University of Kerala

Discipline	CHEMISTRY				
Course Code	**UK4DSECHE200**				
Course Title	**ENVIRONMENTAL CHEMISTRY II**				
Type of Course	**DSE**				
Semester	4				
Academic Level	200 - 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3hours	-	2	5
Pre-requisites	1. Fundamental concept of Aquatic chemistry 2. General chemistry 3. UK3DSECHE200 (preferable)				
Course Summary	This course provides students with the knowledge of the chemical processes and interactions that occur in natural waters, including oceans, rivers, lakes, and groundwater. This course also describes about water pollution and its consequences. This course also highlights the methods of determining water quality parameters and treatment of waste water.				

Detailed Syllabus:

Module	Unit	Content ENVIRONMENTAL CHEMISTRY II	Hrs 75
I	**INTRODUCTION TO AQUATIC CHEMISTRY**		**9**
	1	Aquatic Chemistry: Introduction, structure and physico-chemical properties of water.	1
	2	Composition of water bodies-ocean, lakes, streams, rivers and wetlands.	2
	3	Reactions in water-Acid-base and Redox reactions.	1
	4	Chemical speciation, Biomagnification-Elementary idea only.	2
	5	Aquatic biochemical process- Microbially mediated redox reactions, carbon transformation by bacteria, Nitrogen transformation by bacteria.	3
II	**WATER POLLUTION**		**9**
	6	Introduction, Types and sources of water Pollution.	2
	7	Eutrophication-Causes, Effects and control measures.	1
	8	Organic matter in water- origin and environmental issues.	2

		Inorganic pollutants- acid mine drainage, heavy metals (Hg, Pb, As,Cd).	
	9	Environmental impacts of water pollutants- Sediments, microplastics, Soaps and Detergents.	2
	10	Health effects of water pollution.	2
III	**WATER QUALITY ANALYSIS**		**18**
	11	Objectives of water analysis, Chemical substances affecting potability (Basic concepts and determination)- colour by colorimetric method, odour, turbidity by Jackson Candle Turbidimeter & nephelometer, conductivity - electrical conductivity by conductivity meter, pH by electrometric method.	4
	12	Acidity and Alkalinity by Titrimetric method, Chloride by Mohr's method, Total Solid - suspended solids & dissolved solids by gravimetric method and Hardness by complexometric method.	4
	13	Chemical substances affecting health (Basic Concepts and Determination) - Ammonia by Spectrophotometric Nessler's Method, Sulphate by Volumetric Method, Phosphate by Spectrophotometric Method, Fluoride by Spadns Method.	6
	14	Chemical substances indicative of pollution (Basic Concepts and Determination) – Dissolved Oxygen and BOD by Modified Winkler Method, COD by Titrimetric method, Total Organic Carbon by TOC Analyser	4
IV	**WASTE WATER TREATMENT**		**9**
	15	Criteria of water purity. Waste water treatment methods- Conventional water treatment methods- aeration, settling or sedimentation, coagulation, filtration and disinfection	4
	16	Advanced waste water treatment methods: reverse osmosis, electrodialysis, nutrient removal	4
		Water conservation- concept and significance	1
V	**WATER QUALITY ANALYSIS PRACTICALS I**		**30**
	Preliminary examination of different water samples (Colour, Odour, Temperature, Turbidity, p^H) – Minimum 5 samples		
	Determination of conductivity of water – Using conductivity meter – minimum 3 samples		
	Percentage of chlorine available in bleaching powder – Minimum 3 samples		
	Measurement of chloride, sulphate and salinity of water sample by simple titration method ($AgNO_3$ and potassium chromate)- Minimum 3 samples		
	Determination of DO, BOD and COD-Minimum 3 samples		

References

1. Balram Pani. *Text Book of Environmental Chemistry.* I.K. International Publishing House Pvt. Ltd., 2nd ed., 2017.

2. A. K. De. *Environmental Chemistry.* 7th ed., New Age International Publishers, New Delhi.
3. Gary W. van Loon and Stephen J. Duffy. *Environmental Chemistry: A Global Perspective.* 4th ed., Oxford University Press, 2017.
4. H. Kaur. *Environmental Chemistry.* Pragati Prakashan, 2023.
5. V. K. Ahluwalia. *Environmental Chemistry.* 2nd ed., Ane Books Pvt. Ltd., 2014 (or later).
6. Ronald A. Bailey, Herbert M. Clark, James P. Ferris, Sonja Krause & Robert L. Strong. *Chemistry of the Environment.* 2nd ed., Academic Press.
7. Asim K. Das. *Environmental Chemistry with Green Chemistry.* Books & Allied (P) Ltd., latest known edition.
8. G. S. Sodhi. *Fundamentals of Environmental Chemistry.* 2nd ed., Narosa Publishing House.
9. S. M. Khopkar. *Environmental Pollution Analysis.* Wiley Eastern Ltd., New Delhi.
10. S. S. Dara. *A Textbook of Engineering Chemistry.* S. Chand & Company Ltd., New Delhi.

Course outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO1	Able to describe the chemical composition and physico-chemical properties of water	An	PSO - 1,3
CO2	Describe the main sources of water pollution, the main types of pollutant and their environmental and health impacts	An	PSO - 1,3
CO3	Comprehensive understanding of fundamental principles and analytical methods essential for evaluating the quality of water	E	PSO - 1,3
CO4	Outline how sewage may be treated before discharge to the environment and realise the importance of water conservation	C	PSO - 1,2,3,4
CO5	Understand the appropriate methods and principle behind the practical protocols	C	PSO - 1,3

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: ENVIRONMENTAL CHEMISTRY II

Credits: 3:0:1 (Lecture:Tutorial:Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L) /Tutorial (T)	Practical (P)

1	CO1	PSO - 1,3	An	C	L	-
2	CO2	PSO - 1,3	An	F, C	L	-
3	CO3	PSO - 1,3	E	C	L	-
4	CO4	PSO - 1,2,3,4	C	F, C	L	-
5	CO5	PSO - 1,3	C	F, C	-	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

No:	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO 1	1	-	1	-	-	1	1	-	-	-	-	-	-
CO 2	1	-	1	-	-	1	1	-	-	-	-	-	-
CO 3	1	-	1	-	-	1	1	-	-	-	-	-	-
CO 4	1	2	1	1	-	1	1	-	-	-	-	-	-
CO 5	1	-	1	-	-	1	1	-	-	-	-	-	-

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓	✓		✓
CO 3	✓	✓		✓
CO 4	✓			✓
CO 5	✓			✓