1 Instructor

Instructor:  Brajesh K Dubey, Ph.D  
Office:   RICHS 3511, ext. 52506  
Email:   bdubey@uoguelph.ca  
Office hours:  by appointment

2 Learning Resources

2.1 Course Website

Course material, announcements, and grades will be regularly posted to the ENGG*6630 Coursera site.  
You are responsible for checking the site regularly.

2.2 Recommended Resources

Academic Press (Elsevier), 476 pages.  
Schnoor, J L., 1996, Environmental Modeling: Fate and Transport of Pollutants in Water, Air, and Soil,  
Wiley Interscience, 682 pages.  
Transport, Fate, and Risk in the Environment, John Wiley and Sons, 678 pages

2.3 Additional Resources

Lecture Information: All the lecture notes will be posted on the web page (week #1-#12).
Assignments: Download the assignments, project instructions according to the schedule given in this handout.

3 ASSESSMENT

3.1 Dates and Distribution

Individual Assignments: 20%
- Oct 2nd Assignment # 1 due
- Oct 23rd Assignment # 2 due
- Nov 6th Assignment # 3 due
- Nov 20th Assignment # 4 due

Individual Project: 40% (see attachment for details)
- Sep 25th: Project Outline due
- Oct 23rd First Draft due
- Nov 13th: Project Presentations
- Nov 20th: Project Presentations
- Nov 27th: Final Submission due

Final Exam: 40%
- Take Home Exam, Due on Thurs Dec 4th by 5 PM

3.2 Course Grading Policies

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 in writing, with your name, id#, and e-mail contact. See the graduate calendar for information on regulations and procedures for Academic Consideration:

http://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/sec_d0e1400.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: In order to pass the course, Students must obtain a grade of 65% or higher on the exam portion of the course in order for the project portion of the course to count towards the final grade. Overall score should be 65% or higher to pass this course.
4 AIMS & OBJECTIVES

4.1 Calendar Description

Analysis of fate mechanisms associated with environmental contaminants. Focus on substances which are generally considered to be hazardous to humans, or other animal life at low concentrations. Study of physicochemical properties, fate and transport estimation on control and remediation strategies is the major focus of this course. Quantitative analysis of contaminant partitioning and mass flows, including cross-media transport and simultaneous action of contaminant fate mechanisms.

4.2 Course Aims

The objective of this course is to provide a sound understanding of the mechanisms which determine the fate and transport of various types of chemical contaminants in natural and engineered systems. The analysis will be completed in the context of five systems:

1) Natural surface waters,
2) Unsaturated and saturated soil,
3) Subsurface environment
4) The Ambient atmosphere, and
5) One engineered system (e.g., landfills, constructed wetlands etc.)

Although the course is segmented into distinct media or systems, a key aspect of fate is the multi-media character of many pollutants.

4.3 Learning Objectives

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

1. Understand the important physicochemical properties and environmental conditions that affect the transport and fate of contaminants in water, soil and air,
2. Model the overall fate of a contaminant in any system, and
3. Critically review technical literature related to the fate of contaminants.

Fundamental science and engineering skills will be applied throughout the course. Students will utilize skills in differential equations, fluid mechanics, thermodynamics, chemistry, biology, and mass transfer. Students without background in one or more of these areas should expect to do additional background reading.

4.4 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/D2L 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 classes will be the principal venue to provide information and feedback for assignments, tests and project.
4.5 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.

E-mail Communication: 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 students.

Recording of Materials: Presentations which are made in relation to course work—including lectures—cannot be recorded in any electronic media without the permission of the presenter, whether the instructor, a classmate or guest lecturer.

5 Teaching and Learning Activities

5.1 Timetable

Lectures:
Thursdays (1 PM to 3:50 PM) @ RICH 3527

5.2 Course Topics and Schedule

<table>
<thead>
<tr>
<th>TOPIC</th>
<th>NOMINAL WEEKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. FATE AND TRANSPORT BASIC CONCEPTS</td>
<td>1.5</td>
</tr>
<tr>
<td>2. TRANSPORT BY RANDOM MOTION – DIFFUSION AND DISPERSION</td>
<td>2</td>
</tr>
<tr>
<td>- Diffusion and Dispersion – Fick’s Law</td>
<td></td>
</tr>
<tr>
<td>- Complex Diffusion Equation Solution</td>
<td></td>
</tr>
<tr>
<td>- Case Histories</td>
<td></td>
</tr>
<tr>
<td>3. INTERPHASE MASS TRANSFER AND PARTITIONING</td>
<td>1</td>
</tr>
<tr>
<td>- Interphase Partitioning</td>
<td></td>
</tr>
<tr>
<td>- Properties Affecting Partitioning and Distribution</td>
<td></td>
</tr>
<tr>
<td>- Rates of Interphase Mass Transfer</td>
<td></td>
</tr>
<tr>
<td>4. MASS BALANCE MODELS</td>
<td>1.5</td>
</tr>
<tr>
<td>- Introduction</td>
<td></td>
</tr>
<tr>
<td>- Continuous Stirred Tank Reactors (CSTR)</td>
<td></td>
</tr>
</tbody>
</table>
• Modeling Environmental Systems as a Series
• Plug Flow Reactors
• Case Histories

5. WATER CHEMISTRY ............................................................................................................................. 1
   • pH, Alkalinity and Carbonate Buffer System
   • Oxidation/Reduction Chemistry
   • Ocean Chemistry

6. GROUNDWATER ................................................................................................................................... 1
   • Groundwater Fundamentals, Groundwater Flow
   • Analytical Solutions for Groundwater Flow
   • Transport in Groundwater

7. SURFACE WATER ............................................................................................................................. 1
   • Lakes, Ponds, Reservoirs, Ocean
   • Streams and Rivers

8. ATMOSPHERE ..................................................................................................................................... 1
   • Air Pollution Meteorology - Stability
   • Air Pollution Meteorology – Complex Terrain
   • Mathematical Modeling of Air Emissions

9. STUDENT PRESENTATIONS........................................................................................................ 2

5.3 Other Important Dates

Drop Date: The last date to drop one-semester courses, without academic penalty, is Oct 31st 2014. Two-
semester courses must be dropped by the last day of the add period in the second semester. Refer to the
Graduate Calendar for the schedule of dates:
https://www.uoguelph.ca/registrar/calendars/graduate/2014-2015/pdffiles/sched.pdf

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, GTA or faculty responsible.

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. The Academic Misconduct Policy is detailed in the Graduate Calendar:
http://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/sec_d0e1687.shtml

7.1  Resources

A tutorial on Academic Misconduct produced by the Learning Commons can be found at:
http://www.academicintegrity.uoguelph.ca/

The School of Engineering has adopted a Code of Ethics that can be found at:
http://www.uoguelph.ca/engineering/undergrad-counselling-ethics

The Graduate Calendar is the source of information about the University of Guelph’s procedures, policies and regulations which apply to graduate programs:
http://www.uoguelph.ca/registrar/calendars/graduate/current/

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 or 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 or email csd@uoguelph.ca or see the website:
http://www.csd.uoguelph.ca/csd/
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.
Fate Mechanism Project

Outline Due Date: Sep 25th, 2014
To include a very detailed table of contents and a listing of the literature that you have or intend to include in your work, plan of action for data collection for modeling, problem description etc.

First Draft Due: Oct. 23rd, 2014
Final Submission: Nov 27th 2014

Presentations: week of Nov 13th and Nov 20th 2014

Your task is to complete a steady state, non-equilibrium model of the behaviour of a compound in a natural system(s). It is anticipated that the modelling exercise will be carried out with a literature review of similar systems/case studies. You may choose any compound that you wish (inorganic or organic; related to your thesis work or not). You may choose any system that you wish however you must define (choose) the system such that you incorporate the following mechanisms in your analysis:

- must be multi-media (at least 2 media).
- must include a biological uptake in some form
- must include a reaction process (speciation in the case of inorganic species)
- must include non-equilibrium behaviour between at least two phases
- must attempt to realistically capture the behaviour of your system (no assumptions of convenience about your system)

You may use a spreadsheet, MatLab, Mathcad, or a computer program (Fortran, C, C++, Visual Basic, etc.). You are required to search for, acquire or determine ‘reasonable’ values for each of the parameters necessary to execute your analysis and code. Of course you can use data from your own research projects.
Your report must include:

- Cover page.
- Introduction
  - Provide a description of your system.
- Literature Review: Review of pertinent literature and summary of findings (a minimum of 30 peer reviewed journal articles need to be included)
- Results (displayed in an effective manner) & Discussion
  - describe the behaviour and why the reader should believe your modelled behaviour results, what are the uncertainties and what level of confidence is expected
- References
- Appendix
  - calculations and analysis presented professionally (equations, units, assumptions, sources should all be clearly provided; due diligence should be evident)

Your report quality should strive for a quality that could be published in a journal. That means written with both clarity and brevity in mind while at the same time being complete. The target audience for your report should be your peers in this class. Your report is to be no longer than 40 pages (double spaced, 12 pt font, 1" margins) including title page, table of contents, figures, tables, and references.