Western University - Faculty of Engineering
Department of Civil and Environmental Engineering

CEE 9675L – Modelling and Simulation of Wastewater Processes
Course Outline 2020 Summer

This course has been redesigned for an effective delivery through an online format and does not require any in-person attendance on the Western campus.

Objectives:
The course consists of an overview of state-of-the-art modeling and simulation approaches of wastewater systems. In this course, students will be introduced to fundamental biological, chemical, and physical process modeling concepts for the removal of water pollutants. Students will model different unit processes to elucidate the functioning of processes and communicate knowledge about the performance of the system and recognize the limitations and uncertainty of the models. Students will acquire hands-on experience with simulation methods supported with state-of-the-art software(s) that include both commercial and open-source, model-based design, optimization, and control of wastewater processes.

Topics:
Part I: Fundamentals
1. Introduction to modelling and simulation wastewater processes and process simulation software(s)
2. Mathematical modelling of biological phenomena
   a. Kinetics
   b. Stoichiometry
   c. Mass balance
   d. Hydraulics
   e. Matrix notations
3. Overview of activated sludge models
   a. Model structure and limitations
   b. Influent fraction characterization
   c. Calibration and validation processes
   d. Sensitivity analysis, parameter, and model structure uncertainty
4. Mathematical modelling of physical/chemical phenomena
   a. Phase separation
   b. Gas transfer
   c. Chemical precipitation
   d. pH
Part II: Case studies with real-world modelling objectives and real datasets
5. Scenario analysis linking operational parameters with the performance for wastewater treatment
6. Modelling energy-water nexus
Prerequisites:
CEE 3362a/b or CBE 4409a/b; or with permission from the instructor. This course is intended for graduate students enrolled in civil and environmental or chemical engineering with interest in water/wastewater treatment. It is expected that students will have a basic understanding of water/wastewater treatment fundamentals obtained by taking suitable courses at either the undergraduate or graduate level. Students without a suitable background in water/wastewater treatment shall be given permission to enroll, only at the discretion of the course instructor.

Corequisites:
None

Antirequisites:
None

Instructor:
Martha Dagnew, PhD, CMLP 1302, email: mdagnew@uwo.ca
Administrative Support: Kristen Edwards, SEB 3009, email: khunt29@uwo.ca

Contact Hours:
Three lecture hours per week (Tuesdays 1:00 to 4:00 pm) delivered through a combination of live zoom and video recorded lectures and three computer lab hours per week (Thursdays 1:00 to 4:00 pm) delivered through live zoom sessions. Attendance of the computer lab session is mandatory. Students are responsible for regularly checking their email and the course OWL site for new notices, forum discussions, and resources related to the course. All communication will be through OWL.

Computing:
Assignments will require the processing of data using computer data-analysis software such as Matlab, Excel, or other similar tools, and students will be assumed to be proficient in the use of the software of their choice. Commercial wastewater simulation software will be used during the course. Students can opt to use open source or commercial software to carry out their projects and assignments. Students will use Western’s IT service to access online simulation software.

Assignments and Project
There will be a total of four assignments spaced throughout the course. The project will span the length of the course and will involve a critical literature review, modeling and simulation, progress reports (2), a final report, and online presentations.

Evaluation:
The final course mark will be determined as follows:

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Online class exercise</td>
<td>10%</td>
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<tr>
<td>Assignments (a total of four approximately)</td>
<td>40%</td>
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<tr>
<td>Project (online presentation, two progress, and one final report)</td>
<td>50%</td>
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*The online class exercises will follow live lecture zoom sessions. Students must upload their work at or before the end of the session

**The lab zoom session will be used to develop students modelling skills; as part of this exercise, students will deliver the first part of their assignment at the end of the zoom lab session.

Note: anyone who cannot attend or has technical difficulties during the live portion should speak with the instructor to find an acceptable solution.
Course Materials:
There is no set textbook for the course. However, several books cover many of the aspects of the course material and which are available through Western Libraries or course websites. These include:

- Biological wastewater treatment: principles, modelling, and design. 2008. IWA

Prepared class slides will be made available through the course OWL site at: http://owl.uwo.ca/, along with other useful reference material and data for assignments.

Units: SI units will be used in lectures and deliverables.

Conduct:
Students are expected to submit deliverables on time and to conduct themselves during the zoom sessions and email communications in a professional and respectful manner. Students must abide by the Student Code of Conduct: [http://www.uwo.ca/univsec/board/code.pdf](http://www.uwo.ca/univsec/board/code.pdf)

Use of English:
In accordance with Senate and Faculty Policy, students may be penalised up to 10% of the marks on all assignments, projects, tests, and examinations for the improper use of English. Additionally, poorly written work with the exception of the final examination may be returned without grading. If resubmission of the work is permitted, it may be graded with marks deducted for poor English and/or late submission.

Scholastic Offences:
Scholastic offences are taken seriously, and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site: [http://www.uwo.ca/univsec/handbook/appeals/scholastic_discipline_grad.pdf](http://www.uwo.ca/univsec/handbook/appeals/scholastic_discipline_grad.pdf)

Plagiarism:
University policy states that plagiarism, defined as the “act or an instance of copying or stealing another’s words or ideas and attributing them as one’s own.” (excerpted from Black’s Law Dictionary, West Group, 1999, 7th ed., p. 1170) is a scholastic offence. In submitting any written work as part of the coursework requirements for this course, students must ensure that this work is written in their own words. Whenever students take an idea or a passage of text from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations.

All required papers may be subject to submission for textual similarity review to the commercial plagiarism detection software under license to the University for the detection of plagiarism. All papers submitted for such checking will be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. The use of the service is subject to the licensing agreement, currently between The University of Western Ontario and Turnitin.com ([http://www.turnitin.com](http://www.turnitin.com)).
A student who is found guilty of plagiarism in respect to any written work submitted as part of the coursework requirements for this course will be given a grade of zero for the submitted work. Repeated acts of plagiarism, either in this course or any other course subsequent to a first offence, will result in the student being given a failing grade for the course in which the subsequent offence occurs, and may also incur further penalties such as requiring the student to withdraw from the program in which they are enrolled in.

**Accessibility:**
Please contact the course instructor if you require material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 x 82147 for any specific question regarding accommodation.

**Sickness and Other Problems:**
Students should immediately consult with the Instructor or Department Chair if they have any problems that could affect their performance in the course. Where appropriate, the problems should be documented (see attached). The student should seek advice from the Instructor or Department Chair regarding how best to deal with the problem. Failure to notify the Instructor or Department Chair immediately (or as soon as possible thereafter) will have a negative effect on any appeal.

For more information concerning medical accommodations, please see:
http://www.uwo.ca/univsec/handbook/appeals/accommodation_medical.pdf