



Lahore University of Management Sciences

ChE 202 – Air Pollution: History, Science, Impacts and Solutions Spring 2022

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Course URL (if any)	

Course Teaching Methodology

- Teaching Methodology: The class is designed to be taught synchronously in person.
- Lecture details: The plan is to deliver live lectures.

Course Basics

Credit Hours	3			
Lecture(s)	Nbr of Lec(s) Per Week	2	Duration	75 minutes each
Recitation/Lab (per week)	Nbr of Lec(s) Per Week		Duration	
Tutorial (per week)	Nbr of Lec(s) Per Week		Duration	

Course Distribution

Core	No
Elective	Yes
Open for Student Category	SBASSE
Close for Student Category	N/A

COURSE DESCRIPTION

Anthropological sources, including emissions from power plants, industries, and vehicles, have decreased the quality of air over the last few centuries. This has led to concern over the impact of air pollution on human health and the earth. Air pollution is a multi-faceted issue. This course will study the science behind it, the policy implications on it, and the threats it poses. The focus of this course will be the underlying science behind air pollution and how it originates. Various types of air pollutants and the sources of these pollutants will be described. Physical and chemical interactions between pollutants will also be covered. The topic of indoor air pollution will be introduced which will also highlight the importance of duration of exposure to pollutants. The course will move into studying some of the biological effects of exposure to air pollution, and how these effects are gauged. The apparent and projected effects of air pollution on the health of the earth will be examined. Policy interventions play an important role in the extent of air pollution. The effect of different policy interventions implemented across the world will be analyzed to understand the role that policy and regulation play on air pollution. Science-based and policy-based steps to mitigate air pollution will be presented to help describe possible pathways towards achieving cleaner air.

COURSE PREREQUISITE(S)

<ul style="list-style-type: none">•••	Chem 101 Principles of Chemistry Sophomore and above
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COURSE OBJECTIVES

<ul style="list-style-type: none">•••	This course is meant to introduce students to the topic of air pollution. It provides an overview to the factors that have historically influenced air pollution and the factors that continue to exacerbate this issue. The course will build on the concepts learnt in Chem 101 to describe the interplay of pollutants. The students will develop an understanding of the global effects of air pollution and science- and policy-based strategies to mitigate air pollution.
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Learning Outcomes			
CLO	Level of Learning	Related PLO	Outcome
CLO1	C2	PLO2	Recognize the historical and policy factors that have led to air pollution.
CLO2	C4	PLO1	Compare the generation pathways, prevalence and other characteristics of gaseous and particulate air pollutants.
CLO3	C3	PLO2, PLO6	Interpret the role anthropological sources has on air pollution.
CLO4	C1	PLO7	Identify possible solutions to reduce air pollution.
CLO5	C4	PLO9, PLO10	Analyze and present scientific literature on air pollution and its mitigation strategies.

Grading break up: Component Details and weightages
Presentation: 10% Home Work: 20% (weekly homework on reading response; longer homework assigned 5-6 times through the semester) Quiz(s): 20% (4 quizzes) Class Participation: 5% Attendance: 0% Midterm Examination: 20% Project: Final Examination: 25%

Examination Detail	
Midterm Exam	Yes/No: Yes Combine Separate: Duration: 75 min Preferred Date: Exam Specifications: Closed book
Final Exam	Yes/No: Yes Combine Separate: Duration: 75 min Exam Specifications: Closed book

COURSE OVERVIEW			
Week/ Lecture/ Module	Topics	Recommended Readings	Objectives/ Application
Week # 1	Overview of what comprises air pollution. Gaseous and particulate pollutants. Concentration units.	Tiwary and Williams Chapt 1. Numerical problems from other sources.	Introduction to the problem of air pollution.
Week # 2	History and regulation of urban air pollution: circa 1200 to present century. Composition and evolution of earth's atmosphere.	Jacobson Chapt 4 and supplementary sources. Jacobson Chapt 2, 3.	History of air pollution. Overview of Earth's atmosphere.
Week # 3	Gas-phase pollutants. Gas-phase chemistry driven by ozone. Chemistry of Photochemical smog.	Tiwary and Williams Chapt 2. Supplementary sources e.g. Jacobson Chapt 4.	Chemistry of air pollution.
Week # 4	Gas concentration measurements. Particulate matter. Particle size distributions. Aerosol mechanics.	Tiwary and Williams Chapt 2. Tiwary and Williams Chapt 3.	Chemistry and physics of air pollution.



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Week # 5	Particulate matter (contd). Aerosol mechanics. Particle measurements.	Tiwary and Williams Chapt 3.	Chemistry and physics of air pollution.
Week # 6	Indoor Air Pollution. How it differs from ambient air pollution. Homogeneous and heterogeneous reactions.	Tiwary and Williams Chapt 7.	Chemistry and physics of air pollution.
Week # 7	Road traffic emissions. Dry deposition (deposition velocity) and wet deposition.	Tiwary and Williams Chapt 5. Tiwary and Williams sections 6.4, 6.5, 6.6.	Anthropological effects on air pollution. Physics of air pollution.
Week # 8	Health effects of exposure to pollutants. PM _{2.5} as the respirable fraction of particles. Concept of disability adjusted life years.	Supplementary sources. Jacobson sections 5.6, 5.7.	Biological effects of air pollution.
Week # 9	Effects of Meteorology on Air Pollution	Jacobson Chapt 6	Link between air pollution and meteorology.
Week # 10	Air pollution control and mitigation.	Tiwary and Williams Chapt 9.	Solutions for air pollution.
Week # 11	International regulation of urban smog. Air Quality Standards. Criteria air pollutants. National Air Quality Standards.	Jacobson Chapt 8 (+ other sources). Tiwary and Williams Chapt 14.	Link between policy and air pollution.
Week # 12	Student presentations on scientific literature related to air pollution.	Peer-reviewed journal articles.	Scientific communication.
Week # 13	Greenhouse effect and global warming	Tiwary and Williams Chapt 11 and Jacobson Chapt 12	Impacts of air pollution on the earth.
Week # 14	Energy solutions to air pollution and global warming	Jacobson Chapt 13	Solutions for air pollution.
Week # 15	Final Exam		

Textbook(s)/Supplementary Readings

Required Textbook: Abhishek Tiwary and Ian Williams. Air Pollution: Measurement, Modelling and Mitigation, 4th edition, CRC Press, Taylor and Francis Group, 2019.

Supplementary Reading: Mark Jacobson. Air Pollution and Global Warming: History, Science and Solutions, 2nd edition, Cambridge University Press, 2012.