School of Environmental Sciences
University of Guelph

Course Outline Form: Winter 2021

General Information

Course code: ENVS3060
Course Title: Groundwater

Course Description:
This course provides an understanding of the physical and chemical properties and processes that operate in the soil-groundwater zone under natural and human-induced conditions. The interrelations between the groundwater regime and the other components of the hydrological cycle particularly connecting to soil and soil water are studied.

Credit Weight: 0.5

Academic Department (or campus): School of Environmental Sciences

Campus: Guelph

Semester Offering: Winter 2021

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

Instructor Information

Instructor Name: Asim Biswas
Instructor Email: biswas@uoguelph.ca
Instructor phone and Extension: 519 824 4120 Extn- 54249 (Cell +1 519 731 6252)
Office hours: Wednesday after class- 12:20 pm – 1:15 pm in Microsoft Teams
(continued from class link) or by appointment

GTA Information

GTA Name: Reem Zeitoun
GTA Email: rzeitoun@uoguelph.ca
GTA Phone: Cell +1 289 700 3670
GTA office hours: Monday and Friday 12:30 pm - 1:30 pm or set up an appointment vis Email
Course Content

Specific Learning Outcomes:
1. Define physical properties that control flow, storage of water, and contaminant transport in the unsaturated (soil) and groundwater zones.
2. Apply knowledge of these physical properties to understand unsaturated and groundwater flow (with some examples of contaminant transport problems).
3. Resolve the importance and application of geology in defining groundwater flow.
4. Brief introduction to the importance of modeling as a tool in describing water flow and contaminant transport in unsaturated and groundwater zones.
5. Solve soil water and groundwater flow problems (e.g. unsaturated flow in root zone to saturated flow in groundwater, slug and pumping test problems to identify potential aquifers).
6. Knowing basis for groundwater well construction.
7. Introduction to various instruments used in measuring soil and groundwater properties and flow and storage of water in the unsaturated zone.

Lecture Content:
Approximate Schedule of Lectures and Material

Part 1 (weeks 1 to 4): Physical Properties and Principles of Groundwater and Unsaturated Flow. Chapters. 3, 4, and 6 (Fetter). Bulk soil properties, porosity, soil water, potentials, surface tension, soil water characteristic curves, saturated and unsaturated hydraulic conductivity, permeability, hydraulic head, Darcy’s Law, heterogeneity, anisotropy, piezometer, aquifer, aquitard, transmissivity, compressibility, effective stress, storativity, specific yield

Part 2 (weeks 5 to 6): Geology of Groundwater, Regional Groundwater Flow, and Groundwater Recharge. Chapters. 6, 7 and 8 (Fetter) Texture and parent materials, methods to characterize soil texture, geologic heterogeneity, Groundwater in glacial deposits and fractured rock, mapping groundwater flow systems.


Part 5 (weeks 12): Field Methods. Chapters 6, 10 and 12. (Fetter) Groundwater monitoring, well components and installation of wells, Guelph Ring Infiltrometer, measuring deep drainage.

Part 6 (weeks 13): Groundwater Contamination (point and dispersed sources, physical processes of contaminant transport, agricultural impacts), pollution vs contamination, sources and causes of pollution, transport processes, removal/containment, well head protection, groundwater vulnerability.

Labs: NA

Seminars: NA

Course Assignments and Tests:

<table>
<thead>
<tr>
<th>Assignment or Test</th>
<th>Due Date</th>
<th>Contribution to Final Mark (%)</th>
<th>Learning Outcomes Assessed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assignment 1</td>
<td>Feb 5</td>
<td>10</td>
<td>1,2</td>
</tr>
<tr>
<td>Assignment 2</td>
<td>Feb 22</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>Midterm</td>
<td>Feb 26</td>
<td>30</td>
<td>1,2,3</td>
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<tr>
<td>Assignment 3</td>
<td>Mar 26</td>
<td>10</td>
<td>4</td>
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<tr>
<td>Assignment 4</td>
<td>Apr 9</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Exam</td>
<td>April 22</td>
<td>30</td>
<td>1,2,3,4,5,6,7</td>
</tr>
</tbody>
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Additional Notes (if required):
First day of class- January 11
Winter break (no classes)- February 15-19
Last day to drop the class (40th day of class)- March 12.
Last day of class- April 12

Final examination date and time: April 22, 2021, 2:30-4:30 pm (Online)

Final exam weighting: 30%

Course Resources

Recommended/Supporting 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.
- Soil Physics: Agricultural and Environmental Applications, H. Don Scott
- Canada’s Groundwater Resources, Alfonso Rivera

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 the class on the due date shown above through Dropbox. The Dropbox online submission will have closing date and time. A penalty of 10% of the Assignment mark per day will be imposed for late submission. Please inform the instructor well in advance if you are unable to submit an assignment on time or attend the midterm test (with proper justification/proofs).

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 VIII (Undergraduate Degree Regulations and Procedures) of the Undergraduate Calendar.

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.
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/).

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 for more information.

Drop period:
The drop period for single semester courses starts at the beginning of the add period and extends to the 40th class day (12th March 2021) of the current semester (the last date to drop a single semester courses without academic penalty) which is listed in Section III (Schedule of Dates) of the Undergraduate Calendar.

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.

Additional Course Information