1 INSTRUCTIONAL SUPPORT

1.1 Instructor
Instructor: Sheng Chang, Ph.D., P.Eng.
Office: THRN 2519, ext. 56619
Email: schang01@uoguelph.ca
Office hours: by appointment

2 LEARNING RESOURCES

2.1 Course Website
Course material, news, announcements, and grades will be regularly posted to the course Courselink site. You are responsible for checking the site regularly.

2.2 Required Resources

2.4 Recommended Resources

2.5 Additional Resources

Assignments: To be given through the lecture notes.

3 ASSESSMENT

3.1 Dates and Distribution

Assignment: 40% (Assignment 1 (10%) due on October 7 (wk 4); Assignment 2 (10%) due on October 21 (wk 6); Assignment 3 (10%) due on November 4 (wk 8); Assignment 4 (10%) due on November 18 (wk 10).

Project: 40% (due on November 25, 2015). Your task is to develop a model to describe fate of organics in a natural system. The model should consider the biological degradation and interface mass transfer. You may need to use a spreadsheet, MatLab, Mathcad, or a computer program to solve the model. The final report should include an introduction with a brief review of the models used for your system, the system and modeling methods, results and discussion, and conclusions. The detailed project outline is due on October 21 (wk 6). The final report is due on November 25 (wk 11).

Your report should not exceed 20 pages (double spaced, 12 pt font, 1” margins), excluding the references, figures, tables, and appendices.

Presentation: 20%. TBD.

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. See the undergraduate calendar for information on regulations and procedures for Academic Consideration:

https://www.uoguelph.ca/registrar/calendars/graduate/current/pdffiles/calendar.pdf

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:

https://www.uoguelph.ca/registrar/calendars/graduate/current/pdffiles/calendar.pdf

Passing grade: In order to pass the course, Students must obtain a grade of 65% or higher.
4 AIMS, OBJECTIVES & GRADUATE ATTRIBUTES

4.1 Course 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 chemical contaminants in environment. The analysis will be completed in the context of transport principles, chemical equilibriums, and chemical fate and transport in lakes, rivers, groundwater, and atmospheric systems.

4.3 Learning Objectives

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

1. Analyze the fate and transport mechanisms of environmental contaminates in water, soil, and air;
2. Understand the main equilibrium and kinetic relationships involved in environmental modelling;
3. Develop mathematic model to study eutrophication of lakes;
4. Develop the river dissolved oxygen “sag curve” model and understand fate of toxic organics in aqueous systems;
5. Understand transport mechanisms of contaminants and reactions affecting fate of chemicals in groundwater system.
6. Analyze atmospheric acid precipitation and its effect on soils and waters
7. 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, general chemistry, water chemistry, mass transfer, and organic biological degradation. 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 materials in ways that facilitate learning for a variety of students. Lecture reference materials will be made available to students on Courselink. Scheduled classes will be the principal venue to provide information and feedback for tests and project.
4.5 Students’ Learning Responsibilities

Students are expected to take advantage of the learning opportunities provided. Students, especially those having difficulty with the course content, should attend the lectures and 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.

5 Teaching and Learning Activities

5.1 Timetable

Lectures: Wednesday 9:30 to 12:30 PM

5.2 Lecture Schedule

<table>
<thead>
<tr>
<th>weeks</th>
<th>Lecture Topics</th>
<th>Learning Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introducing the course</td>
<td>Course outlines</td>
</tr>
<tr>
<td>1-2</td>
<td>Transport phenomena</td>
<td>1-2</td>
</tr>
<tr>
<td></td>
<td>Advection and dispersion</td>
<td>Assignment 1</td>
</tr>
<tr>
<td></td>
<td>Fick’s first law and dispersion equation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fick’s second law</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Transport mass balance</td>
<td></td>
</tr>
<tr>
<td>3,4</td>
<td>Chemical reaction equilibrium and kinetics</td>
<td>1-5, 7</td>
</tr>
<tr>
<td></td>
<td>Water chemistry equilibrium principle;</td>
<td>Assignment 2</td>
</tr>
<tr>
<td></td>
<td>Chemical reaction kinetics</td>
<td></td>
</tr>
<tr>
<td>4, 5</td>
<td>Interphase mass transfer</td>
<td>4, 5, 7</td>
</tr>
<tr>
<td></td>
<td>Phase partitioning equilibrium</td>
<td>Assignment 2</td>
</tr>
<tr>
<td></td>
<td>Interphase mass transfer equations</td>
<td></td>
</tr>
<tr>
<td>5, 6</td>
<td>Eutrophication of lakes</td>
<td>6, 7</td>
</tr>
<tr>
<td></td>
<td>Stoichiometry</td>
<td>Assignment 3</td>
</tr>
<tr>
<td></td>
<td>Phosphorus as a limiting nutrient</td>
<td>Project</td>
</tr>
<tr>
<td></td>
<td>Mass balance equation in complete mix system</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mass balance on total phosphorus in lakes</td>
<td></td>
</tr>
<tr>
<td>7, 8</td>
<td>Pollutants in rivers</td>
<td>4, 7</td>
</tr>
<tr>
<td></td>
<td>Mass balance equation in plug flow system</td>
<td>Assignment 4</td>
</tr>
</tbody>
</table>
Streeter-Phelps equation
Fate of toxic organic chemicals

<table>
<thead>
<tr>
<th>Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>5, 7</td>
</tr>
</tbody>
</table>

9,10 Groundwater contaminations
Darcy’s law
Flow equations
Contaminant solute transport equation
Sorption, Retardation, and reactions;
Unsaturated zone

<table>
<thead>
<tr>
<th>Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>5, 7</td>
</tr>
</tbody>
</table>

11,12 Atmospheric deposition
Genesis of acid deposition
Acidity and alkalinity
Wet and dry deposition
Processes that modify the ANC of soils and waters

<table>
<thead>
<tr>
<th>Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>6, 7</td>
</tr>
</tbody>
</table>

5.3 Other Important Dates

Thursday, September 10: Classes commence
Friday, November 6: day--Last day to drop one-semester courses
Wednesday, December 2: Classes rescheduled from Tuesday, October 13
Thursday, December 3: Classes rescheduled from Monday, October 12,
Friday, December 4: Classes conclude
Monday, December 7: Examinations commence
Friday, December 18: Examinations conclude

Refer to the Graduate Calendar for the schedule of dates:
https://www.uoguelph.ca/registrar/calendars/graduate/current/pdffiles/calendar.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.

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.

The Academic Misconduct Policy is detailed in the Graduate Calendar:
https://www.uoguelph.ca/registrar/calendars/graduate/current/pdf/files/calendar.pdf

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 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.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.

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:
https://www.uoguelph.ca/registrar/calendars/graduate/current/pdffiles/calendar.pdf