ENGG*4810: CONTROL OF ATMOSPHERIC PARTICULATES

Fall 2016

UNIVERSITY of GUELPH

School of Engineering

(Revision 0: May. 21, 2016)
(Revision 7: Jan. 04, 2017)

1 INSTRUCTIONAL SUPPORT

1.1 Instructor

Instructor:	Amir A. Aliabadi, Ph.D., P.Eng.
Office:	RICH 2515, ext. 54862
Email:	aliabadi@uoguelph.ca
Website:	http://www.aaa-scientists.com
Office hour:	Wed., 11:00 am - 12:00 noon

1.2 Lab Technician

Technician:	Joanne Ryks
Office:	THRN 1114, ext. 54087
Email:	jryks@uoguelph.ca

1.3 Teaching Assistant(s)

GTA:	Hossam Elmaghraby Abdelaal
Office:	THRN 3114
Email:	helmaghr@uoguelph.ca

2 LEARNING RESOURCES

2.1 Course Website

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

2.2 Required Resources

Required resources will be distributed via CourseLink.

2.3 Recommended Resources

Flagan, R. C. and Seinfeld, J. H. 2012. Fundamentals of Air Pollution Engineering. Courier Corporation, Dover Publications, U.S.A. (primary reference, available in bookstore).

Seinfeld, J. H. and Pandis, S. N. 2016. Atmospheric Chemistry and Physics: from Air Pollution to Climate Change. 3rd Ed. John Wiley & Sons Inc., Hoboken, New Jersey, U.S.A. (support reference, available in bookstore).

Davidson, P. A. 2009. Turbulence: an Introduction for Scientists and Engineers. Oxford University Press, Oxford, U.K. (support reference).

2.4 Additional Resources

Lecture Information: 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: Lab manuals and report specifications will be posted on CourseLink.

Computer Lab Information: Lab manuals will be posted on CourseLink.

Project Information: Project requirements will be posted on CourseLink.

Problem Sets: Problems will be posted on CourseLink.

Miscellaneous Information: Other information will be posted on CourseLink.

2.5 Communication & Email Policy

Please use lectures, labs, and tutorial 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 <mail.uoguelph.ca> e-mail account regularly: e-mail is the official route of communication between the University and its students.

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3 ASSESSMENT

3.1 Dates and Distribution

Computer labs	In lab assessment	20%	Weekly
Experimental Lab	Lab report	20%	December 4, 2016
Settling chamber simulation	Project report 1	10%	October 30, 2016
Impactor design simulation	Project report 2	20%	November 27, 2016
Term test	In class test 1	10%	October 20, 2016
Term test	In class test 2	10%	November 17, 2016
Essay in engineering and science	Essay	10%	November 13, 2016

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 question, verbally, to the instructor or teaching assistant to receive a mark for each lab you successfully complete.

Experimental lab (group): You will attend the lab in small groups and, with the help of the lab technician, you will perform the experiments and collect the data. You later prepare a lab report with your team-mates and submit it via the Dropbox in CourseLink.

Settling chamber and impactor design simulation (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 in class. No electronic device, except for a *non-programmable calculator*, is allowed. All aid sheets including lecture notes and text books are allowed.

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.

3.2 Course Grading Policies

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 determine a makeup that will be scheduled at a time suitable for all individuals involved.

Experimental Lab Work: You must attend and complete the experimental lab. If you miss the lab due to grounds for granting academic consideration or religious accommodation, arrangements must be made with the teaching assistant to complete a makeup lab or join another group. If you do not complete the pre-lab safety quiz, you will not be permitted to complete the lab. Students

who miss laboratories and are not granted accommodation will not receive a mark for the project associated with the lab, regardless of the mark received by other group members.

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.

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4 AIMS, OBJECTIVES & GRADUATE ATTRIBUTES

4.1 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.

Prerequisite(s): 6.00 credits of ENGG courses, ENGG*2230, ENGG*2450, MATH*2130
Restriction(s): ENGG*4330 (discontinued)

4.2 Course Aims

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 pursed by an essay project.

4.3 Learning Objectives

At the successful completion of this course, the student will have demonstrated the ability to:

1. **Analyze** aerodynamic, thermodynamic, and interaction of atmospheric particulates.
2. **Analyze** air-particle systems using analytical skills.
3. **Develop** computer-based models to analyze physics and chemistry of air-particle systems.
4. **Critique** various particle control technologies.
5. **Create** ideas for incremental innovations within particulate control technologies.
6. **Design** a particulate control device using computer-based simulation.

7. **Investigate** social, economic, and environmental impacts of engineering.

8. **Communicate** learning activities in the form of reports and essays.

4.4 Graduate Attributes

Successfully completing this course will contribute to the following CEAB Graduate Attributes:

Graduate Attribute	**Learn. Objective**	**Assessment**
1. Knowledge Base	GA 1: 4	Test 1
2. Problem Analysis	GA 2: 3, 4	Test 2, Projects, Exp. Lab
3. Investigation	GA3: 3	Projects, Exp. Lab
4. Design	-	-
5. Engineering Tools	GA 5: 2	Comp. Labs
6. Individual & Teamwork	-	-
7. Communication	GA 7: 1	Essay, Projects, Exp. Lab
8. Professionalism	-	-
9. Engineering Society and Environment	GA 9: 1, 3	Essay
10. Ethics & Equity	-	-
11. Economics & Project Management	-	-
12. Life-Long Learning	-	-

4.5 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. Lecture notes will be made available to students on CourseLink but these are not intended to be stand-alone course notes. During lectures, the instructor will expand and explain the content of notes and provide example problems that supplement posted notes. Scheduled lectures and tutorial periods will be the principal venue to provide information and feedback for tests and projects.

4.6 Students' Learning Responsibilities

Students are expected to take advantage of the learning opportunities provided during lectures and tutorials. 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.

4.7 Relationships with other Courses & Labs

4.7.1 Previous Courses:

ENGG*1100 & ENGG*2100: Core design process skills are essential for the particulate design project. Team and project management skills are equally important.
ENGG*2560: Principles in mass balance for particle and air systems are essential in theoretical, modelling, and experimental developments.

ENGG*2230: Motion of particles and air streams dominantly build on fluid mechanic principles.
ENGG*3260: Temperature, mass, and heat transfer effects on particles and air systems dominantly build on thermodynamic principles.
ENGG*3180: Air quality sets the context for the atmospheric control challenges that 4810 addresses.

4.7.2 Before (Regular) and After (Coop) Courses:

ENGG*3100: Continuing to advance your design skills is essential for air pollution control.
ENGG*3430 & ENGG*3470: Heat and Mass transfer limitations can play a significant role in the effectiveness of many air pollution control solutions.
ENGG*3410: Automated control systems play an integral role in the operation and success of a very large fraction of emission control technologies.

4.7.3 Follow-on Courses:

ENGG*4130: Many final design teams and projects will draw on 4810 skills, directly benefitting teams addressing air pollution challenges in their design work. Teams will indirectly benefit from ENGG*4810 if they require thermodynamics, fluid mechanics, programming and/or computational fluid dynamics skills in their ENGG*4130 project.

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5 TEACHING AND LEARNING ACTIVITIES

5.1 Timetable

Lectures:		
Tue. & Thu.	08:30 am - 09:50 am	MINS, Room 103
Labs/Tutorials:		
Fri. (Section 01)	01:30 pm - 03:20 pm	THRN, Room 1002, 1116, 2336
Mon. (Section 02)	02:30 pm - 04:20 pm	THRN, Room 1002, 1116, 2336

5.2 Lecture Schedule (Approximate)

Week	Topic	Reference	Learning Objective
0	Introduction	Ch. 1,2	1-2
1	Particle Equation of Motion	Ch. 5	1-3
2	Particle Size Characterization	Ch. 5	1-3
3	Particle Heat and Mass Transfer	Ch. 1,5	1-3
4	Turbulent Flows	Ch. 1,2	1-3
5	Particle Coagulation and Nucleation	Ch. 5	1-3
6	Particle Formation in Combustion, Test 1	Ch. 6	1-3
7	Settling Chambers and Cyclones	Ch. 7	1-8
8	Filtration	Ch. 7	1-8
9	Electrostatic Precipitation	Ch. 7	1-8
10	Wet Collectors, Test 2	Ch. 7	1-8
11	Presentations	-	1-8
12	Air Pollution Control Strategies	Ch. 9	1-8

5.3 Lab/Tutorial Schedule (Approximate)

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. Experimental labs will be run according to a time table to be posted in CourseLink.

5.4 Important Dates (Undergraduate Calendar)

Mon. Aug. 22: add period for Fall semester 2016 begins
Mon. Sep. 5: holiday
Thu. Sep. 8: first day of classes
Fri. Sep. 16: add period ends
Mon. Oct. 10: thanksgiving holiday, no classes or labs, classes rescheduled to Fri. Dec. 2
Tue. Oct. 11: study break day, no classes or labs, classes rescheduled to Thu. Dec. 1
Fri. Nov. 4: 40th class day, last day to drop one semester course
Wed. Nov. 30: Last regular day of classes
Thu. Dec. 1: classes rescheduled from from Tue. Oct. 11, Tue. schedule in effect
Fri. Dec. 2: classes rescheduled from Mon. Oct. 10, Mon. schedule in effect

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6 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, teaching assistants or faculty responsible.

If the laboratory rules are not followed, consequences will include removing student's access to the lab. If this results in lab work not being completed, the student will not receive a grade.

A pre-lab safety quiz must be passed before students may complete labs. A group will not be permitted to complete a lab until all members of the group have individually passed the quiz. Students may be asked equivalent lab safety questions while in the laboratory. Students who cannot demonstrate a working knowledge of laboratory safety will be removed from the lab.

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7 ACADEMIC MISCONDUCT

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 discourages misconduct. 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.

7.1 Resources

The Academic Misconduct Policy is detailed in the Undergraduate Calendar:

http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml

A tutorial on Academic Misconduct produced by the Learning Commons can be found at:

http://www.academicintegrity.uoguelph.ca/

Please also review the section on Academic Misconduct in your Engineering Program Guide. The School of Engineering has adopted a Code of Ethics that can be found at:

http://www.uoguelph.ca/engineering/undergrad-counselling-ethics

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8 ACCESSIBILITY

The University of Guelph is committed to creating a barrier-free environment. Providing services for students is a shared responsibility among students, faculty and administrators. This relationship is based on respect of individual rights, the dignity of the individual and the University community's shared commitment to an open and supportive learning environment. Students requiring service or accommodation, whether due to an identified, ongoing disability for a short-term disability should contact the Centre for Students with Disabilities as soon as possible.

For more information, contact CSD at 519-824-4120 ext. 56208, email csd@uoguelph.ca or see the following website:
http://www.uoguelph.ca/csd/

Alternatively, contact DHR at 519-824-4120 ext. 53000, email dhrinfo@uoguelph.ca or see the following website:
https://www.uoguelph.ca/diversity-human-rights/accessibility/

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9 RECORDING OF MATERIALS

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

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10 RESOURCES

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

http://www.uoguelph.ca/registrar/calendars/index.cfm?index