ENGG*3590 Water Quality

01

Fall 2023
Section(s): C01

School of Engineering
Credit Weight: 0.50
Version 1.00 - September 05, 2023

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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-Requisites:	ENGG*2230, STAT*2120, (BIOL*1090 or MICR*2420), (ENGG*2010 or ENGG*2560)
Restrictions:	This is a Priority Access Course. Enrolment may be restricted to the ENVE and WRE specializations in the BENG and BENG:C programs. See department for more information. Non-BENG students may take a maximum of 4.00 ENGG credits.

1.2 Course Description

Water Quality is an essential course for undergraduate students in the Water Resources and Environmental Engineering programs. The concepts and principles presented give students the necessary engineering skills to address the water quality problems they will face in their senior year and upon graduation. This course builds on the student's experience in chemistry, fluid mechanics, engineering science and provides an engineering perspective on:

- fundamentals of water chemistry
- physical, chemical and biological characteristics of water

- standard methods of water quality analysis
- significance and interpretation of analytical results
- modelling of water quality in natural systems
- introduction to engineered water and wastewater treatment systems

1.3 Timetable

Type	Section	Time	Location
Lectures:			
Tues, Thur	All	10:00AM - 11:20AM	ANNU, Room 204
Labs:			
Monday	01011	11:30AM - 02:20PM	THRN 1116
Wednesday	01021	02:30PM - 05:20PM	THRN 1116
Seminars:			
Tuesday	01011, 01021	05:30PM - 06:50PM	MCKN, Room 233
Midterm 1		10/17/2023, 05:30 PM -06:20 PM	MCKN, Room 233
Midterm 2		11/14/2023, 05:30 PM -06:20 PM	MCKN, Room 233

1.4 Final Exam

Time: 12/12/2023, 8:30am to 10:30am

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2 Instructional Support

2.1 Instructional Support Team

Instructor: Hongde Zhou PhD, PEng
Email: hzhou@uoguelph.ca
Telephone: +1-519-824-4120 x56990
Office: RICH 3511
Office Hours: Thursday 12:30PM to 01:30PM or via TEAMs appointment.

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

2.2 Teaching Assistants

Teaching Assistant (GTA): Evan Chatfield
Email: echatfie@uoguelph.ca
Office Hours: On-line appointments

Teaching Assistant (GTA): TBD TBD TBD TBD

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3 Learning Resources

3.1 Required Resources

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 Resources

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

3.3 Additional Resources

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.

Standard Methods for the Examination of Water and Wastewater (Textbook)
American Public Health Association, American Water Works Association and Water Environment Federation, (2017), 23rd Edition.

3.4 Communication and Email Policy

The announcements, course notes, lab manual, assignments and other information will be posted to the course website as the course progresses. 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. Use oxygen sag models to model water quality in rivers,
4. Perform preliminary design of conventional water treatment plants,
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	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	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	2, 3, 4
1.4	Recall, describe and apply program-specific engineering principles and concepts	1, 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	4
4.1	Describe design process used to develop design solution	4
4.2	Construct design-specific problem statements including the definition of criteria and constraints	4
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 example, timeliness, respect, positive attitude	2, 5
7	Communication Skills	5, 6

#	Outcome	Learning Outcome
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	4, 6
9.1	Analyze the safety, social, environmental, and legal aspects of engineering activity	4, 6
9.3	Anticipate the positive and negative impacts of introducing innovative technologies to solve engineering problems	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:

- **EENGG*4720 and 4760**: 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

Topics: I - Introduction, Sources and Uses of Water

References: Chapter 1
Learning Outcome: 6

Topics: II. Basic Concepts in Water Chemistry

References: Appendix E, Lecture notes

Learning Outcome: 1

Molecular structure of water and behaviours of solutes
Concentration and activity expression of solutes
Chemical reactions and equilibrium
pC-pH diagram and carbonate system
Water inorganic matter speciation
Metal precipitation and complexation

Topics: III - Physical, Chemical and Biological Characteristics of Water and Their Analyses

References: Chapters 2, 3, & 4

Learning Outcome: 1, 2, 5, 6

- Turbidity
- Solids - sludge volume
- pH, acidity, alkalinity and hardness
- Heavy metals

- Nutrients - eutrophication
- Synthetic organics
- COD, ThOD, TOC and BOD
- Biological quality

Topics:	IV - Simple River model (oxygen sag)
References:	Chapters 8.1, 8.2, 9.1
Learning Outcome:	3, 6
Topics:	V – Introduction to Water and Wastewater Treatment
References:	Chapters 11, 12.1, 12.4 to 12.11, 13.1 to 13.4, 14.1 to 4, 14.6 to 14.8, 14.11
Learning Outcome:	4, 6

- Overview of water and wastewater treatment
- Introduction to physiochemical treatment – coagulation, flocculation, sedimentation, filtration, disinfection
- Introduction to biological treatment – activated sludge process for BOD and nutrient removal

5.2 Lab Schedule and Description

There are five labs for this course. The procedures for each laboratory and safety issues are outlined in the Lab Manual. Please read the appropriate sections prior to each of your scheduled lab time to ensure that the lab flows smoothly. The lab section starts from the week of September 11. The first week lab is for safety, lab activities, and grouping. The detailed lab schedule will be determined after the first lab.

5.3 Other Important Dates

Thursday, September 7: Classes commence
Monday, October 9: Thanksgiving (no classes)
Tuesday, October 10: Fall study break day (no classes)

Thursday, November 30: Classes rescheduled from Tuesday, October 10,
Friday, December 1: Classes rescheduled from Monday, October 9, and Classes conclude.

Please refer to University Calendar 2023-2024 for other important dates.

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6 Assessments

6.1 Marking Schemes & Distributions

Name	Scheme A (%)
Lab Report 1	10
Lab Report 2	10
Midterm 1	20
Midterm 2	20
Final exam	40
Total	100

6.2 Assessment Details

Lab Reports (20%)

Learning Outcome: 1, 2, 5, 6

Labs and lab reports will be completed in pairs at your choice. 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.

Each pair of students will submit a total two lab reports using the appropriate data set during the semester. Each report will be counted for 10% toward your final grade. 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. Only electronic copies are acceptable.

Assignments (0%)

Learning Outcome: 1, 2, 5

Tentatively, a total of seven assignments will be provided through the semester. **You are required to submit all the assignments electronically to the course Dropbox in order to pass this course.** You are advised to ask any questions related to the assignments, labs and other course work during the weekly seminars and GTAs' office hours.

Midterm 1 (20%)

Date: Tue, Oct 17, 5:30 PM - 6:30 PM, MCKN 233

Learning Outcome: 1, 2, 6

Midterm 2 (20%)

Date: Tue, Nov 14, 5:30 PM - 6:30 PM, MCKN 233

Learning Outcome: 2, 3, 4

Final Exam (40%)

Date: Tue, Dec 12, 8:30 AM - 10:30 AM, TBD

Learning Outcome: 1, 2, 3, 4, 6

6.3 Course Grading Policies

Missed Assignments/Lab Reports/Midterms: If you are unable to meet an in-course requirement due to medical, psychological, or compassionate reasons, please email the course instructor to obtain an approval. The weight of the missed assessments will be added to the final exam. There will be no makeup assignments, lab reports, and midterms. 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

Late Lab Reports and Assignments: Late submission of lab reports and assignments will be devalued by 25% per day. The report should be technically sound, CLEARLY readable, and concise.

Passing grade: Students must submit all the assignments and obtain a grade of 50% or higher on the lab reports in order to pass the course.

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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.

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 grounds for Academic Consideration are detailed in the Undergraduate and Graduate Calendars.

Undergraduate Calendar - Academic Consideration and Appeals
https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml

Graduate Calendar - Grounds for Academic Consideration
https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml

Associate Diploma Calendar - Academic Consideration, Appeals and Petitions
https://www.uoguelph.ca/registrar/calendars/diploma/current/index.shtml

8.3 Drop Date

Students will have until the last day of classes to drop courses without academic penalty. The deadline to drop two-semester courses will be the last day of classes in the second semester. This applies to all students (undergraduate, graduate and diploma) except for Doctor of Veterinary Medicine and Associate Diploma in Veterinary Technology (conventional and alternative delivery) students. The regulations and procedures for course registration are available in their respective Academic Calendars.

Undergraduate Calendar - Dropping Courses
https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml

Graduate Calendar - Registration Changes
https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/genreg-reg-regchg.shtml

Associate Diploma Calendar - Dropping Courses

https://www.uoguelph.ca/registrar/calendars/diploma/current/c08/c08-drop.shtml

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 make a booking at least 14 days in advance, and no later than November 1 (fall), March 1 (winter) or July 1 (summer). Similarly, new or changed accommodations for online quizzes, tests and exams must be approved at least a week ahead of time.

For Guelph students, information can be found on the SAS website
https://www.uoguelph.ca/sas

For Ridgetown students, information can be found on the Ridgetown SAS website
https://www.ridgetownc.com/services/accessibilityservices.cfm

8.6 Academic Integrity

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 encourages academic integrity. 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.

Undergraduate Calendar - Academic Misconduct

https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml

Graduate Calendar - Academic Misconduct
https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml

8.7 Recording of Materials

Presentations that are made in relation to course work - including lectures - cannot be recorded or copied without the permission of the presenter, whether the instructor, a student, 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 that apply to undergraduate, graduate, and diploma programs.

Academic Calendars
https://www.uoguelph.ca/academics/calendars

8.9 Illness

Medical notes will not normally be required for singular instances of academic consideration, although students may be required to provide supporting documentation for multiple missed assessments or when involving a large part of a course (e.g.. final exam or major assignment).