ENGG*3590 Water Quality

Fall 2018
Section(s): C01

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

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1 Course Details

1.1 Calendar Description

This course builds on the student's experience in chemistry, biology, physics and fluid mechanics, and provides an engineering perspective on: (i) standard methods of water quality analysis for physical, chemical and biological characteristics of water; (ii) significance and interpretation of analytical results, (iii) modeling of water quality in natural systems and (iv) introduction to engineered water and wastewater treatment systems.

Pre-Requisite(s): ENGG*2230, ENGG*2560, (1 of BIOL*1040, BIOL*1090, MICR*1020, MICR*2420), STAT*2120

1.2 Timetable

Type	Section	Time	Location
Lectures:			
Tues, Thur	All	4:00PM - 5:20PM	THRN 1307
Labs:			
Tue	01011, 01012, 01021, 01022	08:30AM - 11:20AM	THRN 1116
Thur	01031, 01032, 01041, 01042	08:30AM - 11:20AM	THRN 1116
Mon	01051, 01052	08:30AM - 11:20AM	THRN 1116
Seminars:			
Wed	01011, 01021, 01031, 01041, 01051	05:30PM - 6:50PM	MCKN 225
Mon	01012, 01022, 01032, 01042, 01052	05:30PM - 6:50PM	MCKN 225

1.3 Final Exam

Thursday, December 13, 11:30AM - 1:30PM, Room: TBD on Webadvisor

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2 Instructional Support

2.1 Instructor(s)

Cam Farrow PhD
Email: cfarrow@uoguelph.ca
Telephone: +1-519-824-4120 x53838
Office: RICH 1515
Office Hours: Open door policy or by appointment.

2.2 Instructional Support Team

Lab Technician: Joanne Ryks
Email: jryks@uoguelph.ca
Telephone: +1-519-824-4120 x54087
Office: THRN 1114

2.3 Teaching Assistant(s)

Teaching Assistant: Na Qin
Email: nqin@uoguelph.ca

Teaching Assistant: Ceilidh Mackie
Email: mackiec@uoguelph.ca

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3 Learning Resources

3.1 Required Resource(s)

Course Website (Website)
https://www.courselink.uoguelph.ca
Course materials, announcements, and grades will be regularly posted to the ENGG*3590 Courselink site. You are responsible for checking the site regularly.

3.2 Recommended Resource(s)

Water Quality: Characteristics, Modeling and Modification (Textbook)
Tchobanoglous, G. and Schroeder, E. (1985). Addison-Wesley, Reading, MA, 768p.

3.3 Additional Resource(s)

Water Chemistry (Textbook)
Benjamin, M.M. (2014). 2nd edition, Waveland Press, Inc., Long Grove, IL.

Water Quality Engineering: Physical/Chemical Treatment Processes (Textbook)
Benjamin, M.M. Desmond F. Lawler, D.L. (2013). John Wiley & Sons, New York, NY.

Water and Wastewater Engineering: Design Principles and Practice (Textbook)
Davis, M.L. (2011). 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.

Recommended Standards for Water Works (Textbook)
Great Lakes–Upper Mississippi River Board of State and Provincial Public health and

Environmental Managers, (2012). Health Research Inc., 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.

Chemistry for Environmental Engineering and Science (Textbook)
Sawyer, C.N., McCarty, P.L. and Gene F. Parkin, G.F. (2003). 5th edition, McGraw Hill, Inc., New York, NY.

Aquatic Chemistry: Chemical Equilibria and Rates in Natural Waters (Textbook)
Stumm, W. and Morgan, J.J. (1996). 3rd edition, John Wiley, New York, NY.

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.

3.4 Communication and Email Policy

Please use the lectures, labs and tutorials as your main opportunities to ask questions about the course. Major announcements will be posted to the course website. It is your responsibility to check the course website regularly. As per university regulations, all students are required to check their <uoguelph.ca> e-mail account regularly: e-mail is the official route of communication between the University and students.

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4 Learning Outcomes

4.1 Course Learning Outcomes

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

1. Understand and characterize important physical, chemical and biological water quality parameters and their implication in water quality issues,
2. Perform water and wastewater analyses and make appropriate interpretations of water quality data,
3. Perform preliminary design of conventional water treatment plants,
4. Use oxygen sag models to model water quality in rivers,
5. Develop investigation skills through laboratory work and communicate findings of laboratory tests to a wide audience, and
6. Understand and communicate the relationship between various water quality parameters, ecosystems and public health.

4.2 Engineers Canada - Graduate Attributes (2018)

Successfully completing this course will contribute to the following:

#	Outcome Set Name	Course Learning Outcome
1	Knowledge Base	1, 2, 3, 4
1.1	Recall, describe and apply fundamental mathematical principles and concepts	1, 2, 3, 4

#	Outcome Set Name	Course Learning Outcome
1.2	Recall, describe and apply fundamental principles and concepts in natural science	1, 2, 3, 4
1.3	Recall, describe and apply fundamental engineering principles and concepts	1, 2, 3, 4
1.4	Recall, describe and apply program-specific engineering principles and concepts	1, 2, 3, 4
2	Problem Analysis	1, 3, 4, 5
2.1	Formulate a problem statement in engineering and non-engineering terminology	1, 3, 4, 5
2.2	Identify, organize and justify appropriate information, including assumptions	1, 3, 4, 5
2.3	Construct a conceptual framework and select an appropriate solution approach	1, 3, 4, 5
2.4	Execute an engineering solution	1, 3, 4, 5
2.5	Critique and appraise solution approach and results	3, 4, 5
3	Investigation	2, 5
3.1	Propose a working hypothesis	2, 5
3.2	Design and apply an experimental plan/investigative approach (for example, to characterize, test or troubleshoot a system)	2, 5
3.3	Analyze and interpret experimental data	2, 5
3.4	Assess validity of conclusions within limitations of data and methodologies	2, 5
4	Design	3
4.1	Describe design process used to develop design solution	3
4.2	Construct design-specific problem statements including the definition of criteria and constraints	3
5	Use of Engineering Tools	2, 3, 5
5.1	Select appropriate engineering tools from various alternatives	2, 3, 5
5.2	Demonstrate proficiency in the application of selected engineering tools	3, 5
5.3	Recognize limitations of selected engineering tools	2, 3, 5
6	Individual & Teamwork	2, 5
6.2	Understand all members’ roles and responsibilities within a team	2, 5
6.3	Execute and adapt individual role to promote team success through, for	2, 5

#	Outcome Set Name	Course Learning Outcome
	example, timeliness, respect, positive attitude	
6.4	Apply strategies to mitigate and/or resolve conflicts	2
6.5	Demonstrate leadership through, for example, influencing team vision and process, promoting a positive team culture, and inspiring team members to excel	2
7	Communication Skills	5, 6
7.1	Identify key message(s) and intended audience in verbal or written communication as both sender and receiver	5, 6
7.2	Interpret technical documentation such as device specification sheets, drawings, diagrams, flowcharts, and pseudocode	5
7.3	Construct the finished elements using accepted norms in English, graphical standards, and engineering conventions, as appropriate for the message and audience	5, 6
7.4	Substantiate claims by building evidence-based arguments and integrating effective figures, tables, equations, and/or references	5, 6
9	Impact of Engineering on Society and the Environment	3, 6
9.1	Analyze the safety, social, environmental, and legal aspects of engineering activity	3, 6
9.2	Evaluate the uncertainties and risks associated with engineering activities	3, 6
9.3	Anticipate the positive and negative impacts of introducing innovative technologies to solve engineering problems	3, 6

4.3 Relationships with Other Courses & Labs

Previous Courses:

- **ENGG*2230:** fluid properties (i.e. density, viscosity, etc.), Bernoulli and Momentum equations, pipe flow and open channel flow.
- **ENGG*2560:** mass balance analysis for steady state and unsteady state situations, reactor types including batch, plug-flow and CSTR, analysis under both equilibrium and non-equilibrium conditions.
- **STAT*2120:** tools and methods for data analysis, the basic concepts for measurement errors. .
- **BIOL*1040, BIOL*1090, MICR*1020 and MICR*2420 (one of them):** diversity and roles

of microorganisms in the environment, laboratory methods to detect and quantify the microorganisms.

Follow-on Courses:

- **ENGG*4260:** Principles and practice to design and operate a variety of physical, chemical and biological systems to treat drinking water, municipal wastewater and industrial wastewater.
- **ENGG*4510:** Knowledge and approaches to perform environmental impact and health risk assessment.

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5 Teaching and Learning Activities

5.1 Lecture

Topic(s): I - Introduction, Sources and Uses of Water and Wastewater
Reference(s): Chapter 1

Topic(s): II - Physical, Chemical and Biological Characteristics of Water
Reference(s): Chapters 2 & 3 except 2.2 & 2.3

- Turbidity
- Solids - sludge volume
- Taste, odour and temperature
- pH, acidity, alkalinity and hardness
- ThOD, COD and BOD
- Nutrients - eutrophication
- Synthetic organics
- Gases
- Microorganisms - bacteria, viruses, pathogens, coliforms, Giardia, Cryptosporidium

Topic(s): III - Analysis and Sampling Methods (water and solid matrices)
Reference(s): Chapters 2.2, 2.3, 4

- Physical, chemical and biological
- Grab, composite, continuous and remote
- Preservation
- Gravimetric (solids), volumetric (titration), photometric (colour, nitrates, iron),
- Electrometric (pH, DO, temperature), culturing (coliform, plate counts)
- Overview of high tech (GC, GC-MS, ICP, HPLC)
- Detection limits

Topic(s): IV - Simple River model (oxygen sag)
Reference(s): Chapters 8.1, 8.2, 9.1

Topic(s): V – Introduction to Water Treatment

Reference(s): Chapters 11, 12.1, 12.4 to 12.11, and 13

- History
- Introduction to physiochemical treatment – coagulation, flocculation, sedimentation (Type I, II and III), filtration, aeration, disinfection
- Introduction to biological treatment – suspended growth processes, attached growth processes, anaerobic digestion, sludge processing

5.2 Lab Schedule and Description

The procedures for each laboratory are outlined in the Lab Manual, including safety issues. Please read the appropriate sections prior to the lab to ensure that the lab flows smoothly. The tentative lab schedule is as follows:

Week 1: Lab orientation and safety

Week 2 to 3: Biological oxygen demand

Week 4: Coliforms (TC and FC)

Week 5: No lab due to Thanksgiving and fall study break

Week 6 and 7: Coagulation/Flocculation (jar tests)

Week 8 and 9: Type 2 settling

Week 10: Chlorine demand

5.3 Other Important Dates

Thursday, September 6: Classes commence
Monday, October 8: Holiday (no classes)
Tuesday, October 9: Fall study break day (no classes)
Friday, November 2: Fortieth class day: Last day to drop single semester courses.
Thursday, November 29 : Classes rescheduled from Tuesday, October 9
Friday, November 30: Classes rescheduled from Monday, October 8. Classes conclude.

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6 Assessments

6.1 Marking Schemes & Distributions

Name	Scheme A (%)
Lab Reports	20
Midterms	40
Final Exam	40

Name	Scheme A (%)
Total	100

6.2 Assessment Details

Lab Reports (20%)
Labs and lab reports will be completed in pairs. Each pair of students will prepare a written lab report for two of the labs using the appropriate data set. The labs for which reports are to be submitted will be determined randomly by the instructor. The lab reports are due one week after the experiments are completed. Laboratory reports can be submitted to the corresponding Dropbox on Courselink.

Midterm I (20%)
Date: Tue, Oct 16, THRN 1307
In-Class

Midterm II (20%)
Date: Tue, Nov 13, THRN 1307
In-Class

Final Exam (40%)
Date: Thu, Dec 13, TBD
11:30AM - 1:30PM

6.3 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: In order to pass the course, students must obtain a grade of 50% or higher.

Lab Work: You must attend and complete all laboratories. If you miss a laboratory due to grounds for granting academic consideration or religious accommodation, arrangements must be made with the teaching assistant to attend an alternate lab (same lab conducted on an alternate date). The report should be technically sound, CLEARLY readable, and concise.

Late Lab Reports and Assignments: Late submission of lab reports and assignments will be devalued by 20% per day.

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7 School of Engineering Statements

7.1 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.

7.2 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.

7.3 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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8 University Statements

8.1 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.

8.2 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.

8.3 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.

8.4 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.

8.5 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

8.6 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.

8.7 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.

8.8 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.