Lahore University of Management Sciences

SCI 203/ENV 237– Air Pollution

Spring 2026

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Teaching Assistant	
Support Services	LUMS offers a range of academic and other services to support students. These are mentioned below, and you are encouraged to use these in addition to in-class assistance from course staff. For a complete list of campus support services available for you click here (https://advising.lums.edu.pk/#supportservices)

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	1 occasionally	Duration	60 min

Course Distribution	
Core	No
Elective	Yes
Open for Student Category	
Close for Student Category	Not for freshmen students

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 also cover 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)
• Chem 101 Principles of Chemistry (or instructor approval obtained by demonstrating prior knowledge of the fundamentals of physical chemistry, inorganic chemistry, and organic chemistry).
• Sophomore standing and above

COURSE OBJECTIVES
• Provide an introduction to the issue of air pollution, including an analysis of its history and its impacts.
• Build on basic concepts of science to teach students about the interaction between different gaseous and particulate pollutants.
• Develop an understanding of the global effects of air pollution, and science- and policy-based strategies to mitigate air pollution.
• Develop an understanding of scientific literature on 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** generation pathways, prevalence & other characteristics of gaseous & particulate pollutants.
CLO3	C3	PLO2, PLO6	**Interpret** the role anthropological sources have 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
Home Work: 15% Quizzes/Assignments: 15% Class Participation: Presentation on scientific literature: 10% Midterm Examination: 25% Final Examination: 35%

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: 120 min Exam Specifications: Closed book

COURSE OVERVIEW (subject to modification)

Week	Topics	Recommended Reading	Objectives/ Application
Week # 1	Overview of what comprises air pollution. Gaseous and particulate pollutants. Concentration units.	Seinfeld and Pandis 1.3-1.7 Numerical problems from other sources.	Introduction to the problem of air pollution.
Week # 2	Composition and structure of earth's atmosphere. History and regulation of urban air pollution: circa 1200 to present century.	Jacobson Chapt 3.1-3.5 Jacobson Chapt 4.1.	Overview of Earth's atmosphere. History of air pollution.
Week # 3	Gas-phase pollutants. Gas-phase chemistry.	Jacobson Chapt 3.6, 4.2.	Chemistry of air pollution.
Week # 4	Gas-phase chemistry. Chemistry of Photochemical smog.	Jacobson Chapt 4.2-4.3.	Chemistry of air pollution.
Week # 5	Chemistry of Photochemical smog. Gas concentration measurements. Particulate matter: Size Ranges	Jacobson Chapt 4.3-4.4. S&P Chapt 6	Physics of air pollution.
Week # 6	Particulate Matter: Sources of fine and coarse particles. Particle size distributions (normal vs. lognormal; number, area, volume).	Seinfeld and Pandis Chapt 8 Jacobson 5.1-5.2, 5.4-5.5	Physics of air pollution.
Week # 7	Particulate Matter: Aerosol mechanics. Guest Lecture - TBA	Seinfeld and Pandis Chapt 8 Jacobson 5.1-5.2, 5.4-5.5	
Week # 8	Particulate Matter: Aerosol mechanics.	Seinfeld and Pandis Chapt 9	Physics of air pollution.
Week # 9	Particulate Matter: Particle measurements. **Midterm**	Seinfeld and Pandis Chapt 9	Physics of air pollution.
Week # 10	Road traffic emissions. Dry deposition (deposition velocity).	Tiwary and Williams Chapt 5.1. Tiwary and Williams Chapt 6.4, 6.6.	Anthropological effects on air pollution. Physics of air pollution.

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Week # 11	Indoor Air Pollution. How it differs from ambient air pollution. Homogeneous and heterogeneous reactions. Health effects of exposure to pollutants. $PM_{2.5}$ as the respirable fraction of particles. Concept of disability adjusted life years.	Review Articles posted on LMS. Jacobson Chapter 9. Davis and Cornwell 2013, section 9.4. Jacobson sections 5.6, 5.7. Review Articles posted on LMS.	Chemistry and physics of air pollution. Biological effects of air pollution.
Week # 12	Health Effects (contd.) International regulation of urban smog. Air Quality Standards. Criteria air pollutants. National Air Quality Standards.	Review Articles (contd.). Jacobson Chapt 8. WHO Ambient Air Pollution article. Davis & Cornwell 2013, section 9.3.	Biological effects of air pollution. Link between policy and air pollution.
Week # 13	Student presentations on scientific literature related to air pollution.	Peer-reviewed journal articles.	Scientific communication.
Week # 14	Student presentations on scientific literature related to air pollution.	Peer-reviewed journal articles.	Scientific communication.
Week # 15	Air pollution control and mitigation. Energy solutions to air pollution and global warming	Jacobson Chapt 13 Jacobson Chapt 12	Solutions for air pollution.
Week # 16	**Final Exam**		

Textbook(s)

Required Textbooks:
Mark Jacobson. Air Pollution and Global Warming: History, Science and Solutions, 2nd edition, Cambridge University Press, 2012.
John H. Seinfeld, Spyros N. Pandis. Atmospheric Chemistry and Physics: From Air Pollution to Climate Change. 3rd edition, April 2016.

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

Teaching Philosophy

I expect students to come prepared for lectures by reading the recommended material beforehand. To incentivize students to do this, I will often hold a short quiz (usually at the start of class) to test some basics of the chapter/sections. Reading the material before prepares you to better absorb the material taught in class.
I will not be able to cover every topic in detail in the lectures. This is also why you are responsible for reading all the recommended material. If you don't understand any of the material, make use of the office hours of the instructor(s)/teaching assistant(s). I believe that 2-way interaction between the instructor and the students leads to better learning and will also try to facilitate that to the extent that our class time permits.
To succeed in college courses, you should expect to spend 3 hours reading and practicing problems for every 1 hour spent in class. Think about homework problems before you come to office hours to discuss them. Work on your own on homework questions; if you are stuck, then seek help from your peers and instructors. Seeking help without first thinking through the questions on your own will limit your learning which can affect your performance on exams. Study groups can be useful, but view your classmates as fellow teachers, not as a quick way to get the answer.
Keep up with the material. Get help early if you are having trouble.

Code of Conduct for Class Participation and Group Work with Peers

- Attend classes regularly, come prepared by having done the reading, take good notes, ask questions.
- Be attentive and respectful in class. Consider others' perspective with respect even if you disagree.
- Be proactive and flexible and take ownership of your learning experience as individuals and as a group.

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Homework Policy
Assignments will be given to help you practice your problem-solving skills. I strongly encourage you to attempt problems on your own before working in groups, if all your work is done in a group setting you are not adequately preparing for quizzes and exams. Copying from other students or other sources (e.g. solution manuals, old solutions, etc.) is viewed as academic misconduct and will be dealt with seriously. Timely submissions of homework help you stay on track. To discourage late submissions, 5% will be deducted from your score per day after the due date (e.g. if you submit homework 2 days late the maximum you can get will be 90%) for the first 3 times you submit homework late. If you submit homework late more than 3 times, your submission may only be accepted for documented cases of family emergency or illness.

Grading Policy
• The final grade will be on a relative basis, however, scores less than 40% will get an F. • At least 75% attendance is expected for passing the course. • We will strive to fairly grade all of your assignments and exams. In all these evaluations, you will be penalized if there is a serious conceptual or mathematical mistake, error in the use of appropriate units, or indication of copying from other students. • If you feel that an assignment or exam has been graded incorrectly you may ask for a re-grade. All requests for re-grading any work must be presented within 7 days of the day the work is returned to the class.

Academic Honesty
I expect that you: • Take responsibility for your own learning. • Attend classes regularly. • Do not attempt to take credit for any work that you did not prepare yourself. • Be respectful. Any instances of academic dishonesty in this course (intentional or unintentional) will be dealt with swiftly and severely. Potential penalties include receiving a failing grade on the assignment in question or in the course overall. Your work (on homeworks, quizzes, exams, other submitted materials) must comply with the policies described in the LUMS Student Handbook.

Campus supports & Key university policies

Campus Supports

Students are strongly encouraged to meet course instructors and TA's during office hours for assistance in course-content, understand the course's expectations from enrolled students, etc. Beyond the course, students are also encouraged to use a variety of other resources. (Instructors are also encouraged to refer students to these resources when needed.) These resources include Counseling and Psychological Services/CAPS (for mental health), LUMS Medical Center/LMC (for physical health), Office of Accessibility & Inclusion/ OAI (for long-term disabilities), advising staff dedicated to supporting and guiding students in each school, online resources (https://advising.lums.edu.pk/advising-resources), etc. To view all support services, their specific role as well as contact information click here (https://advising.lums.edu.pk/#supportservices).

Academic Honesty/Plagiarism

LUMS has zero tolerance for academic dishonesty. Students are responsible for upholding academic integrity. If unsure, refer to the student handbook and consult with instructors/teaching assistants. To check for plagiarism before essay submission, use similarity@lums.edu.pk. Consult the following resources: 1) Academic and Intellectual Integrity (http://surl.li/gpvwb), and 2) Understanding and Avoiding Plagiarism (http://surl.li/gpvwo).

LUMS Academic Accommodations/ Petitions policy

Long-term medical conditions are accommodated through the Office of Accessibility & Inclusion (OAI). Short-term emergencies that impact studies are either handled by the course instructor or Student Support Services (SSS). For more information, please see Missed Instrument or 'Petition' FAQs for students and faculty (https://rb.gy/8sj1h)

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LUMS Sexual Harassment Policy

LUMS and this class are a harassment-free zone. No behavior that makes someone uncomfortable or negatively impacts the class or individual's potential will be tolerated.

To report sexual harassment experienced or observed in class, please contact me. For further support or to file a complaint, contact OAI at oai@lums.edu.pk or harassment@lums.edu.pk. You may choose to file an informal or formal complaint to put an end to the offending behavior. You can also call their Anti-Harassment helpline at 042-35608877 for advice or concerns. *For more information: Harassment, Bullying & Other Interpersonal Misconduct: Presentation (http://surl.li/gpvwt)*