

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

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

Course Coordinator:

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Office hours: MF 11:00-12:00

Class time and location:

Date & Time: MWF 10:00-10:50
Building/Classroom: Van Dyck Hall, Room 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%	

Course Policies

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're 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 Trudi Hodges at 01-350000 ext. 2514, or titleix@aub.edu.lb. An anonymous report may be submitted online via EthicsPoint at www.aub.ethicspoint.com.

⊕ Course Timetable

Week/ Date(s)	Topic	Content	Reading (Guest Speaker)	Course Learning Objective(s)
1 F Aug 30	Course Introduction	<ul style="list-style-type: none"> Content and Requirements 		
2 M Sep 02 W Sep 04 F Sep 06	Air Pollution: An Overview	<ul style="list-style-type: none"> Overview and Definitions Causes of air pollution Major air pollution disasters Atmospheric composition Overview of Fundamental concepts 	Handout	LO1
3 M Sep 09 W Sep 11 F Sep 13	Ambient Air Pollution Sources	<ul style="list-style-type: none"> Categories of Outdoor Air pollutants Sources of emission Smog Formation 	Handout	LO1
4 M Sep 16 W Sep 18 F Sep 20	Indoor Air Pollution Sources	<ul style="list-style-type: none"> Categories & sources of indoor air pollutants Indoor pollution transport Prevention 	Handout	LO1
5-6 M Sep 23 W Sep 25 F Sep 27 M Sep 30 W Oct 02	Air Dispersion Models	<ul style="list-style-type: none"> Fixed Box Model Gaussian Modeling Plume Rise In-Class Exercises Q & A 	Handout	LO2
F Oct 04	EXAM 1: Covering lectures of Weeks 2-6			
7 M Oct 07 W Oct 09 F Oct 11	Air Sampling & Analysis	<ul style="list-style-type: none"> Quality Assurance Particle sampling and detection Gas sampling and detection 	Handout	LO3
8 M Oct 14	Case Study-1*	<ul style="list-style-type: none"> Plume Dispersion for the Zouk Power Plant 	Assigned Reading	LOs 2 & 8
W Oct 16 F Oct 18 9 M Oct 21 W Oct 23 F Oct 25	Climate Change [Case Study-2]*	<ul style="list-style-type: none"> Principles of the greenhouse effect Greenhouse gases (GHG) Evidence of Global Warming Future Projections Greenhouse gas calculations GHG Emissions Inventory & Mitigation for Lebanon 	Handout Assigned Reading	LOs 4 & 8
10 M Oct 28 W Oct 30	AQMS & Emission Inventories	<ul style="list-style-type: none"> Types of Air Quality Monitoring Global and Local AQMS Air Quality Monitoring Instruments 	Handout	LOs 5 & 8

F Nov 01		<ul style="list-style-type: none"> Emissions Inventory Steps and Requirements In-Class Exercises 		
11 M Nov 04 W Nov 06 F Nov 08	Control Technologies	<ul style="list-style-type: none"> NO_x, SO_x, CO_x emission control Pollution control for particulate matter Mercury Emission control In-Class Exercises 	Handout	LO6
12 M Nov 11	Case Study-3	<ul style="list-style-type: none"> Incinerators Air Pollution & Control 	Assigned Reading	LO8
W Nov 13	EXAM 2: Covering sessions of Weeks 7-11			
F Nov 15	Air Pollution Epidemiology & Health Risks	<ul style="list-style-type: none"> Time-Series and Cohort studies Evidence of PM Health Risks AQI & AQHI Associated Cancer Risk in Lebanon 	Handout	LO7
13 M Nov 18 W Nov 20	Local Air Quality	<ul style="list-style-type: none"> Air Quality Monitoring Status in Lebanon Air Pollution from Power Generators in Beirut 	(Charbel Afif) (Najat Saliba)	LO8
F Nov 22	No Class: Independence Day			
14 M Nov 25 W Nov 27 F Nov 29	Clean Energy Options	<ul style="list-style-type: none"> Air Pollution & SDGs Global Clean Energy Investments & Consumption Types of Renewable Energy Sources Clean Energy Policies 		LO6
15 M Dec 02		Review Session: Q & A		
TBA by Registrar	FINAL EXAMINATION: Comprehensive			

φ Changes in the timetable may occur during the term

*Sessions with assigned readings organized by day:

October 14

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 11

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 21st, 2019**

Reading Period: **December 4th, 2019**