University of Manitoba | Price Faculty of Engineering
Department of Biosystems Engineering

Course Outline

BIOE 4460 Air Pollution Assessment and Management

Winter 2024

Instruction Team

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Office Hours

- By email appointment

Teaching Assistant

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Locations

- **Lectures E2-304 EITC**
  M, W, F 11:30 - 12:20AM
- **Labs E2-304 EITC**
  R 2:30 - 5:15PM

Contact Hours

- 4 credit hours
- Lectures:
  3 hours x 12 weeks = 36 hours
- Laboratories:
  1.5 hours x 12 weeks = 18 hours

Prerequisites:

BIOE 2790 or CIVL 2790 or MECH 2262 or the former Mech 2260

Course Website:

http://umanitoba.ca/umlearn

Course Objectives

The intent of this course is to provide students with an understanding of the engineering principles of air pollution control and the process of designing/selecting air pollution control systems.

Course Content

Environmental engineering is a program specialization in the Biosystems Engineering undergraduate program, and air pollution is one of the most important areas in environmental engineering. This course will prepare students in dealing with various air pollution issues, including the transport of pollutants in the atmosphere, and design of systems for controlling particulate and gaseous pollutants.

How does this course fit into the curriculum?

This course is a design elective that students take in their final year. It is one of the courses in the design elective package for the environmental engineering specialization within the Biosystems Engineering program.

The following topics will be covered:

1. Air pollutants and their effects (3 h)
   - 1.1. definitions and types of air pollution
   - 1.2. sources of air pollution
   - 1.3. effects of air pollution
   - 1.4. air quality standards, legislations, and regulations
   - 1.5. approach of addressing air pollution problems
2. Dispersion of pollutants in atmosphere (10 h)
   - 2.1. atmospheric motions and stability
   - 2.2. Gaussian plume dispersion models
   - 2.3. other dispersion models
3. Particulate pollutants (10 h)
   - 3.1. PM definition and description
   - 3.2. behavior of particulate pollutants
   - 3.3. sampling of particulate pollutants
   - 3.4. design of control systems for particulate pollutants
4. Gaseous pollutants (gases and vapors) (10 h)
   - 4.1. typical gaseous pollutants and their properties
     - 4.1.1. sulfur oxides
     - 4.1.2. nitrogen oxides
     - 4.1.3. VOCs (volatile organic compounds)
     - 4.1.4. environmental odours
   - 4.2. sampling methods
   - 4.3. design of control systems for gaseous pollutants
5. GHG and climate change (6 h)

Important Dates

Term Test
March 7, 2024

February 16, 2024
Louis Riel Day Feb. 19, 2024 No classes or examinations

Winter term break Feb. 19 - 23, 2024

Voluntary Withdrawal (VW) Mar. 20, 2024

Good Friday Mar. 29, 2024 No classes or examinations

Assignment #4 due

April 4, 2024
Project Presentation

April 10, 2024
Last Day of Classes Apr. 10, 2024

Accreditation Details

- Mathematics: 0%
- Natural Science: 0%
- Complementary Studies: 0%
- Engineering Science: 20%
- Engineering Design: 80%

Graduate Attributes

KB: A knowledge base for engineering
PA: Problem analysis
IN: Investigation
DE: Design
ET: Use of engineering tools
IT: Individual and teamwork
CS: Communication skills
PR: Professionalism
IE: Impact of engineering on society/environment
EE: Ethics and equity
EP: Economics and project management
LL: Life-long learning

Competency Levels

1 - Knowledge (Able to recall information)
2 - Comprehension (Ability to rephrase information)
3 - Application (Ability to apply knowledge in a new situation)
4 - Analysis (Able to break problem into its components and establish relationships.)
5 - Synthesis (Able to combine separate elements into a whole)
6 - Evaluation (Able to judge the worth of something)

Laboratories:

Topics:

- Facility tours
- Guest speakers
- Stack plume measurement
- Air sampling
- Olfactometer for odour measurement
- Dispersion modelling

Design project

Textbook, Readings, Materials

Required textbook – None

References

De Nevers, N. 2000. Air Pollution Control Engineering, 2nd ed., McGraw-Hill.
Wark, K., C.F. Warner and W.T. Davis. 1998. Air Pollution, Its Origin and Control. Addison Wesley Longman Publishing Company.
Sternberg, S.P.K. 2015. Air Pollution: Engineering, Science, and Policy. College Publishing (www.vitalsource.com).
Kuo, J. 2018. Air Pollution Control Engineering for Environmental Engineers, 1st ed. CRC Press.

Additional Materials
Lecture notes (pdf files) will be posted on UM Learn for download.

Learning Outcomes

By the end of this course, you will be able to:

No.	Learning Outcome	Transferable Skill
1	Understand the sources and types of air pollutions, as well as, there effects on society.	Knowledge Base; Problem Analysis; Impacts of Engineering
2	Find, interpret, and utilize applicable standard and regulations associated with air pollution.	Problem Analysis: Investigation
3	Model air emission dispersion using Gaussian plume models.	Problem Analysis
4	Utilize the Atmospheric dispersion modelling program AERMOD.	Engineering Tools
5	Determine settling velocity and deposition rate of particulate matter in air.	Problem Analysis
6	Understand the testing methods available for measuring both particulate matter and gasses in air.	Knowledge Base; Problem Analysis
7	Design air treatment systems for particulate matter and gases.	Problem Analysis: Engineering Toos; Design; Economics and Project Management
8	Work effectively as a part of an engineering design team.	Investigation; Design; Individual and Team; Communication Skills; Professionalism

Expected Competency Levels

Outcome	KB	PA	IN	DE	ET	IT	CS	PR	IE	EE	EP	LL
1	2.3	3							4			
2			4					1.3				
3		3										
4					3							
5		3										
6	3	3.4.5										
7		3.5			3.4							
8			4,5			3	3	3				

CEAB Graduate Attributes Assessed

KB.3 – Recalls, defines, comprehends, and applies information and concepts in fundamental engineering science.

PA. 3 – Analyzes and solves complex engineering problems.

IN.1 – Gathers information (literature review, measurements, experiments, laboratory exercises) and analyzes data.

IN.3 – Interprets results and reaches appropriate conclusions.

DE.1 – Understands the complexities of an open-ended engineering design problem and defines appropriate objectives and constraints.

DE.2 – Uses an appropriate design process that considers all relevant factors (i.e., health &safety risks; standards; economic, environmental, cultural and societal considerations)

DE.3 – Develops/implements possible solutions to an open-ended design problem, leading to an appropriate recommendation.

ET.1 – Uses tools to complete engineering activities.

IT.2 – Contributes equitably to completion of group work.

IT.3 – Exhibits appropriate interpersonal skills when interacting with team members

CS.2 – Designsand produces appropriate engineering documents (i.e., research reports, engineering reports, design documents, graphics)

CS.3 – Delivers effective technical presentations.

PR.2 – Knows relevant codes, laws and regulations.

IE.1 – Understands the social, environmental, economic, health, safety, legal and/or cultural aspects of engineering activities.

Evaluation

Component	Value (%)	Assessor	Method of Feedback*	Learning Outcomes Evaluated	I/T**
Final Exam	50	INS	S	KB	I
Midterm	20	INS	S	KB	I
Lab reports and assignments	10	TA	F, S	KB, IN, PA	T/I
Design Project	20	INS	F, S	PA	T

* Method of Feedback: **F** - Formative (written comments and/or oral discussion), **S** - summative (numerical grade)

** I/T: **I** – Individual effort, **T** – Team effort

Grading Scale

Note: These boundaries represent a guide for the instructor and class alike. Provided that no individual student is disadvantaged, the instructor may vary any of these boundaries to ensure consistency of grading from year-to-year.

Letter	Mark
A+	92–100
A	85–91
B+	78–84
B	72–77
C+	66–71
C	60–65
D	50-59
F	< 50

Traditional Territories

The University of Manitoba campuses are located on the original lands of the Anishinaabeg, Cree, Oji-Cree, Dakota, and Dene peoples, and on the homeland of the Métis Nation. We respect the Treaties that were made on these territories, we acknowledge the harms and mistakes of the past, and we dedicate ourselves to move forward in partnership with Indigenous communities in a spirit of reconciliation and collaboration.

Description of Lab Reports and Assignments

There will be assignments to help you digest the content of important topics. A report will be required for each lab (including site visits). A project report will be submitted as part of your design project. The project report will include the following elements: defining the system; design data; system design; economics; and limitations and recommendations.

Assignment Guidelines:

1. Late submission of assignments will be accepted up to 5 **days** (including weekends and holidays) following the due date. Each late day after the due date will result in 10% reduction of the mark for each individual assignment. Assignments submitted after 5 days will have no credit.
2. Marked assignments will be handed back approximately two weeks after they were submitted.

Assignment Extension and Late Submission Policy

Deadlines are a reality in the world of engineering; we expect reports and assignments to be completed on time. The reports and assignments are due one week after assigned to you. Submission after the due date will be docked 10% per day. All lab reports must be submitted to pass the course. There will be no “make-up” midterm exam; students who miss the midterm with a reasonable explanation will have the value of the final examination increased by the appropriate percentage.

Examination Description

There will be one (1) midterm examination and one (1) final examination in this course. The midterm examination will be scheduled before the VW deadline. Approximately 80% of the final examination questions will be based on the materials covered after the midterm and 20% before the midterm.

Academic Integrity

Students are expected to conduct themselves in accordance with the highest ethical standards of the Profession of Engineering and evince academic integrity in all their pursuits and activities at the university. As such, in accordance with the *General Academic Regulations* on *Academic Integrity*, students are reminded that plagiarism or any other form of cheating in examinations, term tests, assignments, projects, or laboratory reports is subject to serious academic penalty (e.g. suspension or expulsion from the faculty or university). A student found guilty of contributing to cheating by another student is also subject to serious academic penalty.

Requirements/Regulations

- No programmable devices or systems (such as calculators, PDAs, iPods, iPads, cell phones, smart watches, wireless communication, or data storage devices) are allowed in examinations unless approved by the course instructor.
- All email communication must conform to the Communicating with Students university policy.

Communicating with Students

- Attending lectures and laboratories is essential for the successful completion of this course.
- Self-declaration forms may be completed for missed tests, exams, or assignments during short-term absences (≤72 hours) for extenuating circumstances. Students don’t need to share personal information about their situation beyond declaring the nature of the extenuating circumstance on the self-declaration form.

Self-Declaration Form for Brief or Temporary Absence

- This form cannot be used for planned absences like vacations. It is also not to be used for longer-term absences, or ongoing circumstances (e.g., Authorized Withdrawals, Leaves of Absence, or other accommodations), which will still require additional documentation.

  Self-Declaration Policy for Brief or Temporary Absences

- It is the responsibility of each student to contact the instructor in a timely manner if he or she is uncertain about his or her standing in the course and about his or her potential for receiving a failing grade. Students should familiarize themselves with the University's *General Academic Regulations*, as well as Section 3 of the Faculty of Engineering *Academic Regulations* dealing with incomplete term work, deferred examinations, attendance, and withdrawal.

  General Academic Regulations

  Engineering Academic Regulations

- Students should be aware that they have access to an extensive range of resources and support organizations. These include Academic Resources, Counselling, Advocacy and Accessibility Offices as well as documentation of key University policies e.g. Academic Integrity, Respectful Behaviour, Examinations and related matters.

  Supplemental Resources

Should the instructor fall ill

The Department of Biosystems Engineering has devised a plan so that there is minimal impact on the delivery and content of the course, should the instructor fall sick and is unable to continue lectures in-person. Please be assured that the alternative plan outlining any deviation from the normal mode of instruction will be communicated to you as quickly as possible if/when the need arises.

Retention of Student Work

Students are advised that copies of their work submitted in completing course requirements (i.e. assignments, laboratory reports, project reports, test papers, examination papers, etc.) may be retained by the instructor and/or the department for the purpose of student assessment and grading, and to support the ongoing accreditation of each Engineering program. This material shall be handled in accordance with the University's *Intellectual Property Policy* and the protection of privacy provisions of *The Freedom of Information and Protection of Privacy Act (Manitoba)*. Students who do not wish to have their work retained must inform the Head of Department, in writing, at their earliest opportunity.

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