# Course Outline Form: Winter 2016

## General Information

**Course Title:** ENVS\*3060 Groundwater

**Course Description:** This course will focus on the occurrence, distribution, and movement of groundwater as a function of the geological environment. As a valuable natural resource, it is important to develop a general understanding of how groundwater systems work and react to human-induced conditions. Considerable emphasis is placed on field methods used during soil water and groundwater monitoring; in addition to exploration, testing and development of aquifers for water supply. A brief overview of groundwater contamination and remediation techniques will also be provided.

**Credit Weight:** 0.50

**Academic Department (or campus):** School of Environmental Sciences

**Campus:** Guelph

**Semester Offering:** Winter 2016

**Class Schedule and Location:** Mon, Wed, Fri, 11:30 am – 12:20 pm, ALEX 100

## Instructor Information

Instructor Name: Heather McLeod

Instructor Email: [hmcleo03@uoguelph.ca](mailto:hmcleo03@uoguelph.ca)

Office location and office hours: Mon, 1:30 - 2:20 pm, ALEX 204 OR by appointment, arranged via email

## GTA Information

GTA Name: Tyson Jennett

GTA Email: [tjennett@uoguelph.ca](mailto:tjennett@uoguelph.ca)

GTA office location and office hours: TBA

GTA Name: Amy Pawlick

GTA Email: [pawlicka@uoguelph.ca](mailto:pawlicka@uoguelph.ca)

GTA office location and office hours: TBA

## Course Content

### Specific Learning Outcomes:

1. Define physical properties that control flow, storage of water, and contaminant transport in the unsaturated and/or groundwater zones.
2. Apply knowledge of these physical properties to evaluate and solve practical unsaturated and groundwater water flow problems.
3. Identify the various instruments and/or techniques used in measuring flow and storage in the unsaturated and saturated zones.
4. Resolve the importance and application of geology in defining groundwater flow.
5. Develop an intuitionfor how groundwater systems work and react to human-induced conditions.
6. Identify the various designs and materials used in groundwater well construction.
7. Solve slug and pumping test problems to identify potential aquifers and also understand the limitations of these techniques.

### Lecture Content:

|  |  |
| --- | --- |
| **Approx. Schedule** | **Lectures and Materials** |
| Weeks  1 - 3 | Part 1: Importance of groundwater for environmental systems and as a natural resource (Chapters 1 and 2, Fetter). Physical properties and principles of groundwater and unsaturated flow, such as porosity, permeability, hydraulic conductivity and its measurement within the lab, hydraulic head, Darcy's Law, unsaturated hydraulic conductivity, soil water characteristic curves (Chapters 3, 4 and 6, Fetter). |
| Weeks  4 - 5 | Part 2: Geology of groundwater, learning about the types of hydrogeologic units (aquifers and aquitards), and how groundwater flows within and/or between them, considering impacts of heterogeneity and anisotropy. Groundwater storage (compressibility, effective stress, storativity, specific yield). Chapters 3 and 8, Fetter. |
| Week 6 | Winter Break |
| Week 7 | Part 2 Continued. Midterm |
| Weeks  8 - 9 | Part 3: Groundwater flow equations (equation of continuity, law of mass conservation, steady-state and transient flow equations, etc.,) to provide an understanding the parameters used and the key assumptions or conditions that apply. Introduction to groundwater flow nets. Chapters: 4, 5, 6 and 7, Fetter. |
| Weeks  10 - 11 | Part 4: Groundwater monitoring and resource evaluation, including: design and installation of wells, slug and pumping tests to estimate aquifer parameters and impact of pumping wells (Chapters 5 and 10, Fetter). |
| Weeks  12 - 13 | Part 5: Introduction to groundwater contamination, including the fate and transport of solutes and general remedial techniques (Chapter 10, Fetter). Numerical Modeling (Chapter 13, Fetter). Review for the final exam. |

### Course Assignments and Tests:

| **Assignment or Test** | **Due Date** | **Contribution to Final Mark (%)** | **Learning Outcomes Assessed** |
| --- | --- | --- | --- |
| Assignment 1 | Jan 29 | 5 | Part 1, Outcomes 1 - 2 |
| Assignment 2 | Feb 12 | 5 | Part 2, Outcome 3 - 4 |
| Midterm | Feb 26 | 30 | Parts 1 - 2, Outcomes 1 - 4 |
| Assignment 3 | Mar 18 | 5 | Part 3, Outcome 5 |
| Assignment 4 | Apr 1 | 5 | Part 4, Outcome 6 - 7 |
| Exam | Apr 19 | 50 | Parts 1 - 5, Outcomes 1 - 7 |

### Final examination date and time: April 19, 2016; 2:30 - 4:30 pm

### Final exam weighting: 50% of Final Mark

## Course Resources

### Required Texts: The following are on reserve in the library: Applied Hydrogeology by C.W. Fetter; and Groundwater by A. Freeze and J. Cherry.

### Other Resources: Lecture slides, practice questions, discussions, etc., are available on Courselink.

## Course Policies

### Grading Policies: Assignments are due at the beginning of class on the due date shown above. A penalty of 25% per day will be assessed for late assignments. Late assignments must be submitted electronically to the Instructor via email. Timestamp on emails will be used to apply late penalties. Please inform the Instructor in advance if you are unable to submit an assignment on time or attend the midterm test so that it can be re-scheduled for you.

### Course Policy on Group Work: Individual assignments must be submitted by each student. Plagiarism will not be tolerated.

### Course Policy regarding use of electronic devices and recording of lectures: Electronic recording of classes is expressly forbidden without consent of the instructor. When recordings are permitted they are solely for the use of the authorized student and may not be reproduced, or transmitted to others, without the express written consent of the instructor.

## University Policies

### Academic Consideration:

The University of Guelph is committed to supporting students in their learning experiences and responding to their individual needs and is aware that a variety of situations or events beyond the student's control may affect academic performance. Support is provided to accommodate academic needs in the face of personal difficulties or unforeseen events in the form of Academic Consideration.

Information on regulations and procedures for Academic Consideration, Appeals and Petitions, including categories, grounds, timelines and appeals can be found in [Section VIII (Undergraduate Degree Regulations and Procedures) of the Undergraduate Calendar](https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml).

### 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.

Detailed information regarding the Academic Misconduct policy is available in [Section VIII (Undergraduate Degree Regulations and Procedures) of the Undergraduate Calendar](https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml).

### 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 or a short-term disability should contact the Student Accessibility Services (SAS), formerly Centre for Students with Disabilities (CSD), as soon as possible.

For more information, contact SAS at 519-824-4120 ext. 56208 or email sas@uoguelph.ca or visit the [Student Accessibility Services website (http://www.uoguelph.ca/csd/)](http://www.uoguelph.ca/csd/).

### Course Evaluation Information:

End of semester course and instructor evaluations provide students the opportunity to have their comments and opinions used as an important component in the Faculty Tenure and Promotion process, and as valuable feedback to help instructors enhance the quality of their teaching effectiveness and course delivery.

While many course evaluations are conducted in class others are now conducted online. Please refer to the [Course and Instructor Evaluation Website](https://courseeval.uoguelph.ca/) **for more information.**

### Drop period:

The drop period for single semester courses starts at the beginning of the add period and extends to the Fortieth (40th) class day of the current semester (the last date to drop a single semester courses without academic penalty), March 11, 2016, as listed in [Section III (Schedule of Dates) of the Undergraduate Calendar](https://www.uoguelph.ca/registrar/calendars/).

The drop period for two semester courses starts at the beginning of the add period in the first semester and extends to the last day of the add period in the second semester.

Information about Dropping Courses can be found in [Section VIII (Undergraduate Degree Regulations and Procedures) of the Undergraduate Calendar](https://www.uoguelph.ca/registrar/calendars/undergraduate/current/).

**Additional Course Information**

None