

The University of Western Ontario (Western University)
Faculty of Engineering
Department of Civil and Environmental Engineering

CEE 9675L – Modeling and Simulation of Wastewater Processes
Course Outline- Summer 2019

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 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 characterisation
 - 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 performance for wastewater treatment
6. Modelling energy-water nexus
7. Process control systems including feedforward, feed backward and cascade controllers and optimization of wastewater treatment.

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 an interest in water/wastewater treatment. It is expected that students will have 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 enrol, only at the discretion of the course instructor.

Corequisites:

None

Antirequisites:

None

Instructor:

Martha Dagneu, PhD, CMLP 1302, email: mdagneu@uwo.ca

Administrative Support: Kristen Edwards, SEB 3009, email: khunt29@uwo.ca

Contact Hours:

Three lecture hours per week

Course Materials:

There is no set textbook for the course. However, there are a number of books that cover many of the aspects of the course material and which are available through Western Libraries or course website. These include:

- Dochain, D and Vanrolleghem, P.A. 2001. Dynamical modelling and estimation in wastewater treatment processes. IWA Publishing, London, UK.
- Guidelines for using activated sludge models. 2012. IWA Publishing, London, UK.
- Instrumentation, control and automation in wastewater systems. 2005. IWA
- Biological wastewater treatment: principles, modelling and design. 2008. IWA
- Methods for wastewater characterization in activated sludge modelling. 2003. WEF

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

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 project and assignments.

Units:

SI units will be used in lectures and examinations

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 critical review of literature review, modeling and simulation, progress reports (2), a final report, and a class presentation.

Evaluation:

The final course mark will be determined as follows:

Assignments (a total of four approximately):	40%
Project (Class presentation, two progress and one final report):	60%
Total	100%

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.

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. Use of the service is subject to the licensing agreement, currently between The University of Western Ontario and Turnitin.com (<http://www.turnitin.com>).

A student who is found guilty of plagiarism in respect of 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.

Attendance:

Any student who, in the opinion of the instructor, is absent too frequently from class, laboratory, or tutorial periods will be reported to the Dean (after due warning has been given). On the recommendation of the Department concerned, and with the permission of the Dean, the student will be debarred from taking the regular final examination in the course.

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 an accommodation.

Conduct:

Students are expected to arrive at lectures on time, and to conduct themselves during class in a professional and respectful manner that is not disruptive to others. Late comers may be asked to wait outside the classroom until being invited in by the Instructor. Please turn off your cell phone before coming to a class, tutorial, quiz or exam.

On the premises of the University or at a University-sponsored program, students must abide by the Student Code of Conduct: <http://www.uwo.ca/univsec/board/code.pdf>.

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.

Notice: Students are responsible for regularly checking their email, and the course OWL site for new notices related to the course.