techniques, Pollutant measurement methods– Principles and instruments, Ambient air quality standards, Principles and techniques for Control of Particulate and Gaseous Emission, Introduction to Air Act

**Unit 6: [Laboratory Course – 16 hrs]**

**Laboratory Course-** Water Quality Analysis (pH, Conductivity, Acidity, Alkalinity, Total Solids, Salinity, Hardness, Iron, Dissolved Oxygen, Biochemical Oxygen Demand, Chemical Oxygen Demand, Total Coliform)

## 5. Evaluation & Assessment

- a. Quizzes & Assignments
- b. Laboratory Course Assessment

## Evaluation Pattern

Category	Marks
Continuous Assessment	20
Mid-Term	30
End Semester	50
<b>Total</b>	<b>100</b>

## 6. Prerequisites

A system(laptop/Desktop) and lab coat, gloves, and shoes for laboratory course

## 7. Books and References

1. Peavy, H.S, Rowe, D.R and Tchobanoglous, G. Environmental Engineering, Mc Graw Hill Education, 2013
2. Metcalf and Eddy, Waste Water Engineering, Tata McGraw Hill Publishing Co Ltd, 2003
3. Garg, S.K, Water Supply Engineering, Khanna Publishers. 2010
4. Garg, S.K, Sewage disposal and air pollution engineering, Khanna Publishers. 2008
5. Rao, C.S. 2006. Environmental Pollution Control Engineering. New Age International Ltd. Publishers. ISBN 81-224-1835-x
6. "Pollution Control Acts, Rules, Notification issued there under" CPCB, Ministry of Env. And Forest, G.O.I., 3rd Ed. 2006
7. Pichtel J., Waste Management Practices: Municipal, Hazardous and Industrial, CRC. 2005
8. Tchobanoglous G., Burton F. L. and Stensel H.D., "Wastewater Engineering: Treatment and Reuse", 4th Ed., Tata McGraw Hill. 2003
9. Abbasi, S.A., Ramasamy, E.V. Biotechnological Methods of Pollution Control. Universities Press of India Ltd. India.1999
10. Abbasi, S.A. Water Quality: Sampling and Analysis, Discovery Publishing House, New Delhi.1998
11. Tchobanoglaus, G. Theisen and Vigil, S.A. Integrated Solid Waste Management: Engineering Principles and Management Issues, Mc Graw Hill International Edit.1993

12. Standard Methods for the Examination of Water and Wastewater, 23rd edition, American Public Health Association, American Water Works Association, Water Environment Federation, 2017.
13. Vallero D., "Fundamentals of Air Pollution", 4th Ed. Academic Press.(2007)
14. De N.N. (2000) Air Pollution Control Engineering, McGraw-Hill International Edition

### **Further Reading**

1. Punmia, B.C , Wastewater Engineering, Laxmi Publications Pvt.Ltd
2. Modi P.N. 2020. Sewage Treatment & Disposal & Waste Water Engineering. Vol. II, ISBN-13: 9788194359715
3. Wang, L.W., Hung, Y.T., Shamma, T.K. 2005. Physicochemical treatment processes. Vol III. ISBN 1-59259-820-x
4. Hussain, C.M., Kodialbail, V.M. 2023. Concept of Zero Liquid Discharge Innovations and Advances for Sustainable Wastewater Management. Elsevier. ISBN: 9780323917452
5. IS: 10500:2012 Drinking Water - Specification, Second revision, Bureau of Indian Standards, 2012.