



**University of Kerala**

Discipline	CHEMISTRY				
Course Code	UK5DSECHE300				
Course Title	ENVIRONMENTAL CHEMISTRY III				
Type of Course	DSE				
Semester	5				
Academic Level	300 - 399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	4 hours	-	-	4
Pre-requisites	1. Fundamental concept of Atmospheric chemistry 2. Basic chemistry of reactions 3. UK3DSECHE200, UK4DSECHE200				
Course Summary	This course gives information regarding composition of earth atmosphere and various factors causing air pollution. This course also highlights mechanism of ozone layer depletion and the strategies adopted for improving the quality of air. This course enlightens the students with the analytical methods adopted for the determination of air quality parameters and policy framework for ensuring the quality of air				

**Detailed Syllabus:**

Module	Unit	Content	Hrs
		<b>ENVIRONMENTAL CHEMISTRY III</b>	<b>60</b>
<b>I</b>		<b>INTRODUCTION AND IMPORTANCE OF ATMOSPHERIC CHEMISTRY</b>	<b>8</b>
	1.1	Introduction to Atmospheric Chemistry	1
	1.2	Structure and Composition of atmosphere	2
	1.3	Particles (Dust, Pollen, Volcanic Ash, soot)- ions and radicals in the atmosphere (Hydroxyl and peroxide radicals, Chlorine free radical)-sources and its environmental effects.	3
	1.4	Photochemical reactions in the atmosphere-Photochemical smog	2
<b>II</b>		<b>AIR POLLUTION – CAUSES, EFFECTS, CONSEQUENCES AND TYPES</b>	<b>13</b>
	2.1	Introduction to air pollution – Major sources of air pollution: Natural and man-made sources, Point and Non-Point sources Classification of air pollutants-Primary and Secondary Pollutants, Gaseous and Particulate pollutants; Examples	4
	2.2	Major air pollutants – Oxides of Carbon, Nitrogen & Sulphur; Metallic pollutants (Pb, Hg, Cd, As, Cr & Ni), Radiation, Particulates: Categorization based on size. (Asbestos, Fly ash)-Sources and Health Effects	5

	2.3	The ozone layer - importance, causes of Ozone layer depletion and its consequences .Green House Effect, Global Warming	4
<b>III</b>	<b>METHODS FOR MONITORING AIR POLLUTION</b>		<b>12</b>
	3.1	National Ambient Air Quality Standards (NAAQS) and air quality management; introduction.	2
	3.2	Need for Monitoring and control of air pollutants – NO <sub>x</sub> , SO <sub>2</sub> , H <sub>2</sub> S, Ozone, Hydrocarbons, and particulates (Brief idea only)	3
	3.3	Beer Lambert's law, Methods of sampling of air: Grab and Continuous Sampling. Types of air samplers: Active, Passive, stack and high volume samplers.	3
	3.4	Instrumental methods for measuring air pollution – FTIR, AAS, GC-MS & LIDAR (Principle working and uses; Basic Idea only).	4
<b>IV</b>	<b>CONTROL MEASURES, POLICIES AND CASE STUDIES</b>		<b>12</b>
	4.1	Case studies: Bhopal Gas tragedy, Chernobyl incident, Delhi air pollution	3
	4.2	Methods to control particulates – Gravitational settling chambers and wet collection (Scrubbers)	2
	4.3	Methods to control gaseous pollutants – adsorption and condensation	2
	4.4	Government policies and legislation in India to control air pollution (Air Act 1981, Environmental protection Act 1986, Article 21)	3
	4.5	The role of an individual in the protection of atmosphere	2
<b>V</b>	<b>OPEN ENDED MODULE: Learning through problem solving, seminars, open discussions, assignment discussions, Quizzes, Open book exams etc</b>		<b>15</b>
	1	Introduction to the composition of atmosphere and reactions(both chemical and photochemical) taking place in atmosphere	
	2	Sources, Types ,effects and consequence of air pollution	
	3	Analytical methods adopted for the monitoring of air pollutants	
	4	Environmental Disaster caused by air pollution	
	5	Policies and laws enforced for the control of air pollution	

### References

1. Balram Pani, *Text Book of Environmental Chemistry*, I.K International Publishing House Pvt Ltd
2. A.K De, *Environmental Chemistry*, Seventh Edition, New Age International Publishers
3. Gray W. vanLoon & Stephen J. Duffy, *Environmental Chemistry: A Global Perspective*, Oxford University Press
4. H. Kaur, *Environmental Chemistry*, Pragati Prakashan
5. V.K Ahluwalia, *Environmental Chemistry*, Second Edition, Ane Books Pvt. Ltd.
6. Ronald A. Bailey, Herbert M. Clark, James P. Ferris, Sonja Krause, Robert L. Strong, *Chemistry of the Environment*, Second Edition, Academic Press
7. Asim K. Das, *Environmental Chemistry with Green Chemistry*, Books and Allied (P) Ltd.
8. G S Sodhi, *Fundamentals Environmental Chemistry*, Second Edition, Narosa Publishing House.

### Course outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed	R-
CO1	Help to analyse the composition of Earth's atmosphere, including the major gases and aerosols present and the chemical reactions that occur in the atmosphere namely Photochemical reaction	An	1,3	
CO2	Enable the students to analyse the sources, transport, and health effects of air pollutants, including pollutants like nitrogen oxides, sulfur dioxide, and particulate matter, as well as greenhouse gases and ozone-depleting substances.	An	1,3	
CO3	Explain the principles regarding air quality management and be familiarized with strategies for reducing emissions of air pollutants and improving air quality. Evaluate the analytical techniques for measuring and monitoring air pollutants	E	1,3	
CO4	Evaluate various air pollution control measures, environmental policies, and legislation in India, and develop awareness about the individual's role in protecting the atmosphere.	C	1,2,3	
CO 5	Design and develop strategies for air quality management by integrating knowledge of atmospheric composition, air pollutants, monitoring techniques, pollution-related disasters, and environmental regulations through seminars, quizzes, poster presentations, and assignments.	C	1,2,3,4	

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

**Name of the Course: ENVIRONMENTAL CHEMISTRY III**

**Credits: 4:0:0 (Lecture:Tutorial:Practical)**

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
1	CO1	1,3	An	C	L	
2	CO2	1,3	An	F, C	L	
3	CO3	1, 3	E	C	L	
4	CO4	1, 2, 3	C	F, C	L	
5	CO5	1, 3	C	F, C	L	

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

**Mapping of COs with PSOs and POs:**

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PO1	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	-	-	-	-	-	-
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	✓	✓	✓	