



ENGG*4810 Control of Atmospheric Particulates

01

Fall 2020

Section(s): C01

School of Engineering

Credit Weight: 0.50

Version 1.00 - September 08, 2020

1 Course Details

1.1 Calendar Description

The focus of this course is understanding, analyzing and designing conventional and innovative atmospheric particulate control systems. The properties and transport of atmospheric particulates, and the principles of cyclones, filtration and electrostatic precipitation will be taught through theory, simulations, experiments and a design project.

Pre-Requisites: 6.00 credits of ENGG courses, ENGG*2230, ENGG*2450, MATH*2130

Restrictions: ENGG*4330

1.2 Course Description

Same as Calendar Description

1.3 Timetable

ENGG*4810*0101 (1347) Atmospheric Particulates:

LEC Tues, Thur

02:30PM - 03:50PM

AD-S, Room Virtual

LAB Thur

06:00PM - 07:50PM

AD-S, Room Virtual

ENGG*4810*0102 (1348) Atmospheric Particulates:

LEC Tues, Thur

02:30PM - 03:50PM

AD-S, Room Virtual

LAB Tues

06:00PM - 07:50PM

AD-S, Room Virtual

1.4 Final Exam

There is no final exam

2 Instructional Support**2.1 Instructional Support Team**

Instructor: Amir Aliabadi Ph.D., P.Eng.
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Lab Technician: Joanne Ryks
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Office: THRN 1114

2.2 Teaching Assistants

Teaching Assistant: Mohsen Moradi
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Office Hours: TBAIC
 TBAIC

3 Learning Resources

3.1 Required Resources

Course Website (Website)

<https://courselink.uoguelph.ca>

Course material, news, announcements, and grades will be regularly posted to the ENGG*4810 CourseLink site. You are responsible for checking the site regularly.

Required Resources (Other)

Required resources will be distributed via CourseLink.

3.2 Recommended Resources

Fundamentals of Air Pollution Engineering (Textbook)

Flagan, R. C. and Seinfeld, J. H. 2012. Courier Corporation, Dover Publications, U.S.A. (primary reference, freely available online: <https://authors.library.caltech.edu/25069/1/AirPollution88.pdf>).

Atmospheric Chemistry and Physics: from Air Pollution to Climate Change (Textbook)

Seinfeld, J. H. and Pandis, S. N. 2016. 3rd Ed. John Wiley & Sons Inc., Hoboken, New Jersey, U.S.A. (support reference).

3.3 Additional Resources

Lecture Information (Notes)

Lecture notes and supporting material will be posted on CourseLink, generally before the specific lecture. Note that posted notes may be incomplete, prepared with the intention that students will take additional notes during lectures.

Experimental Lab Information (Other)

Lab manuals and report specifications will be posted on CourseLink.

Computer Lab Information (Other)

Lab manuals will be posted on CourseLink

Project Information (Other)

Project requirements will be posted on CourseLink.

Problem Sets (Other)

Problems will be posted on CourseLink.

Miscellaneous Information (Other)

Other information will be posted on CourseLink.

4 Learning Outcomes

The primary aim of this course is to have students learn about generation, transportation, and transformation of atmospheric particulates. We will investigate aerodynamics, thermodynamics, and interaction of atmospheric particulates. The focus is on technologies that help remove atmospheric particulates from air-particle streams including settling chambers, cyclones, electrostatic precipitators, and Filtration. A secondary aim is to

understand the impact of engineering on society, economy, and the environment. The primary aim will be pursued through analytical, experimental, and numerical investigations, while the secondary aim is pursued by an essay project.

4.1 Course Learning Outcomes

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

1. Develop key message(s) for the appropriate audience in an essay about the biography of an engineer or scientist whose theory is used in the atmospheric particulates topic (7.1)
2. Using norms in English, graphical standards, and engineering conventions, communicate well-constructed arguments in a written biographical essay and the course project reports (7.3).
3. In an essay, analyze the safety, social, environmental, and legal aspects of engineering or science while developing the biography of an engineer or scientist whose theory is used in the atmospheric particulates topic (9.1)
4. In an essay, anticipate the positive and negative impacts of introducing innovative technologies to solve engineering or science problems while developing the biography of an engineer or scientist whose theory is used in the atmospheric particulates topic (9.3)
5. Comprehend and apply concepts in aerodynamics and thermodynamics of air-particle systems (1.4)
6. Design and apply an experimental plan/investigative approach (for example, to characterize, test or troubleshoot a system) to perform air-particle simulations using MATLAB and conduct particle impaction experiments (3.2).
7. Analyze and interpret experimental data from the impactor experiment (3.3)
8. Demonstrate proficiency in the application of MATLAB programming in analyzing air-particle systems (5.2)
9. Execute an engineering solution to design or analyze a particle collection technology (2.4)
10. Evaluate alternative design solutions for particle collection technologies (4.4).
11. Develop and refine an engineering design solution for particle collection technologies, through MATLAB simulations (4.5).
12. Assess validity of conclusions within limitations of experimental data and methodologies used in the particle impaction experiment (3.4).
13. Recognize limitations of selected engineering tools such as the MATLAB programming language for analysis and the instruments used in the particle impaction experiment (5.3).

4.2 Engineers Canada - Graduate Attributes (2018)

Successfully completing this course will contribute to the following:

| # | Outcome | Learning Outcome |
|-----|--|------------------|
| 1 | Knowledge Base | 5 |
| 1.4 | Recall, describe and apply program-specific engineering principles and concepts | 5 |
| 2 | Problem Analysis | 9 |
| 2.4 | Execute an engineering solution | 9 |
| 3 | Investigation | 6, 7, 12 |
| 3.2 | Design and apply an experimental plan/investigative approach (for example, to characterize, test or troubleshoot a system) | 6 |
| 3.3 | Analyze and interpret experimental data | 7 |
| 3.4 | Assess validity of conclusions within limitations of data and methodologies | 12 |
| 4 | Design | 10, 11 |
| 4.4 | Evaluate alternative design solutions based on problem definition | 10 |
| 4.5 | Develop and refine an engineering design solution, through techniques such as iteration, simulation and/or prototyping | 11 |
| 5 | Use of Engineering Tools | 8, 13 |
| 5.2 | Demonstrate proficiency in the application of selected engineering tools | 8 |
| 5.3 | Recognize limitations of selected engineering tools | 13 |
| 7 | Communication Skills | 1, 2 |
| 7.1 | Identify key message(s) and intended audience in verbal or written communication as both sender and receiver | 1 |
| 7.3 | Construct the finished elements using accepted norms in English, graphical standards, and engineering conventions, as appropriate for the message and audience | 2 |
| 9 | Impact of Engineering on Society and the Environment | 3, 4 |
| 9.1 | Analyze the safety, social, environmental, and legal aspects of engineering activity | 3 |

| # | Outcome | Learning Outcome |
|-----|---|------------------|
| 9.3 | Anticipate the positive and negative impacts of introducing innovative technologies to solve engineering problems | 4 |

4.3 Relationships with other Courses and Labs

CHEM*1040: General Chemistry I
 ENGG*1500: Engineering Analysis
 MATH*1200: Calculus I
 PHYS*1130: Physics with Applications
 CHEM*1050: General Chemistry II
 CIS*1500: Introduction to Programming
 ENGG*1210: Engineering Mechanics I
 MATH*1210: Calculus II
 PHYS*1010: Introductory Electricity and Magnetism
 ENGG*2130: Introduction to Environmental Engineering
 MATH*2270: Applied Differential Equations
 ENGG*2230: Fluid Mechanics
 ENGG*2560: Environmental Engineering Systems
 MATH*2130: Numerical Methods
 STAT*2120: Probability and Statistics for Engineers
 ENGG*3180: Air Quality
 ENGG*3260: Thermodynamics
 ENGG*3430: Heat and Mass Transfer
 ENGG*3470: Mass Transfer Operations
 ENGG*4820: Atmospheric Emission Control: Combustion Systems
 ENVS*2030: Meteorology and Climatology

5 Teaching and Learning Activities

5.1 Lecture

| | |
|--------------------|---------------------------------|
| Topics: | Introduction |
| References: | Ch 1,2 |
| Topics: | Particle Equation of Motion |
| References: | Ch. 5 |
| Topics: | Particle Size Characterization |
| References: | Ch. 5 |
| Topics: | Particle Heat and Mass Transfer |
| References: | Ch. 1,5 |
| Topics: | Turbulent Flows |
| References: | Ch. 1,2 |

| | |
|--------------------|--|
| Topics: | Particle Coagulation and Nucleation |
| References: | Ch. 5 |
| Topics: | Particle Formation in Combustion, Test 1 |
| References: | Ch. 6 |
| Topics: | Settling Chambers and Cyclones |
| References: | Ch. 7 |
| Topics: | Filtration |
| References: | Ch. 7 |
| Topics: | Electrostatic Precipitation |
| References: | Ch. 7 |
| Topics: | Wet Collectors, Test 2 |
| References: | Ch. 7 |
| Topics: | Air Pollution Control Strategies |
| References: | Ch. 9 |
| Topics: | Wrap-up |

5.2 Lab/Tutorial Schedule

Computer labs and tutorials will run continuously during all weeks except for dates exempted in the undergraduate calendar. Students will be notified and reminded for these dates via the CourseLink. Students will use these computer labs and tutorials to learn the course material and ask questions at their own pace. Their computer lab work, however, will be marked. The experimental lab is offered virtually online. Students will use a synthetic dataset to complete the experimental lab report.

5.3 Important Dates

Thursday, September 10

- Classes commence

Friday, September 18

- Last day to add F20 courses

Monday, October 12

- Holiday--NO CLASSES SCHEDULED -- classes rescheduled to Friday, December 4

Tuesday, October 13

- Fall Study Break Day - NO CLASSES SCHEDULED – classes rescheduled to Thursday, December 3

Wednesday, October 14

- Fall Break ends and classes resume

Wednesday, December 2

- Last day for regularly scheduled classes

Thursday, December 3

- Classes rescheduled from Tuesday, October 13, Tuesday schedule in effect

Friday, December 4

- Classes rescheduled from Monday, October 12, Monday schedule in effect
- Classes conclude
- Last day to drop F20 one-semester courses and S20/F20 two-semester courses
- Last day for in-course students to apply for co-op programs that permit entry in Winter 2021

6 Assessments

6.1 Marking Schemes & Distributions

Virtual computer labs (individual): In these labs you should guide yourself by the instruction sheets and complete various scripts in MATLAB to perform particle simulations. You should be able to reproduce results in the form of numbers, text files, or graphs from the instructions and answer questions, verbally, to the instructor or teaching assistant to receive a mark for

each lab you successfully complete. The interaction with instructors will be online.

Virtual experimental lab (group): You will attend a virtual video of the lab online, where you will observe the experiments and data collection. Synthetic data will be provided to you separately. You later prepare a lab report with your team-mates and submit it via the Dropbox in CourseLink.

Simulation projects (group): With the knowledge gained in the computer labs you will write MATLAB scripts to perform particle simulations, given necessary resources from the instructor, and you prepare project reports with your team-mates and submit it via the Dropbox in CourseLink.

Term tests (individual): These tests will be held during class time online synchronously. The tests will not be invigilated. You should submit your answers via the Dropbox in CourseLink.

Essay in engineering and science (group): You will submit an essay about the biography of an engineer or scientist whose theories we will introduce and use in this course. The submission is via Dropbox in CourseLink.

Note: lab and project groups will be announced in CourseLink.

| Name | Scheme A (%) |
|--|--------------|
| Computer Labs: In lab assessment | 20 |
| Experimental Lab: Lab report | 10 |
| Simulation Project 1: Project report 1 | 10 |
| Simulation Project 2: Project report 2 | 10 |
| Term Test: In class test 1 | 20 |
| Term Test: In class test 2 | 20 |
| Essay in Engineering and Science | 10 |
| Total | 100 |

6.2 Assessment Details

Computer labs: In lab assessment (20%)

Learning Outcome: 1, 8

Weekly

Experimental lab: Lab report (10%)

Date: Sun, Dec 6

Learning Outcome: 1, 1, 1, 1, 1, 1, 6, 7, 12, 13

Simulation Project 1: Project report 1 (10%)

Date: Sun, Oct 25

Learning Outcome: 1, 1, 1, 1, 1, 1, 2, 6, 7, 8

Simulation Project 2: Project report 2 (10%)

Date: Sun, Nov 29

Learning Outcome: 1, 1, 1, 1, 1, 1, 1, 2, 8, 10, 11

Term Test: In class test 1 (20%)

Date: Thu, Oct 22

Learning Outcome: 1, 1, 1, 5

Term test: in class test 2 (20%)

Date: Thu, Nov 26

Learning Outcome: 1, 1, 1, 9

Essay in engineering and science (10%)

Date: Sun, Nov 15

Learning Outcome: 1, 1, 1, 2, 3, 4

6.3 Course Grading Policies

Disclaimer: Please note that the ongoing COVID-19 pandemic may necessitate a revision of the format of course offerings and academic schedules. Any such changes will be announced via CourseLink and/or class email. All university-wide decisions will be posted on the COVID-19 website (<https://news.uoguelph.ca/2019-novel-coronavirus-information/>) and circulated by email.

Illness: the university will not require verification of illness (doctor's notes) for the Fall 2020 and Winter 2021 semesters.

Missed Assessments: If you are unable to meet an in-course requirement due to medical, psychological, or compassionate reasons, please email the course instructor. Please see below for specific details and consult 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>

Passing grade: The passing grade for this course is 50%.

Missed tests: If you miss a test due to grounds for granting academic consideration or religious accommodation, the instructor will distribute the mark associated with that test to other course deliverables in a mutual agreement with the student. There will be no make-up

tests.

Late Submissions: Late (> 4 hours) submissions will be penalized if there are not acceptable compassionate or medical grounds. A 30% penalty will be applied for reports submitted between 4 and 72 hours late. Reports received more than 72 hours will not be evaluated.

Team Work: Team work is required for various deliverables above. If there is some observation or evidence that you have not been an approximately equal contributor to the work then you will be asked to provide evidence of your individual efforts, contributions, and results. Keeping a logbook may be one effective means to help demonstrate your contributions.

7 School of Engineering Statements

7.1 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.

7.2 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.

7.3 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.

8 University Statements

8.1 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.

8.2 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>

8.3 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>

8.4 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.

8.5 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 book their exams at least 7 days in advance and not later than the 40th Class Day.

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>

8.6 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>

8.7 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.

8.8 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>

8.9 Disclaimer

Please note that the ongoing COVID-19 pandemic may necessitate a revision of the format of course offerings and academic schedules. Any such changes will be announced via CourseLink and/or class email. All University-wide decisions will be posted on the COVID-19 website (<https://news.uoguelph.ca/2019-novel-coronavirus-information/>) and circulated by email.

8.10 Illness

The University will not normally require verification of illness (doctor's notes) for fall 2020 or winter 2021 semester courses. However, requests for Academic Consideration may still require medical documentation as appropriate.
