Department of Environmental Health
Faculty of Health Sciences
American University of Beirut

ENHL 238 (3 cr.)
Indoor & Outdoor Air Pollution

Course Coordinator:

Name: Hassan R. Dhaini, MSc, PhD
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Office hours: MW 11:30am -12:30

Class time and location:

Term, Dates and times: Fall Term; MW 3:00 - 4:15 pm
Classroom: Van Dyck Hall 101

Prerequisites:

ENHL 220, CHEM 208 or CHEM 211 and 212

Course description:

This course provides an introduction to the principles of indoor and ambient air pollution. Topics covered include basic meteorological processes, air quality monitoring, emission sources, air sampling, and dispersion modeling. Additionally, students are exposed to technologies for air pollution control and prevention. The course also discusses climate change, and air pollution epidemiology and health impact. In addition to in-class exercises, hot topics of local and global relevance are introduced through case studies and hosted guest speakers.

Course learning objectives

By the end of the course, students will be able to:

1. Demonstrate an understanding of the causes and sources of indoor and ambient air pollution
2. Apply air dispersion modeling to predict downwind pollutant concentrations from a point source
3. Describe techniques for particulates and gases sampling and detection
4. Examine evidence and influencing factors in climate change
5. Explain the types of air quality monitoring and steps in emission inventory development
6. Summarize technologies available and their effectiveness in controlling and preventing air pollution
7. Describe the health risks and burden of disease associated with air pollution
8. Demonstrate an understanding of local and global air pollution challenges

Course Material Readings:

Daniel Vallero. Fundamentals of Air Pollution. Fifth Edition. Academic Press, Elsevier. ISBN 978-0-12-401733-7.

The course material includes lecture handouts and reading assignments used for discussion. The lecture handouts and reading material will be posted on Moodle prior to class. If the lecture handouts are not posted on Moodle ahead of class, the course coordinator is responsible for bringing in hard copies to class.

Course requirements and student evaluations:

Students will be evaluated on two exams, class participation, and a final examination as following:

	Assessment	**% Grade**	**Linked Course Objectives**
A.	Exam 1	30%	LOs 1 & 2
B.	Exam 2	30%	LOs 3-6, 8
C.	Final Exam	35%	LOs 1-8
D.	Class Participation	5%	

Evaluation tools will assess both (1) the acquired level of knowledge of the student, and (2) the ability of the student to use provided data or premise in critical reasoning.

Attendance
You are urged to attend all classes. In cases of absence, you are responsible for the material missed and for any announcement made. Students who miss more than one-fifth of class sessions are subject to withdrawing from the course (W) as per the University policy.

Academic Integrity
Education is demanding and time management is essential. Do not hesitate to use the resources around you but do not cut corners. Cheating and plagiarism will not be tolerated. Please review the Student Code of Conduct in your handbook and familiarize yourself with definitions and penalties. If you are in doubt about what constitutes plagiarism, ask your instructor because it is your responsibility to know. The American University of Beirut has a strict anti-cheating and anti-plagiarism policy. Penalties include failing marks on the assignment in question, suspension or expulsion from University and a permanent mention of the disciplinary action in the student's records.

Students with Special Needs
If you have documented special needs and anticipate difficulties with the content or format of the course due to a physical or learning disability, please contact me and/or your academic advisor, as well as the Counseling Center in the Office of Student Affairs (Ext.

3196), as soon as possible to discuss options for accommodations. Those seeking accommodations must submit the Special Needs Support Request Form along with the required documentation.

Non-Discrimination – Title IX

AUB is committed to facilitating a campus free of all forms of discrimination including sex/gender-based harassment prohibited by Title IX. The University's non-discrimination policy applies to, and protects, all students, faculty, and staff. If you think you have experienced discrimination or harassment, including sexual misconduct, we encourage you to tell someone promptly. If you speak to a faculty or staff member about an issue such as harassment, sexual violence, or discrimination, the information will be kept as private as possible, however, faculty and designated staff are required to bring it to the attention of the University's Title IX Coordinator. Faculty can refer you to fully confidential resources, and you can find information and contacts at www.aub.edu.lb/titleix. To report an incident, contact the University's Title IX Coordinator at 01-350000 ext. 2514, or titleix@aub.edu.lb. An anonymous report may be submitted online via EthicsPoint at www.aub.ethicspoint.com.

Privacy Statement

By signing up for this course, you confirm that you have read and accepted the terms and provisions of the AUB's Privacy Statement.

Course Timetable[¥]

Session(s)* /Date(s)	Topic	Content	Reading	Course Learning Objective(s)
1 M Aug 28	Course Introduction	• Content and Requirements		
2-3 W Aug 30 M Sep 04	Air Pollution: An Overview	• Overview and Definitions • Causes of air pollution • Major air pollution disasters • Atmospheric composition • Overview of Fundamental concepts	Handout	LO1
4-5 W Sep 06 M Sep 11	Ambient Air Pollution Sources	• Categories of Outdoor Air pollutants • Sources of emission • Smog Formation	Handout	LO1
6-7 W Sep 13 M Sep 18	Indoor Air Pollution Sources	• Categories & sources of indoor air pollutants • Indoor pollution transport • Prevention	Handout	LO1
8-9 W Sep 20 M Sep 25	Air Dispersion Models	• Fixed Box Model • Gaussian Modeling • Plume Rise	Handout	LO2
W Sep 27	**No Class: Prophet's Birthday**			
10 M Oct 02	Air Dispersion Models (cont.)	• In-Class Exercises • Q & A		
11-12 W Oct 04 M Oct 09	Air Sampling & Analysis	• Particle sampling and detection • Gas sampling and detection	Handout	LO3
W Oct 11	**EXAM 1: Covering sessions 1-10**			
13 M Oct 16	Case Study-1**		Assigned Reading	LOs 2 & 8
14-16 W Oct 18 M Oct 23	Climate Change	• Principles of the greenhouse effect • Greenhouse gases (GHG) • Evidence of Global Warming • Future Projections	Handout	LOs 4 & 8

W Oct 25	Case Study-2**		Assigned Reading	
17 M Oct 30	Lebanon's National Policy on Climate Change		Guest Speaker	LO8
18 -19 W Nov 01 M Nov 06	AQMS & Emission Inventories	• Types of Air Quality Monitoring • Global and Local AQMS • Air Quality Monitoring Instruments • Emissions Inventory Steps and Requirements • In-Class Exercises	Handout	LOs 5 & 8
20 W Nov 08	AP Control Technologies	• NOx, SOx, COx emission control • Pollution control for particulate matter	Handout	LO6
M Nov 13	**EXAM 2: Covering sessions 11-19**			
21 W Nov 15	AP Control Technologies (Cont.)	• Mercury Emission control • In-Class Exercises		LO6
22 M Nov 20	Case Study-3**		Assigned Reading	LO8
W Nov 22	**No Class: Independence Day**			
23 M Nov 27	Air Pollution Epidemiology & Health Risks	• Time-Series and Cohort studies • Evidence of PM Health Risks • AQI & AQHI • Associated Cancer Risk in Lebanon	Handout	LO7
24-25 W Nov 29 Extended Session	Clean Energy Options	• Air Pollution & SDGs • Global Clean Energy Investments & Consumption • Types of Renewable Energy Sources • Clean Energy Policies		LO6
TBA by Registrar	***FINAL EXAMINATION: Comprehensive***			

¥***Changes in the timetable may occur during the term***
**Each session is 75 min*
***Sessions with assigned readings organized by day:*

October 16
Salloum et al. (2018). PM10 Plume dispersion data of the Zouk power plant in Lebanon. *Data in Brief 20: 1905–1911.*

October 25
MoE/UNDP/GEF (2015). National Greenhouse Gas Inventory Report and Mitigation Analysis for the Transport Sector in Lebanon. Beirut, Lebanon.

November 20
Beylot et al. (2017). Municipal Solid Waste Incineration in France: An Overview of Air Pollution Control Techniques, Emissions, and Energy Efficiency. *Journal of Industrial Ecology 22 (5): 1016-1026.*

Course Withdrawal end period: **November 17, 2023**
Reading Period: **December 01, 2023**

List of Lecturers:

Dr. Hassan Dhaini
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Mr. Vahakn Kabakian
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