

# School of Environmental Sciences

University of Guelph

# Course Outline Form: Winter 2018

## General Information

### Course code: ENVS3060 Course Title: Groundwater

**Course Description:**

This course provides an understanding of the physical and chemical processes that operate in the groundwater zone under natural and human-induced conditions. The interrelations between the groundwater regime and the other components of the hydrological cycle are studied. Considerable emphasis is placed on the applied aspects of topics such as exploration, testing and development of aquifers for water supply, the chemical quality of groundwater, and the hydrogeological aspects of waste disposal.

### Credit Weight: 0.5

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

**Campus:** Guelph

**Semester Offering:** Winter 2018

**Class Schedule and Location:** Mon, Wed, Friday 11:30 am - 12:20 pm,

### Richards Room 2520

**Instructor Information**

Instructor Name: Asim Biswas Instructor Email: [biswas@uoguelph.ca](mailto:biswas@uoguelph.ca)

Instructor phone and Extension: 519 824 4120 Extn- 54249

Office location and office hours: ALEX 225; set an appointment by email

## GTA Information

GTA Name: Serge Lévesque GTA Email: [serge@uoguelph.ca](mailto:serge@uoguelph.ca)

GTA phone and Extension: 519 824 4120 Extn-

GTA office location and office hours: ECBA Bovey Building room 2103, Mon Friday

12:30 pm – 2:30 pm

## Course Content

### Specific Learning Outcomes:

1. Define physical properties that control flow, storage of water, and contaminant transport in the unsaturated and groundwater zones.
2. Apply knowledge of these physical properties to solving unsaturated and groundwater water flow and contaminant transport problems.
3. Resolve the importance and application of geology in defining groundwater flow.
4. Appreciate the importance of modeling as an effective tool in describing water flow and contaminant transport in unsaturated and groundwater zones.
5. Solve slug and pumping test problems to identify potential aquifers.
6. Identify the various designs and materials used in groundwater well construction.
7. Identify the various instruments used in measuring flow and storage of water in the unsaturated zone.

### Lecture Content:

Approximate Schedule of Lectures and Material

Part 1 (weeks 1 and 2 and half): Physical Properties and Principles of Groundwater and Unsaturated Flow. Chapters. 3, 4, and 6 (Fetter). Porosity, hydraulic conductivity, permeability, hydraulic head, Darcy's Law, lab measurement of hydraulic conductivity, piezometer, aquifer, aquitard, transmissivity, compressibility, effective stress, storativity, specific yield, heterogeneity, anisotropy, unsaturated hydraulic conductivity, soil water characteristic curves.

Part 2 (weeks 3 and 4): Geology of Groundwater, Regional Groundwater Flow, and Groundwater Recharge. Chapters. 6, 7 and 8 (Fetter) Groundwater in glacial deposits and fractured rock, mapping groundwater flow systems, soil water budgets.

Part 3 (weeks 5 and 6): Groundwater and Soil Water Flow Modelling. Chapters. 4 and

1. (Fetter) Equation of continuity (law of conservation of mass), steady-state and transient flow equations, flow nets, groundwater flow computer models, soil water infiltration models.

Part 4 (weeks 7 and 8): Groundwater Resource Evaluation. Chapter. 5. (Fetter) Slug and pumping tests to estimate aquifer parameters and impact of pumping wells.

Part 5 (weeks 9 and 10): Field Methods. Chapters. 6, 10 and 12. (Fetter) Groundwater monitoring, installation of wells, Guelph Ring Infiltrometer, measuring soil water content and pressure head.

Part 6 (weeks 11 and 12): Groundwater Contamination (point and dispersed sources, physical processes of contaminant transport, agricultural impacts). Source Water Protection (contaminant load + vulnerability = groundwater pollution risk).

### Labs: NA Seminars: NA

**Course Assignments and Tests:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Assignment or Test** | **Due Date** | **Contribution to Final Mark (%)** | **Learning Outcomes Assessed** |
| Assignment 1 | Jan 26 | 5 | 1,2 |
| Assignment 2 | Feb 9 | 5 | 3 |
| Midterm | Feb 26 | 30 | 1,2,3 |
| Assignment 3 | Mar 16 | 5 | 4 |
| Assignment 4 | Mar 30 | 5 | 5 |
| Exam | TBA | 50 | 1,2,3,4,5,6,7 |

**Additional Notes (if required):** Winter break (February 19-23)- no classes; Last day of class (April 6)

### Final examination date and time: TBA

**Final exam weighting:** 50%

**Course Resources**

**Recommended Texts:**

The following are on reserve in the library:

* + Applied Hydrogeology, C.W. Fetter
  + Groundwater, Freeze, A. and Cherry, J.
  + Soil Physics, Jury, W. A. and Horton, R.

### Lab Manual: NA Other Resources:

Lecture slides, practice quizzes, old tests and exams, discussions, etc., available on

Courselink.

### Field Trips: NA Additional Costs: NA

**Course Policies**

**Grading Policies**

Assignments are due at the beginning of class on the due date shown above. A penalty of 10% per day will be assessed for late assignments. 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 (with proper justification).

Written Assignments will be marked according to the University of Guelph grade range definitions published in the Undergraduate Calendar and as listed below.

* **80 - 100 (A) Excellent:** An outstanding performance in which the student demonstrates a superior grasp of the subject matter, and an ability to go beyond the given material in a critical and constructive manner. The student demonstrates a high degree of creative and/or logical thinking, a superior ability to organize, to analyze, and to integrate ideas, and a thorough familiarity with the appropriate literature and techniques.
* **70 - 79 (B) Good:** A more than adequate performance in which the student demonstrates a thorough grasp of the subject matter, and an ability to organize and examine the material in a critical and constructive manner. The student demonstrates a good understanding of the relevant issues and a familiarity with the appropriate literature and techniques.
* **60 - 69 (C) Acceptable:** An adequate performance in which the student demonstrates a generally adequate grasp of the subject matter and a moderate ability to examine the material in a critical and constructive manner. The student displays an adequate understanding of the relevant issues, and a general familiarity with the appropriate literature and techniques.
* **50 - 59 (D) Minimally Acceptable:** A barely adequate performance in which the student demonstrates a familiarity with the subject matter, but whose attempts to examine the material in a critical and constructive manner are only partially successful. The student displays some understanding of the relevant issues, and some familiarity with the appropriate literature and techniques.
* **0 - 49 (F) Fail:** An inadequate performance.

### Course Policy on Group Work:

Individual assignments must be submitted by each student.

**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](https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml)  [VIII (Undergraduate Degree Regulations and Procedures) of the Undergraduate](https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml)  [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](https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml)  [VIII (Undergraduate Degree Regulations and Procedures) of the Undergraduate](https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml)  [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](mailto:sas@uoguelph.ca) or visit the [Student Accessibility Services website](http://www.uoguelph.ca/csd/)  [(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) which is listed in [Section III](https://www.uoguelph.ca/registrar/calendars/)  [(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](https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml)  [Degree Regulations and Procedures) of the Undergraduate Calendar](https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml).

## Additional Course Information