



ENGG*3180 Air Quality

01

Fall 2022

Section(s): C01

School of Engineering

Credit Weight: 0.50

Version 1.00 - September 06, 2022

1 Course Details

1.1 Calendar Description

The study of the transport, transformation and deposition processes associated with air pollutants. The chemical and biological nature, impacts, and sources of air pollutants. The physical aspects of the atmospheric boundary layer. The mathematical treatment of diffusion in a homogeneous field in a boundary layer. Regulatory approaches worldwide and their use of air quality modeling. The use of models for the design of stacks and monitoring networks.

Pre-Requisites: ENGG*2230, (ENGG*2560 or ENGG*2660)

Co-Requisites: ENGG*3260

Restrictions: This is a Priority Access Course. Enrolment may be restricted to the ENVE specialization in the BENG and BENG:C programs. See department for more information.

1.2 Course Description

The air quality course is an introduction to major historic air pollution episodes and current air quality issues. The course also introduces the major elements of the planetary boundary layer (PBL) and how contaminants released into the PBL are transported both via fundamental equations and a computer model (AERMOD). Methods to measure various air pollutants are presented as well as techniques used to create emission inventories ranging in scale from individual facilities to national levels.

1.3 Timetable

Lectures:

Tuesday	01:00 - 02:20	MCKN 224
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Thursday 01:00 - MCKN 224
02:20

Tutorials/Lab:

Monday Sec 11:30 am Tut.: THRN 1006 / Lab:
01 – 1:20 pm THRN 1116 / Comp.
Lab: THRN 1313

Friday Sec 12:30 pm Tut.: THRN 1006 / Lab:
02 – 2:20 pm THRN 1116 / Comp.
Lab: THRN 1313

1.4 Final Exam

Date and Time: Monday Dec. 5, 8:30 am to 10:30 am.

Format: in-person, two hour final exam unless changes are required due to public health or university requirements.

2 Instructional Support

2.1 Instructional Support Team

Instructor: William Lubitz Ph.D., P.Eng.
Email: wlubitz@uoguelph.ca
Telephone: 519-824-4120 ext. 54387
Office: THRN 1340
Office Hours: TBD

Lab Technician: Joanne Ryks
Email: jryks@uoguelph.ca
Telephone: +1-519-824-4120 x54087
Office: THRN 1114

2.2 Teaching Assistants

Teaching Assistant (GTA): Banyan Lehman
Email: blehman@uoguelph.ca

3 Learning Resources

3.1 Required Resources

Course Website (Website)

<http://courselink.uoguelph.ca>

Course material, news, announcements, and grades will be regularly posted to the ENGG*3180 CourseLink site. You are responsible for checking the site regularly.

ENGG*3180 Air Quality Course Notes (Van Heyst, 2021) (Textbook)

The Air Quality course notes are provided electronically on the CourseLink web site free of charge and at the generous offering of Dr. Bill Van Heyst. No other textbook is required.

3.2 Additional Resources

Lab and Project Information (Notes)

The handouts for the lab and projects will be distributed via CourseLink and discussed in class.

Assignments (Notes)

Assignments are posted on the CourseLink web site. The teaching assistant will assist students with the assignments in the tutorials. Assignments will not be graded.

Final Exam (Notes)

A copy of a previous year's final exam will be posted on Courselink as a sample with the solutions either taken up in class or tutorial.

3.3 Communication & E-mail Policy

Please use lectures and tutorial/lab help sessions as your main opportunity to ask questions about the course. Major announcements will be posted to the course website. **It is your responsibility to check the course website regularly.** As per university regulations, all students are required to check their <uoguelph.ca> e-mail account regularly: e-mail is the official route of communication between the University and its student.

4 Learning Outcomes

The course covers the fundamentals associated with air quality. The course will provide an overview of historic air pollution events as well as current air quality issues and concerns. The focus of the course will be on the thermodynamics and fluid mechanics of the planetary boundary layer (PBL), the behaviour of plumes released into the PBL, and the computer modelling of air pollution sources. In addition, emission inventory preparation and air quality measurements will be addressed. This is a core course for Environmental Engineering students and will provide practical knowledge applicable to work placements.

4.1 Course Learning Outcomes

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

1. Explain air pollution events from chemical, physical and meteorological perspectives as well as explain the importance of historical air pollution events in society and the development of the air quality field of study.
2. Construct the various levels of the planetary boundary layer using fundamental thermodynamic and fluid mechanic equations and apply assumptions regarding the dominant forces.
3. Predict the dispersion of contaminants downwind using mass transfer relationships and the Gaussian plume model.
4. Generate downwind point of impingement concentrations using AERMOD.
5. Assemble air emission inventories for sources using a variety of methods.
6. Differentiate and explain the required analytical methods required to measure pollutants in the atmosphere and the role of the Air Quality Health Index (AQHI).
7. Defend and justify the use of EPA Method 5 for measuring particulate matter from point sources.

4.2 Engineers Canada - Graduate Attributes (2018)

Successfully completing this course will contribute to the following:

#	Outcome	Learning Outcome
1	Knowledge Base	1, 2, 3, 5, 6
1.3	Recall, describe and apply fundamental engineering principles and concepts	1, 2, 3, 5, 6
1.4	Recall, describe and apply program-specific engineering principles and concepts	1, 2, 3, 5, 6
2	Problem Analysis	2, 3, 4, 5
2.2	Identify, organize and justify appropriate information, including assumptions	2, 3, 4, 5
2.3	Construct a conceptual framework and select an appropriate solution approach	2, 3, 4, 5
2.4	Execute an engineering solution	2, 3, 4, 5
2.5	Critique and appraise solution approach and results	2, 3, 4, 5
3	Investigation	2, 3, 4, 5, 7
3.2	Design and apply an experimental plan/investigative approach (for example, to characterize, test or troubleshoot a system)	7
3.3	Analyze and interpret experimental data	4, 5, 7

#	Outcome	Learning Outcome
3.4	Assess validity of conclusions within limitations of data and methodologies	2, 3, 4, 5, 7
5	Use of Engineering Tools	4, 5, 7
5.1	Select appropriate engineering tools from various alternatives	4, 5
5.2	Demonstrate proficiency in the application of selected engineering tools	4, 5, 7
5.3	Recognize limitations of selected engineering tools	4, 5, 7
6	Individual & Teamwork	4, 7
6.2	Understand all members' roles and responsibilities within a team	4, 7
6.3	Execute and adapt individual role to promote team success through, for example, timeliness, respect, positive attitude	4, 7
6.4	Apply strategies to mitigate and/or resolve conflicts	4, 7
6.5	Demonstrate leadership through, for example, influencing team vision and process, promoting a positive team culture, and inspiring team members to excel	4, 7
7	Communication Skills	4
7.1	Identify key message(s) and intended audience in verbal or written communication as both sender and receiver	4
7.2	Interpret technical documentation such as device specification sheets, drawings, diagrams, flowcharts, and pseudocode	4
7.3	Construct the finished elements using accepted norms in English, graphical standards, and engineering conventions, as appropriate for the message and audience	4
7.4	Substantiate claims by building evidence-based arguments and integrating effective figures, tables, equations, and/or references	4
7.5	Demonstrate ability to process oral and written communication by following instructions, actively listening, incorporating feedback, and formulating meaningful questions	4
9	Impact of Engineering on Society and the Environment	1, 6
9.1	Analyze the safety, social, environmental, and legal aspects of engineering activity	1, 6

5 Teaching and Learning Activities

5.1 Lecture Schedule - Tentative

Lectures	Lecture Topics	References	Learning Objectives
(Tentative timeline)			
Week 0	Introductio	Chapter 1	1
Week 1/2	Air Quality Issues, Planetary Boundary Layer (PBL)	Chapters 1,2	1, 2
Week 3	PBL	Chapter 2	1, 2
Week 4	PBL	Chapter 2	1, 2
Week 5	PBL / Plume Behaviour	Chapters 2,3	1, 2, 3
Week 6	Plume Behaviour	Chapter 3	1, 3
Week 7	Plume Behaviour	Chapter 3	1, 3
Week 8	Plume Dispersion Modelling	Chapter 4	4
Week 9	Plume Dispersion Modelling	Chapter 4	4
Week 10	Emission Inventories / Ambient Air Quality	Chapters 5, 5, 6	6
Week 11	Ambient Air Quality / Industrial Source Testing	Chapter 6	6, 7
Week 12	Industrial Source Testing /	Chapter 6	1, 7

Current Issues in Air Quality

5.2 Lab Schedule

The Method 5 stack sampling lab will be completed over two weeks: September 26-September 30 and October 3-7. It will be completed in the Environmental Engineering Lab THRN 1116 and the rooftop of THRN. Sessions will be held over the course of 2 hours during tutorial times and other time slots (TBD) that will be available. Further details will be announced in class. Students are to arrive at THRN 1116 promptly at the beginning of the lab session.

The ESDM project using AERMOD will be presented during lecture/tutorial sections after the midterm exam. AERMOD activities will take place in the computer lab in THRN 1313. Further details will be announced in class.

5.3 Other Important Dates

Thursday, September 8, 2022: First class

Monday, October 10, 2022: Thanksgiving holiday – no classes nor tutorials

Tuesday, October 11, 2022: Fall Study Break – no classes nor tutorials

Thursday, December 1, 2022: Last lecture (Tuesday schedule in effect)

Friday, December 2, 2022: Classes conclude (Monday schedule in effect); last day to drop F22 classes

December 5 to 16, 2022: Final Exam Period

6 Assessments

6.1 Marking Schemes & Distributions

The marking distribution for the various course assessments is given in the table below.

Missed Assessments: If you are unable to meet an in-course requirement due to medical, psychological, or compassionate reasons, please email the course instructor. See the undergraduate calendar for information on regulations and procedures for Academic Consideration:

<http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml>

Accommodation of Religious Obligations: If you are unable to meet an in-course requirement due to religious obligations, please email the course instructor within two weeks of the start of the semester to make alternate arrangements. See the undergraduate calendar for information on regulations and procedures for Academic Accommodation of Religious Obligations:

<http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-accomrelig.shtml>

Name	Scheme A (%)
Chemical Survey	5
Method 5 Lab	10
Midterm Exam	20
AERMOD Modelling	20
Final Exam	45
Total	100

6.2 Assessment Details

Chemical Survey (5%)

Due: Thu, Sep 22, Drop Box on CourseLink

Learning Outcome: 1

This project involves the investigation of the historic usage, environmental and health concerns and personal exposure to a selected chemical. More details will be provided in class.

An electronic copy of your report is to be submitted via a drop box on CourseLink.

Method 5 Lab (10%)

Date: Mon, Sep 26 - Fri, Oct 7, Environmental Engineering Lab (THRN 1116) and Roof Top of Adams Atrium

Learning Outcome: 7

The course has one lab that entails the measurement of particulate matter from a smoke stack using the US EPA Method 5. The lab will be performed in two parts (glass assembly and smoke stack measurement) during a 2-hour session the weeks of Sept. 26 - Oct. 7. More details on scheduling and the lab methodology will be provided in class.

An electronic copy of the lab report is to be submitted via a drop box on CourseLink on Tuesday October 18, 2022.

Midterm Examination (20%)**Date:** Tue, Oct 25, MCKN 224**Learning Outcome:** 1, 2, 7

The midterm exam will be held during the lecture period on Tuesday October 25. It will be closed book. Equation and data sheets will be provided with the exam: these sheets will be posted on Courselink before the exam. Non-communicating, non-programmable calculators may be used. No other notes or aids are permitted.

Air Emission Summary and Dispersion Modelling (ESDM) project (20%)**Due:** Tue, Nov 29, Drop Box on CourseLink**Learning Outcome:** 3, 4, 5

This project, to be conducted in groups of two, will investigate a facility using AERMOD, and produce an Air Emissions Summary and Dispersion Modelling report for the facility. The project will involve the verification of the emission summaries as well as conducting air dispersion modelling runs in accordance to Ontario's regulatory requirements.

An electronic copy of your report is to be submitted via a drop box on CourseLink.

Final Exam (45%)**Date:** Mon, Dec 5, 8:30 AM - 10:30 AM, TBA**Learning Outcome:** 1, 2, 3, 4, 5, 6, 7

The final exam will be closed book. Equation and data sheets will be provided with the exam: these sheets will be posted on Courselink before the exam. Non-communicating, non-programmable calculators may be used. No other notes or aids are permitted.

6.3 Additional Notes

1. Late submissions of lab and project reports will not be accepted.
2. Necessary equations and information for the final exam will be provided or announced prior to the end of lectures. Calculators are permitted, but they must be non-communicating devices.

7 Course Statements**7.1 Lab Safety**

Details of the lab safety specific for the course will be discussed in class prior to conducting the lab.

8 School of Engineering Statements**8.1 Instructor's Role and Responsibility to Students**

The instructor's role is to develop and deliver course material in ways that facilitate learning for a variety of students. Selected lecture notes will be made available to students on Courselink but these are not intended to be stand-alone course notes. Some written lecture notes will be presented only in class. During lectures, the instructor will expand and explain the content of notes and provide example problems that supplement posted notes. Scheduled classes will be the principal venue to provide information and feedback for tests and labs.

8.2 Students' Learning Responsibilities

Students are expected to take advantage of the learning opportunities provided during lectures and lab sessions. Students, especially those having difficulty with the course content, should also make use of other resources recommended by the instructor. Students who do (or may) fall behind due to illness, work, or extra-curricular activities are advised to keep the instructor informed. This will allow the instructor to recommend extra resources in a timely manner and/or provide consideration if appropriate.

8.3 Lab Safety

Safety is critically important to the School and is the responsibility of all members of the School: faculty, staff and students. As a student in a lab course you are responsible for taking all reasonable safety precautions and following the lab safety rules specific to the lab you are working in. In addition, you are responsible for reporting all safety issues to the laboratory supervisor, GTA or faculty responsible.

9 University Statements

9.1 Email Communication

As per university regulations, all students are required to check their e-mail account regularly: e-mail is the official route of communication between the University and its students.

9.2 When You Cannot Meet a Course Requirement

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. The grounds for Academic Consideration are detailed in the Undergraduate and Graduate Calendars.

Undergraduate Calendar - Academic Consideration and Appeals

<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml>

Graduate Calendar - Grounds for Academic Consideration

<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml>

Associate Diploma Calendar - Academic Consideration, Appeals and Petitions

<https://www.uoguelph.ca/registrar/calendars/diploma/current/index.shtml>

9.3 Drop Date

Students will have until the last day of classes to drop courses without academic penalty. The deadline to drop two-semester courses will be the last day of classes in the second semester. This applies to all students (undergraduate, graduate and diploma) except for Doctor of Veterinary Medicine and Associate Diploma in Veterinary Technology (conventional and alternative delivery) students. The regulations and procedures for course registration are available in their respective Academic Calendars.

Undergraduate Calendar - Dropping Courses

<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml>

Graduate Calendar - Registration Changes

<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/genreg-reg-regchg.shtml>

Associate Diploma Calendar - Dropping Courses

<https://www.uoguelph.ca/registrar/calendars/diploma/current/c08/c08-drop.shtml>

9.4 Copies of Out-of-class Assignments

Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

9.5 Accessibility

The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.

When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is required; however, interim accommodations may be possible while that process is underway.

Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not constitute a disability.

Use of the SAS Exam Centre requires students to make a booking at least 14 days in advance, and no later than November 1 (fall), March 1 (winter) or July 1 (summer). Similarly, new or changed accommodations for online quizzes, tests and exams must be approved at least a week ahead of time.

For Guelph students, information can be found on the SAS website

<https://www.uoguelph.ca/sas>

For Ridgetown students, information can be found on the Ridgetown SAS website

<https://www.ridgetownc.com/services/accessibilityservices.cfm>

9.6 Academic Integrity

The University of Guelph is committed to upholding the highest standards of academic

integrity, and it is the responsibility of all members of the University community-faculty, staff, and students-to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff, and students have the responsibility of supporting an environment that encourages academic integrity. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

Undergraduate Calendar - Academic Misconduct

<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml>

Graduate Calendar - Academic Misconduct

<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml>

9.7 Recording of Materials

Presentations that are made in relation to course work - including lectures - cannot be recorded or copied without the permission of the presenter, whether the instructor, a student, or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

9.8 Resources

The Academic Calendars are the source of information about the University of Guelph's procedures, policies, and regulations that apply to undergraduate, graduate, and diploma programs.

Academic Calendars

<https://www.uoguelph.ca/academics/calendars>

9.9 Disclaimer

Please note that the ongoing COVID-19 pandemic may necessitate a revision of the format of course offerings, changes in classroom protocols, and academic schedules. Any such changes will be announced via CourseLink and/or class email.

This includes on-campus scheduling during the semester, mid-terms and final examination schedules. All University-wide decisions will be posted on the COVID-19 website (<https://news.uoguelph.ca/2019-novel-coronavirus-information/>) and circulated by email.

9.10 Illness

Medical notes will not normally be required for singular instances of academic consideration, although students may be required to provide supporting documentation for multiple missed assessments or when involving a large part of a course (e.g.. final exam or major assignment).

9.11 Covid-19 Safety Protocols

For information on current safety protocols, follow these links:

- <https://news.uoguelph.ca/return-to-campus/how-u-of-g-is-preparing-for-your-safe-return/>
- <https://news.uoguelph.ca/return-to-campus/spaces/#ClassroomSpaces>

Please note, these guidelines may be updated as required in response to evolving University, Public Health or government directives.
