ENGG*4760 Biological Wastewater Treatment Design

Winter 2018
Section(s): C01

School of Engineering
Credit Weight: 0.50
Version 1.00 - January 05, 2018

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1 Course Details

1.1 Calendar Description

The course applies design principles for a variety of biological treatment systems for both municipal and industrial wastewater. This involves the design of suspended growth and attached growth processes, anaerobic digestion, sludge processing and utilization, water reuse and resource recovery facilities.

Pre-Requisite(s): ENGG*3590
Restriction(s): ENGG*4260

1.2 Course Description

The goal of this course is to provide the students with the theories and practices for the planning, design and operation of commonly used wastewater treatment facilities. Emphasis will be placed on integrating individual unit operations and processes to achieve multiple treatment objectives while satisfying the economic, environmental and societal constraints.

1.3 Timetable

Lectures:	Section	Time	Location
Monday		1:30pm – 2:20pm	MCKN 223
Wednesday		1:30pm – 2:20pm	MCKN 223
Friday		1:30pm – 2:20pm	MCKN 223

1.4 Final Exam

Thursday April 20, 7:00 PM to 9:00PM, ROOM: TBD

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2 Instructional Support

2.1 Instructor(s)

Hongde Zhou Ph.D., P.Eng.
Email: hzhou@uoguelph.ca
Telephone: +1-519-824-4120 x56990
Office: RICH 3511
Office Hours: Monday 11:30am to 12:30pm or by appointment

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3 Learning Resources

3.1 Required Resources(s)

2.1 Course Website (Website)
https://courselink.uoguelph.ca
Course material, announcements, and grades will be regularly posted to the ENGG*4760 Courselink site. You are responsible for checking the site regularly.

Wastewater Engineering: Treatment and Resource Recovery (Textbook)
Metcalf & Eddy, Inc. (2014). 5th edition, McGraw Hill, Inc., New York, NY, 2018p.

3.2 Recommended Resources(s)

Water and Wastewater Engineering: Design Principles and Practice (Textbook)
Davis, M.L. (2010). McGraw Hill, Inc., New York, NY.

Theory and Practice of Water and Wastewater Treatment (Textbook)
Droste, R.L. (1997). John Wiley & Sons, New York, NY, 800p.

Biological Wastewater Treatment (Textbook)
Grady, C.P.L., Jr., Gaigger, G.T. G.T., Love, N.L. and Filipe, C.D.M. (2011). 3rd edition, CRC Press, Boca Raron, FL, 991p.

Biological Wastewater Treatment: Principles, Modelling and Design (Textbook)
Henze, M., van Loosdrecht M.C.M., Ekama, G.A., Brdjanovic, D. (2008). IWA Publishing, London, UK, 511p.

Water Reuse: Issues, Technologies and Applications (Textbook)
Metcalf & Eddy, Inc. (2006). McGraw Hill, Inc., New York, NY, 1570p.

WastewaterTtreatment Plants: Planning, Design, and Operation (Textbook)
Qasim, S.R. (1999). Technomic Pub. Co, Lancaster, PA, 1107p.

Recommended Standards for Wastewater Facilities (Textbook)
2014 Edition, The Great Lakes – Upper Mississippi River Board of State and Provincial Public health and Environmental Managers, Albany, NY.

Unit Operations and Processes in Environmental Engineering (Textbook)
Reynolds, T.D. and Richards, P.A. (1996). 2nd Edition, PWS Publishing Co. Boston, MA, 798p.

Water Supply and Pollution Control (Textbook)
Viessman, W. Jr., Hammer, M.J., Perez, E.M. and Chadik, P.A. (2009). Pearson Prentice Hall,U pper Saddle River, NJ, 843p.

Design of Water Resource Recovery Facilities (Textbook)
WEF and ASCE/EWRI, (2018). 6th Edition, Alexandria, VA, 2044p.

Wastewater Treatment Plant Design. Edited by A. Vesilind, Water Environment Federation (Textbook)
WEF and IWA, (2003). Alexandria, VA.

3.3 Additional Resources(s)

Lecture Information (Notes)
All the lecture notes are posted on the Courselink throughout the semester

Design Project and Assignments (Notes)
The information for all the design projects and assignments will be posted on the Courselink. Download them according to the schedule given in this handout.

Exams (Notes)
Sample exams from previous years are posted on the Courselink

Miscellaneous Information (Notes)
Other information related to the course is also posted on the Courselink.

3.4 REFEREED JOURNALS

Water Research

Water Environment Research
American Water Works Association Journal

Journal of Environmental Engineering, ASCE

Environmental Science & Technology

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4 Learning Outcomes

4.1 Course Learning Outcomes

By the end of this course, you should be able to:

1. properly identify the critical issues and challenges in planning, design and operation of modern wastewater treatment facilities to meet not only current but also anticipated regulatory requirements,
2. develop reasonable working knowledge and hands-on experiences that can be used to devise and design the efficient, cost-effective treatment and water reuse systems, and
3. gain the independent learning skills and enhance your ability to work effectively in teams through problem based learning format.

4.2 Engineers Canada - Graduate Attributes

Successfully completing this course will contribute to the following:

#	Outcome Set Name	Course Learning Outcome
1	Knowledge base	1, 2
1.1	Recall, describe and apply fundamental mathematical principles and concepts	1, 2
1.2	Recall, describe and apply fundamental concepts and principles in natural sciences	1, 2
1.3	Comprehend and apply fundamental engineering concepts	1, 2
1.4	Comprehend and apply program-specific engineering concepts	1, 2
2	Problem analysis	1, 2
2.1	Formulate a problem statement in engineering and nonengineering terminology	1, 2
2.2	Construct a conceptual framework	1, 2
2.3	Identify, organize and justify appropriate information	1, 2
2.4	Execute an engineering solution	1, 2
2.5	Critique and appraise results	1, 2
3	Investigation	1, 2

#	Outcome Set Name	Course Learning Outcome
3.1	Propose and test working hypotheses	1, 2
3.2	Design and apply an investigation plan	1, 2
3.3	Analyze and interpret experimental data	1, 2
3.4	Assess validity of conclusions within limitations of data and methodologies	1, 2
4	Design	1, 2
4.1	Describe the design process	1, 2
4.2	Construct design-specific problem statements	1, 2
4.3	Create engineering design solutions	1, 2
4.4	Develop engineering design solutions	1, 2
4.5	Assess engineering design solutions	1, 2
4.6	Implement engineering design solutions	1, 2
5	Use of engineering tools	1, 2
5.1	Select appropriate engineering tools from various alternatives	1, 2
5.2	Apply selected engineering tools	1, 2
5.3	Recognize limitations of selected engineering tools	1, 2
6	Individual and team work	3
6.1	Act as an individual team member to promote team success	3
6.2	Demonstrate leadership through team building, providing feedback and positive attitude	3
7	Communication skills	1, 2, 3
7.1	Develop and deliver clear, key concepts using methods appropriate for the intended audience	1, 2, 3
7.2	Critically evaluate received information	1, 2, 3
7.3	Demonstrate active listening and follow instructions	1, 2, 3
11	Economics and project management	1, 2, 3
11.1	Apply project management techniques and manage resources within identified constraints	1, 2, 3
11.2	Estimate the life cycle engineering benefits and costs associated with engineering design	1, 2, 3

4.3 Relationships with other Courses & Labs

Previous Courses:

ENGG*2560: mass balance analysis for steady state and unsteady state situations, reactor types and analysis, reaction equilibrium and kinetics
ENGG*31X: some design tools, writing and public speaking techniques, codes, safety issues, environmental assessment and professional management
ENGG*3590: water quality, basic theories of physical, chemical and biological treatment processes

Follow-on Courses:

None

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5 Teaching and Learning Activities

5.1 Lecture

Topic(s): 0 – Introduction
Reference(s): 1.1 to 1.2, 1.6
Course outline
Overview of wastewater treatment

Topic(s): I - Fundamentals of Wastewater Treatment and Reuse
Reference(s): 1.3 to 1.5, 2, 3, 4
Physical, chemical and biological characteristics
Wastewater sources and flow rates
Treatment objectives
Introduction to wastewater treatment process selection

Topic(s): II – Wastewater Microbiology
Reference(s): 7.1 to 7.5
Role and classification of microorganisms
Microbial growth kinetics
Types of biological treatment processes

Topic(s): III – Suspended Growth Biological Treatment Processes
Reference(s): 7.6, 8.1 to 8.5, 8.9 to 8.11, 5.10 to 5.11
Activated sludge process analysis and control
Aeration selection and design
Secondary settling

Topic(s): IV –Biological Nutrient Removal Processes
Reference(s): 7.8 to 7.10, 7.13, 8.6 to 8.8
Nitrogen removal
Phosphorous removal
Combined BNR processes

Topic(s): Midterm

Room: TBD

Topic(s): V – Attached Growth Biological Treatment
Reference(s): 7.7, 9.1 to 9.4
Attached growth kinetics and mass transfer limitation
Tricking Filter
Rotating biological contactors
Hybrid processes

Topic(s): VI – Anaerobic Processes
Reference(s): 7.14, 10.1 to 10.6
Process fundamentals and analysis
Types and design of AD processes

Topic(s): VII – Sludge Processing, Utilization and Disposal
Reference(s): 13.1 to 13.4, 13.9, 14.1 to 14.2, 14.7 to 14.10
Sources, quantities and characteristics
Regulations for the utilization and disposal
Sludge processing
Land application

Topic(s): Final
ROOM: TBD

5.2 Lab Schedule and Description

Section:	Time	Location
0101	Wednesday 2:30 – 4:20pm	MCKN 224/THRN 1116
0102	Friday 9:30 – 11:20pm	ROZH 107/THRN 1116

The main purposes of the design labs include: 1) to demonstrate the application of computer simulation packages in designing and optimizing wastewater treatment facilities, 2) to introduce selected regulatory design guidelines and standards currently employed by provincial, federal and international agencies, and 3) to provide more informal discussions among the group students to resolve the issues arising from the design projects and ask the questions about lectures and previously assigned reading materials which

5.3 Other Important Dates

Monday, 9 January: First class

Monday, February 20 to Friday, February 24: Spring Break Friday, 10 March 2015: Fortieth drop date

Friday, 7 April 2015: classes conclude

Please refer to University Calendar 2016-2017 for other important dates.

6 Assessments

6.1 Assessment Details

Projects (15.00%)
Due: Wed, Mar 15, in class
Note: You are allowed to submit either the hardcopies (preferred) or electronic copies on Courselink dropbox.

Assignments (5) (15.00%)
All the assignments must be submitted prior to the lectures on the dates specified. (3% each)

Midterm (30.00%)
Date: Mon, Mar 6, 2:30 PM - , 4:20 PM, TBD

Final Exam (40.00%)
Date: Thu, Apr 20, 7:00 PM - , 9:00 PM, TBD

7 Course Statements

7.1 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: http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.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: You must achieve a passing grade on the project design component in order to pass the course. If you fail to do so, your final grade will be equal to that failing percentage.

Missed Midterm/Design Report/Assignments: If you miss the midterm/design report/assignments due to grounds for granting academic consideration or religious accommodation, the weight of the missed course work will be added to the final exam. There will be no makeup midterm test/Project Report/Assignments.

Project Report: The project will be completed in group. Maximum group size is four students. Some groups of three may be permitted depending on the final numbers in the class. You may choose the group members.

The project report must meet the requirements and formats specified in the course handout in order to achieve the perceived course objectives. The report should be technically sound, CLEARLY readable, and concise. Don't use your spare time to create a huge report!

Late Project Report: Late submission of the project report will be devalued by 50% per every day.

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8 School of Engineering Statements

8.1 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 but these are not intended to be stand-alone course notes. Some written lecture notes will be presented only in class. 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 tests and labs.

8.2 Students' Learning Responsibilities

Students are expected to take advantage of the learning opportunities provided during lectures and lab sessions. 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.

8.3 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.

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9 University Statements

9.1 Email Communication

As per university regulations, all students are required to check their e-mail account regularly: e-mail is the official route of communication between the University and its students.

9.2 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 instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. The regulations and procedures for Academic Consideration are detailed in the Undergraduate Calendar.

9.3 Drop Date

Courses that are one semester long must be dropped by the end of the fortieth class day; two-semester courses must be dropped by the last day of the add period in the second semester. The regulations and procedures for Dropping Courses are available in the Undergraduate Calendar.

9.4 Copies of Out-of-class Assignments

Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

9.5 Accessibility

The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.

When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is required, however, interim accommodations may be possible while that process is underway.

Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not constitute a disability.

Use of the SAS Exam Centre requires students to book their exams at least 7 days in advance, and not later than the 40th Class Day.

More information: www.uoguelph.ca/sas

9.6 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 or faculty advisor.

The Academic Misconduct Policy is detailed in the Undergraduate Calendar.

9.7 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, a classmate or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

9.8 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.

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