



Lahore University of Management Sciences

SCI 203 – Air Pollution Summer 2023

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Course Teaching Methodology

Teaching Methodology: The class is designed to be taught synchronously in person.

Course Basics

Credit Hours	3			
Lecture(s)	Nbr of Lec(s) Per Week	5	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	
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 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)

- 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 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
Home Work: 15% (reading-based and numerical problems) Quizzes/Written Assignments/Mini-presentation: 15% Class Participation: 10% Presentation on scientific literature: 10% Midterm Examination: 20% Final Examination: 30%

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 (<i>Supplemental Reading in italics</i>)	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	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 and relevant sections from T&W.	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. (<i>Tiwary and Williams Chapt 2, 12.1</i>)	Chemistry of air pollution.
Week # 5	Chemistry of Photochemical smog. Gas concentration measurements. Particulate matter: Size Ranges	Jacobson Chapt 4.3-4.4. Tiwary and Williams Chapt 2.4. Tiwary and Williams Chapt 3.	Physics of air pollution.
Week # 6	Particulate Matter: Sources of fine and coarse particles. Particle size distributions (normal vs. lognormal; number, area, volume).	Tiwary and Williams Chapt 3.	Physics of air pollution.
Week # 7	Particulate Matter: Aerosol mechanics. Guest Lecture by Dr. Abubakr Muhammad on air quality measurements and land-atmosphere models research project (~Mar 3).	Tiwary and Williams Chapt 3.	Air quality monitoring and research in Punjab.
Week # 8	Particulate Matter: Aerosol mechanics.	Tiwary and Williams Chapt 3.	Physics of air pollution.
Week # 9	Particulate Matter: Particle measurements. Midterm	Tiwary and Williams Chapt 3.	Physics of air pollution.



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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.
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.	Tiwary and Williams Chapt 7. Review Articles posted on LMS. 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. (<i>T&W Chapt 14</i>)	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	Tiwary and Williams Chapt 9. Jacobson Chapt 13	Solutions for air pollution.
Week # 16	Final Exam		

Textbook(s)

Required Textbooks: Abhishek Tiwary and Ian Williams. Air Pollution: Measurement, Modelling and Mitigation, 4th edition, CRC Press, Taylor and Francis Group, 2019.
Mark Jacobson. Air Pollution and Global Warming: History, Science and Solutions, 2nd edition, Cambridge University Press, 2012.

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 homework, quizzes, exams, other submitted materials) must comply with the policies described in the LUMS Student Handbook.

Harassment Policy

There is absolutely zero tolerance for any behaviour that is intended, or has the expected result of making anyone uncomfortable and negatively impacts the class environment, or any individual's ability to work to the best of his/her potential. In case a differently-abled student requires accommodations for fully participating in the course, students are advised to contact the instructor so that they can be facilitated accordingly.

If you think that you may be a victim of harassment, or if you have observed any harassment occurring in the purview of this class, please reach out and speak to the instructor. If you are a victim, it is strongly encouraged to reach out to the Office of Accessibility and Inclusion at oai@lums.edu.pk or the sexual harassment inquiry committee at harassment@lums.edu.pk for any queries, clarifications, or advice. You may choose to file an informal or a formal complaint to put an end to offending behaviour. You can find more details regarding the LUMS sexual harassment policy at: <https://mgshss.lums.edu.pk/lums-harassment-policy>. To file a complaint, please write to harassment@lums.edu.pk. In addition to LUMS resources, SSE's Council on Belonging and Equity is committed to devising ways to provide a safe, inclusive and respectful learning environment for students, faculty and staff. To seek counsel related to any issue, please feel free to approach either a member of the council or email at cbe.sse@lums.edu.pk.