ENGG*3650 Hydrology

Fall 2016

School of Engineering

Revised: August 22, 2016

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1. INSTRUCTIONAL SUPPORT

1.1 Instructor

Name: Andrew Binns, Ph.D.
Office: THRN 2414, ext. 54011
Email: binns@uoguelph.ca
Office hours: TBA on CourseLink and by appointment.

1.2 Lab Technicians

Name: John Whiteside
Office THRN 3403
Email**:** jwhitesi@uoguelph.ca

1.3 Teaching Assistants

GTA	Email	Office	Office Hours
Dustin Brown	tba1@uoguelph.ca	TBA	TBA on CourseLink
Christopher Morgan	tba2@uoguelph.ca	TBA	TBA on CourseLink

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2. LEARNING RESOURCES

2.1 Course Website

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.

2.2 Required Resources

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

2.3 Recommended Resources

Bedient, P.B. and W.C. Huber 2012. Hydrology and Floodplain Analysis. 4th ed., Prentice Hall, Upper Saddle River, NJ.

2.4 Additional Resources

1. Dingman, S.L. 2014. Physical Hydrology. 3rd ed., Waveland Press Inc.
2. Viessman, W. and G.L. Lewis 2002. An Introduction to Hydrology. 5th ed., Pearson.
3. Hydrology**,** An Introduction, Custom Edition for University of Guelph, Prentice Hall, Toronto.
4. Bureau of Reclamation 1987. Design of Small Dams. 3rd ed., U.S. Department of the Interior, Denver.
5. Chow, V.T., D.R. Maidman and L.W. Hays 1988. Applied Hydrology. McGraw Hill, New York.

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.

2.5. 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 <mail.uoguelph.ca> e-mail account regularly: e-mail is the official route of communication between the University and its students.

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3. ASSESSMENT

The breakdown of the grading scheme for the course is given below:

`	Stream gauging laboratory	-	6%
	Modeling assignment	-	6%
	Seminar problems (8)	-	8%
	Midterm examinations (2)	-	40%
	Final examination	-	40%

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.

3.1 Date and Distribution

Midterm Examinations (2): 40% (each midterm is worth 20%)
October 21, 2016, 08:30 – 09:20; in class (JTP, Room 214).
November 11, 2016, 08:30 – 09:20; in class (JTP, Room 214)

Final Examination: 40%
December 6, 2016,19:00-21:00; Room To Be Announced

Stream Gauging Laboratory: 6%
Due date: October 28, 2016
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).

Model Computational Assignment: 6%
Due date: November 28, 2016
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: 8% (eight problem sets worth 1% each)
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.

3.2 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%.

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4. AIMS, OBJECTIVES AND GRADUATE ATTRIBUTES

4.1 Calendar Description

Quantitative study of natural water circulation systems with emphasis on basic physical principles and inter-relationships among major processes; characteristics of mass and energy; inputs to and outputs from watersheds; factors governing precipitation occurrence, evaporation rates, soil-water storage changes, ground-water recharge and discharge, runoff generation; methods of stream flow analysis; mathematical modeling. Prerequisites ENGG*2230 or MET*2030, MATH*1210 or MATH*2080, STAT*2120 or STAT*2040, and competency in computing.

4.2 Course Aims

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.

4.3 Learning Objectives

At the successful completion of this course, the student will have demonstrated ability 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.

4.4 Graduate Attributes

Graduate Attribute	**Learning Objectives**	**Assessment**
1. Knowledge Base for Engineering	1,2,3,4,5	Exams, Quizzes, Assignment
2. Problem Analysis	2	Exams, Quizzes, Assignment
3. Investigation	3	-
4. Design	-	-
5. Use of Engineering Tools	3	Assignment
6. Communication	5	Assignment, Lab
7. Individual and Teamwork	1,2,3,4,5	Exams, Quizzes, Assignment, Lab
8. Professionalism	5	Assignment, Lab
9. Impact of Engineering on Society and the Environment	2, 4	-
10. Ethics and Equity	-	-
11. Environment, Society, Business, & Project Management	1,2,3,4,5	-
12. Life-Long Learning	2,3,4	Exams, Quizzes, Assignment

4.5 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. As an ***instructor*** my responsibility is to create the environment for learning by presenting the course material in a clear manner, by providing necessary learning resources and by animating the class activities. I will be available to help you with any kind of problem you may have regarding the content of this course. Material covered in lectures will focus on hydrologic processes.

The Teaching Assistants (TA) will go over the assignments in the tutorial period. You are encouraged to discuss the assignments with the instructor, TA and with members of the class but copying is not allowed. 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).

4.6 Students' Learning Responsibilities

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

- As a ***student*** your responsibility is to come to class on time, read the required readings before and/or after the class and ask questions in the class if you don't understand. Class attendance at the University of Guelph is not mandatory but research has shown that student's success rate is directly related to class attendance. Those who attend classes and tutorials generally have higher success rates than those who do not. If I am unable to assist you during the class, ask the question after class or during office hours. It is YOUR fault if you don't ask questions when you do not understand.
- You have the responsibility to consult with the course site regularly and will be responsible for the material posted on the site.
- ***Professors are human and can make error***. If you think that I have made an error, point it out during the class because it is easier for me to correct the mistake and set the learning back on track rather than waiting until next class.
- Don't disturb (by talking to) your classmates during the class just because you feel bored.
- Turn off your cellphone during the lecture and tutorial.
- If you have a commitment more important than the class and could not attend the class ask for material covered in the class from your classmate. If you are not too late enter the classroom with minimum disturbance.
- Do not leave during the class and interrupt your classmates and the instructor unless it is very important. If you know you have to leave during the class, have the courtesy to sit near an exit.

Students will be expected to carry out fairly extensive numerical computations. A set of problems will be given for practice purposes. The Teaching Assistant (TA) will go over some of the practice problems in the tutorial sessions. You are encouraged to discuss these problems with the instructor, TAs and with members of the class. The quizzes will be based on the material covered in the lectures and the practice problems related to the material covered.

4.7 Relationships with other Courses & Labs

Previous Courses

ENGG*2230 or MET*2030,
MATH*1210 or MATH*2080,
STAT*2120 or STAT*2040, and competency in computing.

The fundamentals of fluid mechanics covered in ENGG*2230, meteorological characteristics covered in MET*2030, calculus covered in MATH*1210 or MATH*2080 and statistics and probability covered in STAT*2120 or STAT*2040 and competency in computing are applied to describe hydrological processes and to quantify hydrologic variables.

Follow-on Courses:

ENGG*4250, ENGG*4360, ENGG*4370, ENGG*4130, and ENGG*4150.

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5. TEACHING AND LEARNING ACTIVITIES

5.1 Time Table

Lectures:

Monday	08:30 – 09:30	JTP, Room 214
Wednesday	08:30 – 09:30	JTP, Room 214
Friday	08:30 – 09:30	JTP, Room 214

Tutorial:

Friday (Section 01)	13:30 – 14:20	MCKN, Room 224
Monday (Section 02)	16:30 – 17:20	MCKN, Room 224

5.2 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 vs. 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.*

5.4 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	09-Sep	12-Sep
Tutorial problems 1: Water balance*	16-Sep	19-Sep
Tutorial problems 2: Precipitation 1*	23-Sep	03-Oct
Tutorial problems 3: Precipitation 2*	30-Sep	10-Oct
Review	07-Oct	
Tutorial problems 4: Infiltration*	14-Oct	17-Oct
Tutorial problems 5: Evapotranspiration*	21-Oct	24-Oct
Tutorial problems 6: Streamflow and runoff*	28-Oct	31-Oct
Tutorial problems 7: Hydrograph analysis*	04-Nov	07-Nov
Hydrologic modeling assignment introduction	11-Nov	14-Nov
Tutorial problems 8: Flood routing*	18-Nov	21-Nov
Tutorial problems 9: Frequency analysis	25-Nov	28-Nov
Review		02-Dec

* indicates submission of tutorial problems

5.5. Other Important Dates

Thursday, September 8, 2016: First day of class
Monday, October 10, 2016: Thanksgiving holiday
Tuesday, October 11, 2016: Fall study day, no classes
Friday, November 4, 2016: 40th class day, last day to drop classes
Friday, December 2, 2016: last day of class

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6. 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.

6.1 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.

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7. 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.

7.1 Resources

The Academic Misconduct Policy is detailed in the Undergraduate Calendar:
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml

A tutorial on Academic Misconduct produced by the Learning Commons can be found at:
http://www.academicintegrity.uoguelph.ca/

Please also review the section on Academic Misconduct in your Engineering Program Guide.

The School of Engineering has adopted a Code of Ethics that can be found at:
http://www.uoguelph.ca/engineering/undergrad-counselling-ethics

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8. ACCESSIBILITY

The University of Guelph is committed to creating a barrier-free environment. Providing services for students is a shared responsibility among students, faculty and administrators. This relationship is based on respect of individual rights, the dignity of the individual and the University community's shared commitment to an open and supportive learning environment. Students requiring service or accommodation, whether due to an identified, ongoing disability for a short-term disability should contact the Centre for Students with Disabilities as soon as possible

For more information, contact CSD at 519-824-4120 ext. 56208 or email csd@uoguelph.ca or see the website: http://www.uoguelph.ca/csd/

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9. 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.

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10. 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: http://www.uoguelph.ca/registrar/calendars/index.cfm?index