Western University
Faculty of Engineering
Department of Civil and Environmental Engineering

CEE 9675L – Modeling and simulation of wastewater processes

COURSE OUTLINE 2020-2021

DESCRIPTION

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.

PREREQUISITES

CEE 3362a/b or CBE 4409a/b; or comparable courses 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.

TOPICS

Topic #	Description	Learning Activities	Tentative timeline
Part I	Fundamentals		
	Lesson 1: Introduction to modelling and simulation wastewater processes and process simulation software(s)	• Two live/ recorded lecture • Additional reading material	Week 1
	Lesson 2: Mathematical modelling of biological phenomena a. Kinetics b. Stoichiometry c. Mass balance d. Hydraulics e. Matrix notations	• Two live/recorded lectures • Additional reading material • Assignment-1	Week 2

	Lesson 3: Good modelling practice a. Data quality b. Calibration and validation processes c. Sensitivity analysis, parameter, and model structure uncertainty	• Two live/recorded lectures • Assignment 2	Week 3
Part II	Lesson 4: Overview of activated sludge, clarifier and DO models and anaerobic digestion models a. Soluble and particulate organic modeling b. Clarifier and aeration models c. Nitrification modeling d. Total nitrogen process modelling e. P removal processes f. Process control g. AD model	• Seven live/recorded lectures • Seven live computer lab sessions • Assignment 3 • Assignment 4 • Assignment 5	Weeks 4 – 6
Part III	Lesson 5: Case studies - Scenario analysis with real-world modelling objectives and real datasets	• one live/recorded lecture	Week 7

Note: anyone who cannot attend or has technical difficulties during the live portion should speak with the instructor to find an acceptable solution.

SPECIFC LEARNING OUTCOMES

Degree Level Expectation	Weight	Assessment Tools	Outcomes
Depth and breadth of knowledge	25%	• Assignments • Project	• Understanding of advanced concepts and theories • Awareness of important current problems in the field of study • Understanding of computational and/or empirical methodologies to solve related problems
Research & scholarship	15%	• Project	• Ability to conduct critical evaluation of current advancements in the field of specialization • Ability to conduct coherent and thorough analyses of complex problems using established techniques/principles and judgment
Application of knowledge	30%	• Assignments • Project	• Ability to apply knowledge in a rational way to analyze a particular problem • Ability to use coherent approach to design a particular engineering system using existing design tools

Professional capacity / autonomy	5%	• Project	• Awareness of academic integrity • Ability to implement established procedures and practices in the coursework • Defends own ideas and conclusions • Integrates reflection into his/her learning process
Communication skills	15%	• Project	• Ability to communicate (oral and/or written) ideas, issues, results and conclusions clearly and effectively
Awareness of limits of knowledge	10%	• Project	• Awareness of the need of assumptions in complex scientific analyses and their consequences • Understanding of the difference between theoretical and empirical approaches • Ability to acknowledge analytical limitation due to complexity of practical problems

ASSESSMENTS

Assessment Type	Material Covered	Tentative Due Date	Weight
Homework Assignments (five)	Lessons 2, 3 and 4		40%
In-class synchronous/ asynchronous problem solving	Lessons 2, 3 and 4		10%
Project proposal presentation		Week 4	10%
Project final presentation		Week 7/8	20%
Project report submission		Week 8	20%

Activities in which collaboration is permitted:

- Assignments and in-class exercises

Activities in which students must work alone (collaboration is not permitted):

- Project related work

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.

CONTACT INFORMATION

Course instructor: Martha Dagnew
Email address: mdagnew@uwo.ca
Contact policy:

- Contact instructor via email (above) or through messages in OWL
- Weekly Office hours are held via Zoom
- A general FAQ section on the 'forums' section of OWL will be used for students to pose course-related questions so that all have the same information.

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.

REQUIRED TEXTBOOK

- **Grady, C.P.L, Daigger, G.T., Love, N.G. and Filipe, C.D.M. 2011. Biological wastewater treatment. IWA publishing**
- Biological wastewater treatment: principles, modelling, and design. 2008. IWA

OPTIONAL COURSE READINGS

- Guidelines for using activated sludge models. 2012. IWA Publishing, London, UK.
- Methods for wastewater characterization in activated sludge modelling. 2003. WEF

COURSE CONTENT

The lecture notes and online lecture videos are copyrighted to the instructor and legally protected. Do not post these videos and lecture notes on any other website or online forums. The recording of the live/synchronous sessions of the course without the permission from the instructor is prohibited. The illegal posting and sharing of the copyrighted course content could be subjected to legal actions.

CHEATING, PLAGIARISM/ACADEMIC OFFENCES

Academic integrity is an essential component of learning activities. Students must have a clear understanding of the course activities in which they are expected to work alone (and what working alone implies) and the activities in which they can collaborate or seek help; see information above under "Assessments" and ask instructor for clarification if needed. Any unauthorized forms of help-seeking or collaboration will be considered an academic offense. University policy states that cheating is an academic offence. If you are caught cheating, there will be no second warning. Students must write their essays and assignments 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. Plagiarism is a major academic offence. Academic offences are taken seriously and attended by academic penalties which may include expulsion from the program. Students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence (see Western's scholastic discipline regulations for graduate students).

SYNCHRONOUS LEARNING ACTIVITIES

Students are expected to participate in synchronous learning activities as outlined in the course syllabus and/or described by the instructor. If you have issues that will impede your ability to participate in synchronous activities, please discuss with the course instructor at the beginning of the course.

CONDUCT

Students are expected to follow proper etiquette during synchronous and asynchronous activities to maintain an appropriate and respectful academic environment. Any student who, in the opinion of the instructor, is not appropriately participating in the synchronous and asynchronous learning activities and/or is not following the rules and responsibilities associated with the online learning activities, will be reported to the Associate Dean (Graduate) (after due warning has been given). On the recommendation of the Department concerned, and with the permission of the Associate Dean (Graduate), the student could be debarred from completing the assessment activities in the course as appropriate.

HEALTH/WELLNESS

As part of a successful graduate student experience at Western, we encourage students to make their health and wellness a priority. Western provides several health and wellness related services (remotely accessible) to help you achieve optimum health and engage in healthy living while pursuing your graduate degree. Information regarding health- and wellness-related services available to students may be found at http://www.health.uwo.ca/.

Students seeking help regarding mental health concerns are advised to speak to someone they feel comfortable confiding in, such as their faculty supervisor, their program director (graduate chair), or other relevant administrators in their unit. Campus mental health resources may be found at http://www.health.uwo.ca/mental_health/resources.html
https://www.uwo.ca/health/psych/index.html

SICKNESS

Students should immediately consult with the Instructor (for a particular course) or Associate Chair (Graduate) (for a range of courses) if they have problems that could affect their performance. The student should seek advice from the Instructor or Associate Chair (Graduate) regarding how best to deal with the problem. Failure to notify the Instructor or the Associate Chair (Graduate) immediately (or as soon as possible thereafter) will have a negative effect on any appeal. Obtaining appropriate documentation (e.g., a note from the doctor) is valuable when asking for accommodation due to illness.

ACCESSIBLITY

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 Accessible Education at 661-2111 x 82147 or http://academicsupport.uwo.ca/accessible_education/index.html, for any specific question regarding an accommodation.