ENGG*3650 Hydrology

Fall 2017

Sections(s): C01

School of Engineering

Credit Weight: 0.50

Version 1.00 - September 07, 2017

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1 Course Details

1.1 Calendar Description

Quantitative study of natural water circulation systems with emphasis on basic physical principles and interrelationships among major processes; characteristics of mass and energy; inputs to and output from watersheds; factors governing precipitation occurrence, evaporation rates, soil-water storage changes, groundwater recharge and discharge, run-off generation; methods of streamflow analysis; mathematical modeling.

Pre-Requisite(s): (ENGG*2230 or MET*2030), (MATH*1210 or MATH*2080), (STAT*2120 or STAT*2040), and competency in computing.

1.2 Timetable

Lectures:		
Monday	14:30 – 15:30	MCKN, Room 031
Wednesday	14:30 – 15:30	MCKN, Room 031
Friday	14:30 – 15:30	MCKN, Room 031

Tutorial:		
Thursday (Section 01)	17:30 – 18:30	MCKN, Room 225

Monday (Section 02)	17:30 – 18:30	MCKN, Room 225

1.3 Final Exam

December 15, 2017, 14:30-16:30, Room TBA

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2 Instructional Support

2.1 Instructor(s)

Andrew Binns

Email:	binns@uoguelph.ca
Telephone:	+1-519-824-4120 x54011
Office:	THRN 2414
Office Hours:	TBA on CourseLink and by appointment.

2.2 Instructional Support Team

Lab Technician:	John Whiteside
Email:	jwhitesi@uoguelph.ca
Telephone:	+1-519-824-4120 x54424
Office:	THRN 1136

2.3 Teaching Assistant(s)

Name	Details
Dustin Brown	dbrown24@uoguelph.ca TBA on CourseLink
Yu Hou	yhou05@uoguelph.ca TBA on CourseLink

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3 Learning Resources

3.1 Required Resources(s)

Course Website (Website)

http://courselink.uoguelph.ca
Course material, news, announcements, and grades (except final) will be regularly posted to the ENGG*3650 CourseLink site. You are responsible for checking the site regularly.

There is no officially required textbook for this course, however, the recommended text below is highly recommended. (Other)

3.2 Recommended Resources(s)

Bedient, P.B. and W.C. Huber 2012. Hydrology and Floodplain Analysis. 5th ed., Prentice Hall, Upper Saddle River, NJ. (Textbook)

3.3 Additional Resources(s)

Dingman, S.L. 2014. Physical Hydrology. 3rd ed., Waveland Press Inc. (Textbook)

Viessman, W. and G.L. Lewis 2002. An Introduction to Hydrology. 5th ed., Pearson. (Textbook)

Hydrology, An Introduction, Custom Edition for University of Guelph, Prentice Hall, Toronto. (Textbook)

Bureau of Reclamation 1987. Design of Small Dams. 3rd ed., U.S. Department of the Interior, Denver. (Textbook)

Chow, V.T., D.R. Maidman and L.W. Hays 1988. Applied Hydrology. McGraw Hill, New York. (Textbook)

3.4 Lecture Information

Material is covered in lectures, with emphasis on the quantitative description of the various components of the hydrologic cycle such as precipitation, watershed abstractions, stream flow characteristics, hydrograph analysis, overland and channel flow routing, time series analysis, ground water in hydrology and simulation of hydrologic processes.

3.4 Communication & Email Policy

Please use lectures and lab help sessions as your main opportunity 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 its students.

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4 Learning Outcomes

This course on hydrology is a core course in water resources engineering and environmental engineering programs. The main goals of the course are (1) to teach students the components of the hydrologic cycle and (2) to provide description of basic hydrologic processes including precipitation, watershed abstractions, stream flow characteristics, hydrograph analysis, overland and channel flow routing, hydrologic time series analysis, ground water in hydrology and simulation of hydrologic processes.

4.1 Course Learning Outcomes

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

1. Recognize and quantify basic hydrologic processes, such as runoff generation, infiltration and evaporation, in order to perform analyses of the hydrologic functioning of a watershed.
2. Describe commonly-used methods of measuring quantities which are important in hydrologic calculations.

3. Select and apply methods of calculation to obtain quantitative estimates of the response of a watershed to atmospheric inputs.
4. Apply statistical methods to assess the relative frequency of hydrologic events and determine the risk associated with the selection of specific hydrologic design values for inputs and/or outputs from watersheds.
5. Apply a representative hydrologic model and describe its attributes, strengths and weaknesses.

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, 3, 4, 5
1.1	Recall, describe and apply fundamental mathematical principles and concepts	1, 2, 3, 4, 5
1.2	Recall, describe and apply fundamental concepts and principles in natural sciences	1, 2, 3, 4, 5
1.3	Comprehend and apply fundamental engineering concepts	1, 2, 3, 4, 5
1.4	Comprehend and apply program-specific engineering concepts	1, 2, 3, 4, 5
2	Problem analysis	2
2.1	Formulate a problem statement in engineering and nonengineering terminology	2
2.2	Construct a conceptual framework	2
2.3	Identify, organize and justify appropriate information	2
2.4	Execute an engineering solution	2
2.5	Critique and appraise results	2
3	Investigation	3
3.1	Propose and test working hypotheses	3
3.2	Design and apply an investigation plan	3
3.3	Analyze and interpret experimental data	3
3.4	Assess validity of conclusions within limitations of data and methodologies	3
5	Use of engineering tools	3
5.1	Select appropriate engineering tools from various alternatives	3
5.2	Apply selected engineering tools	3

#	Outcome Set Name	Course Learning Outcome
5.3	Recognize limitations of selected engineering tools	3
6	Individual and team work	5
6.1	Act as an individual team member to promote team success	5
6.2	Demonstrate leadership through team building, providing feedback and positive attitude	5
7	Communication skills	1, 2, 3, 4, 5
7.1	Develop and deliver clear, key concepts using methods appropriate for the intended audience	1, 2, 3, 4, 5
7.2	Critically evaluate received information	1, 2, 3, 4, 5
7.3	Demonstrate active listening and follow instructions	1, 2, 3, 4, 5
8	Professionalism	5
8.1	Identify what it means to be a professional and distiguish between legislated and non-legislated based professions	5
8.2	Perform in a professional manner	5
8.3	Effectively describe engineering law and its impact on professional engineering practice	5
9	Impact of engineering on society and environment	2, 4
9.1	Analyze the social, environmental and legal aspects of engineering activity	2, 4
9.2	Summarize the common sources of uncertainty and risk in their engineering field	2, 4
9.3	Identify the impact of introducing innovative technologies to solve engineering problems	2, 4
11	Economics and project management	1, 2, 3, 4, 5
11.1	Apply project management techniques and manage resources within identified constraints	1, 2, 3, 4, 5
11.2	Estimate the life cycle engineering benefits and costs associated with engineering design	1, 2, 3, 4, 5
12	Life-long learning	2, 3, 4
12.1	Identify personal career goals and opportunities for professional development	2, 3, 4
12.2	Analyze a self-assessment of skills relative to SOE defined learning	2, 3, 4

#	Outcome Set Name	Course Learning Outcome
	outcomes	
12.3	Identify and critique limits of their field	2, 3, 4

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5 Teaching and Learning Activities

5.1 Lecture Schedule

Week	Topic	Description
1	**Introduction**	Course overview, definition of hydrology, historical development, global and regional water quantities, hydrologic cycle, water budget analysis
2-3	**Precipitation**	Storm types and their formation, point versus areal precipitation values, spatial and temporal averaging techniques, measurement techniques and analysis of precipitation
4	**Hydrologic abstractions**	Infiltration (description, measurements and calculation)
5	**Hydrologic abstractions**	Evapotranspiration (description, measurement and calculation)
6-7	**Stream flow and runoff**	Streamflow characteristics, components of hydrograph, surface runoff, baseflow, interflow, measurement of stream flows and analysis of runoff
8	**Hydrologic simulation**	Hydrologic modelling, types of hydrologic models, model selection, model evaluation including sensitivity analysis, calibration and validation
9-10	**Flood routing**	Hydrologic routing (storage indication, Muskingum methods), hydraulic routing and watershed analysis for the purposes of routing

11	**Frequency analysis**	Review of probability concepts, return periods, common probabilistic models and model fitting, risk and design levels
12	**Hydrologic design**	Frequency levels, design storms/continuous records and minor structure design

Disclaimer: *Slight change in the sequence of topics is possible.*

5.2 Lab Schedule

Stream gauging lab will be conducted during the first three to four weeks of the semester depending upon the outside climatic conditions.

Tutorial activity	**Date**	
	Section 01	**Section 02**
Stream gauging laboratory introduction	07-Sep	11-Sep
Tutorial problems 1: Water balance*	14-Sep	18-Sep
Tutorial problems 2: Precipitation 1*	21-Sep	25-Sep
Tutorial problems 3: Precipitation 2*	28-Sep	02-Oct
Review	05-Oct	
Tutorial problems 4: Infiltration*	12-Oct	16-Oct
Tutorial problems 5: Evapotranspiration*	19-Oct	23-Oct
Tutorial problems 6: Streamflow and runoff*	26-Oct	30-Oct

Tutorial problems 7: Hydrograph analysis*	02-Nov	06-Nov
Hydrologic modeling assignment introduction	09-Nov	13-Nov
Tutorial problems 8: Flood routing*	16-Nov	20-Nov
Tutorial problems 9: Frequency analysis	23-Nov	27-Nov
Review		01-Dec

* indicates submission of tutorial problems

5.3 Other Important Dates

Thursday, September 7, 2017: First day of class

Monday, October 9, 2017: Thanksgiving holiday

Tuesday, October 10, 2017: Fall study day, no classes

Friday, November 3, 2017: 40th class day, last day to drop classes

Friday, December 1, 2017: last day of class

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6 Assessments

6.1 Marking Schemes & Distributions

Name	Scheme A (%)
Stream gauging laboratory	7.00
Modeling assignment	7.00
Seminar problems (8)	6.00
Midterm examinations (2)	40.00
Final examination	40.00
Total	100.00

6.2 Assessment Details

Stream gauging laboratory

Due: Friday, October 27

Hydrologic modeling assignment

Due: Monday, November 27

Seminar problems (8)

Date: Thursday, September 7 - Friday, December 1

Midterm examinations (2)

Date:

Friday, October 20 and Friday, November 10

Final examination

Date: Friday, December 15, TBA

14:30-16:30

6.3 Note

To pass the course you must pass the final examination (> 50%) or have an average of greater than 50% on the two equally-weighted midterm examinations (> 50%). Any student failing both the final examination and the midterms (average mark of the two) will receive their final examination mark as the mark for the course.

6.4 Date and Distribution

Midterm examinations (2): 40% (each midterm is worth 20%)

October 20, 2017, 14:30 – 15:30; in class (MCKN, Room 031).

November 10, 2017, 14:30 – 15:30; in class (MCKN, Room 031)

Final examination: 40%

December 15, 2017,14:30-16:30; Room To Be Announced

Stream gauging laboratory: 7%

Due date: October 27, 2017

Details: Each student, as a part of a group of four, will be required to determine the discharge of a local river. This will be done in a separately scheduled lab during the first three or four weeks of the semester.

You are encouraged to discuss the stream gauging lab and the modelling assignment with the

instructor, TAs and with members of the class but copying is not permitted. Copying is similar to plagiarism in that it involves the appropriation of others' work as one's own. It includes copying in whole or in part another's test or examination answer(s), laboratory report, essay, or other assignment. Copying also includes submitting the same work, research or assignment for credit on more than one occasion in two or more courses, or in the same course, without the prior written permission of the instructor(s) in all courses involved (including courses taken at other post-secondary institutions).

Hydrologic modeling assignment: 7%

Due date: November 27, 2017

Details: There will be one group assignment on the calibration and validation of some components of a hydrologic model. Each group will work with a computer model to simulate some components of the hydrologic cycle. They will be required to prepare the data files, run the program, perform calibration and validation, and analyze the simulated results.

Practice problems: A list of practice problems will be provided (posted to CourseLink) periodically throughout the semester to coincide with lecture topics.

Seminar problems: 6% (eight seminar problem sets throughout the semester)

Date due: at the end of tutorial time (see dates in Section 5.4 Lab Schedule)

Details: Tutorials will be used for additional examples and working through problems individually and as a group. Problem set will be required to be handed-in at the end of the tutorial session. These will be marked out of 2, with two marks being awarded for a correct solution, one mark being awarded for an incorrect solution, and no marks being awarded for no submission.

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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 contact the course instructor. See the undergraduate calendar for information on regulations and procedures for Academic Consideration:
http://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/sec_d0e1400.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

Missed midterm exam or quizzes: If you miss a midterm exam or quiz due to grounds for granting academic consideration or religious accommodation, the weight of the missed midterm or quiz will be added to the final exam. There will be no makeup midterm or quizzes.

Late lab reports or assignments: Late submissions of lab reports or assignments will receive a 10% penalty per day. Lab reports or assignments submitted after five days past the due date will no longer be accepted.

The passing grade for this course is 50%.

7.2 Stream Gauging Laboratory Safety

Clearly follow the instructions of the technician or TA and act in professional manner.

- Absolutely no horseplay or misconduct will be tolerated.
- Do no attempt to modify or recalibrate the equipment.
- When in the stream move slowly and carefully; there can be unseen hazards below the water surface.
- Stream water is non-potable – **do not drink it**.
- The electronics used for this lab are **not** waterproof – keep them dry.
- Bring warm clothing (thick socks to wear in waders, extra pair of socks).
- One person adjusts the wading rods, one takes readings and calls them to a person on shore, who records the readings.
- Sunscreen and insect repellent are recommended.
- The group must stay together or keep track of where the team members are at all times.
- Fabric tape measures are not to be tied – they are to be able to rebound properly.
- All equipment is to be returned to the technician or TA before leaving the site; waders must be stored right side out.

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.

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.
