ENGG*3180 – Air Quality

School of Engineering
University of Guelph
Fall 2011

Instructor: Bill J. Van Heyst, Ph.D., P.Eng.
THRN 1333; Ext. 53665, e-mail: bvanheys@uoguelph.ca

GTA: Rob Morgan, FVMI 140, e-mail: rmorgan@uoguelph.ca

Lecture Times: Tuesday and Thursday @ 10:00AM - 11:20AM MACK 115
Tutorial: Monday @ 03:30PM - 05:20PM THRN 1006 / THRN 2313
Wednesday @ 03:30PM - 05:20PM THRN 1006 / THRN 2313
Lab: TBA

Text: Course notes are provided electronically on Courselink@Guelph

Exams: Midterm: Tuesday, October 25, 2011 @ 10:00AM to 11:20AM in MACK 115 (room may change)
Final: Wednesday, December 7, 2011 @ 07:00PM – 09:00PM – room to be announced

Prerequisites:
a) ENGG*2230 – Fluid Mechanics
b) ENGG*2560 – Environmental Engineering Systems *or* ENGG*2660 – Biological Engineering Systems
c) ENGG*3260 – Thermodynamics (co-requisite)

COURSE SUMMARY

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 term placements.

GRADUATE ATTRIBUTES

The Canadian Engineering Accreditation Board (CEAB) is moving towards an outcome based evaluation of engineering programs. Of the 12 CEAB graduate attributes, ENGG*3180 – Air Quality covers and assesses the following:

Graduate Attribute	Covers	Assesses	Graduate Attribute	Covers	Assesses
Knowledge Base for Engineering	Y	Y	Communication Skills	N	Y
Problem Analysis	Y	Y	Professionalism	Y	N
Investigation	Y	Y	Impact of Engineering on Society & the Environment	Y	?
Design	N	N	Ethics and equality	Y	N
Use of Engineering Tools	Y	Y	Economics & Project Management	N	N
Individual & Team Work	Y	Y	Life-long Learning	Y	N

EVALUATION

- Reports 25%
- Midterm 25%
- Final Exam 50%

Assignments

Assignments will be issued on a regular basis to assist students in mastering the course content. The GTA will be available

for assistance during the tutorial session. **These assignments will not be graded.** This policy is consistent with a learner-based environment and it is advisable that students complete these assignments. Solutions will not be posted, however, they will be available from the GTA during the tutorial.

Project and Lab Reports:
Three reports will be assessed during the term from various projects and/or labs. They are:

- Literature survey of a chemical pollutant with report (5%)
- Air quality laboratory and report (5%)
- Computer modelling project with report (15%)

The instructor will determine the various topics and due dates. Further details on the reports will be given in class.

Mid-Term Exam:
The material covered will include the last lecture prior to the exam. The exam will be closed book. Permitted aids will be announced prior to midterm. Failure to attend the exam will lead to a zero for that exam unless valid documentation is provided for medical or compassionate grounds. **There will be no exceptions.**

Final Exam:
The final exam will cover the material presented for the entire course and will be closed book. Permitted aids will be announced prior to exam. Failure to attend the exam will lead to a zero for that exam unless valid documentation is provided for medical or compassionate grounds. **There will be no exceptions.**

Lecture Topics

	Topic	# of Weeks
a.	Introduction & Air Quality Issues • major air pollution incidents, air pollution defined, atmospheric composition, particulate matter, acid rain, ground-level ozone, smog, persistent organic pollutants, climate change	1.0
b.	Planetary Boundary Layer (PBL) • PBL defined, equations of state, laws of thermodynamics, specific heat, potential temperature, moisture variables, wet bulb temperature, virtual temperature, dew point, vertical variations in the atmosphere, hydrostatic equation, lapse rate, hydrostatic stability, regions of atmospheric movement, Eulerian versus Lagranian frames of reference, vector notation, atmospheric turbulence, equations of motion, geostrophic wind, surface wind, Coriolis force, eddy diffusivity, surface roughness, Ekman spiral layer, similarity theory, urban heat island, land and sea breezes,	3.5
c.	Plume Behaviour • contaminant transport and diffusion, categories of plume behaviour, turbulent mass transfer, Gaussian plume model, ground level point source, elevated point source, Pasquill-Gifford sigmas, effective stack height, lines source, stack-tip downwash, building effects, terrain effects	2.5
d.	Plume Dispersion Modelling • Ontario Regulation 419 (previously O.Reg. 346) dispersion model and Point of Impingement standards, AERMOD Prime dispersion model, AERMET	2.5
e.	Emission Inventories • top-down versus bottom-up approach, mass balance, source measurement, engineering calculations, emission factors, U.S. EPA AP-42, MOE's Air Emission Summary and Dispersion Modelling Report, case studies	1
f.	Ambient Air Quality Monitoring • targeted pollutants, MOE's network, MOE Air Quality Index (AQI), Sarnia-Lambton Environmental Association, monitoring techniques	1
g.	Industrial Source Testing • EPA Method 5	0.5