

**WESTERN UNIVERSITY - FACULTY OF ENGINEERING
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING**

**CEE 9870 – Groundwater Flow and Contaminant Transport
Course Outline 2019/20**

Objectives:

This course is an advanced course in groundwater flow and subsurface contamination. The general objectives are for the student to develop and understanding of:

- Groundwater and its role in the hydrologic cycle
- Water movement in geological formations
- Analytical solutions for flow problems
- Subsurface characterization and the need of accurate conceptual site models
- Contamination of subsurface water and sources of pollution
- Numerical solutions to groundwater flow and mass transport equations
- Current and future issues facing groundwater management

This course also strives to improve communication skills through (i) open interactions in class, (ii) written assignments and project, and (iii) oral presentation on a key topic in the course (e.g., current approaches for aquifer evaluation or contaminant remediation).

Topics:

The following topics will be covered during this course:

- Groundwater
- The Hydrologic Cycle
- Near Surface Environment
- Groundwater Flow
- Groundwater Flow Equations
- Well Hydraulics
- Field Investigations and Aquifer Evaluation
- Groundwater Flow Modeling
- Groundwater Contamination
- Mass Transport Processes and Equations
- Multiphase Flow
- Groundwater Remediation

Prerequisites:

An introductory course in hydrogeology. In exceptional circumstances, by permission of the instructor.

Corequisites:

None

Antirequisite:

None

Note: It is the **student's responsibility** to ensure that all Prerequisite and Corequisite conditions are met or that special permission to waive these requirements has been granted by the Faculty. It is also the **student's responsibility** to ensure that they have not taken a course listed as an Antirequisite. The student may be dropped from the course or not given credit for the course towards their degree if they violate the Prerequisite, Corequisite or Antirequisite conditions.

Instructor:

Dr. Christopher Power, cpower24@uwo.ca, SEB 3039A

Administrative Support:

Kristen Edwards, SEB 3118

Contact Hours:

3 lecture hours: Monday (1:30PM–3:30PM in ACEB 1415) and Thursday (1:30PM–2:30PM in SEB 2099)

1 tutorial hour: Thursday (2:30PM–3:30PM in SEB 2099)

Course Materials:*Course Notes:*

No textbook required. Prepared class notes will be provided on the course OWL site and should be downloaded and brought to each class.

Supplementary References:

Pinder, G.F. and Celia, M.A. 2006. Subsurface Hydrology. Wiley-Interscience, New York.

Domenico, P.A. and Schwartz, F.W. 1998 Physical and Chemical Hydrogeology. 2nd Edition. Wiley and Sons, New York.

Fetter, C.W. 2001. Applied Hydrogeology. 4th Edition. Merrill Publishing Co.

Fetter, C.W. 1993. Contaminant Hydrology. 2nd Edition. Prentice-Hall, Inc.

Units:

SI units will be used in lectures and examinations.

Evaluation:

The final course mark will be determined as follows:

Participation	5%
Assignments	20%
Midterm	20%
Project	15%
Final Examination	40%
Total	100%

- Note:* (a) **Students must pass the final examination to pass this course.** Students who fail the final examination will be assigned the aggregate mark, as determined above, or 48%, whichever is less.
- (b) **Students must turn in their assignments and achieve a passing grade in this component, to pass this course.** Students who do not satisfy this requirement will be assigned 48% or the aggregate mark, whichever is less.
- (c) **Students who have failed this course previously must repeat all components of the course.** No special permissions will be granted enabling a student to retain assignment or test marks from previous years. Previously completed assignments and laboratories cannot be resubmitted.

1. Examinations:

One midterm examination (2 hours) will be held during the lecture/tutorial period on February 13, 2020. The final examination (3 hours) will be held during Western's examination period in April 2020. The examinations will be **CLOSED BOOK** and a sheet will be provided containing necessary equations. **No programmable calculators or other external sources of information, including books, notes or crib sheets, are permitted.** A list of acceptable calculators for closed book exams will be posted on the bulletin board across from the Department of Civil and Environmental Engineering Office: please be sure your calculator is on it!

2. Assignments

Three assignments will be scheduled during the term. Assignments are to be done individually. Each assignment will be posted on the OWL course website on specified weeks. The tutorial for working on the assignments will be on the Thursday (2:30PM–3:30PM). You should review the assignment before the tutorial and may only ask for assistance on a question you have attempted.

Late Assignments: Late assignments will be accepted for 3 days following their due date. 10% per day will be deducted for late assignments. An assignment will not be accepted after 3 days. Extensions are to be negotiated with Dr. Power. If no assignment is received for a student, the mark assigned is zero for that assignment. The maximum number of missed assignments for each student will be one; if more than one assignment is missed then a student may be barred from writing the final exam.

Plagiarism on Assignments: Each person must hand in an assignment that contains only their own work. If an assignment is deemed to be similar to another assignment, this will be taken as a case of plagiarism. In such circumstances, both individuals (e.g., the person providing the answer and the person copying it) will both receive a mark of zero on the entire assignment. For a first offense, both individuals will receive a personal warning and the infraction will be recorded. For a second offense, further action will be taken.

3. Project

Students will conduct a project and present their findings via an oral presentation to the class on a specialized topic relevant to the course.

4. Participation

As part of the course mark breakdown, 5% will be allocated to student participation in class. Participation is an important component of this course and will be assessed by attendance and interaction in the lectures.

5. Use of English

In accordance with Senate and Faculty Policy, students may be penalised up to 10% of the marks on all assignments, tests, and examinations for the improper use of English. Additionally, poorly written work with the exception of the final examination may be returned without grading. If resubmission of the work is permitted, it may be graded with marks deducted for poor English and/or late submission.

Plagiarism:

University policy states that plagiarism, defined as the “act or an instance of copying or stealing another’s words or ideas and attributing them as one’s own.” (excerpted from Black’s Law Dictionary, West Group, 1999, 7th ed., p. 1170) is a scholastic offence. In submitting any written work as part of the coursework requirements for this course students must ensure that this work is written in their own words. Whenever students take an idea or a passage of text from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations.

All required papers may be subject to submission for textual similarity review to the commercial plagiarism-detection software under license to the University for the detection of plagiarism. All papers submitted for such checking will be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between The University of Western Ontario and Turnitin.com (<http://www.turnitin.com>).

A student who is found guilty of plagiarism in respect of any written work submitted as part of the coursework requirements for this course will be given a grade of zero for the submitted work. Repeated acts of plagiarism, either in this course or any other course subsequent to a first offence, will result in the student being given a failing grade for the course in which the subsequent offence occurs, and may also incur further penalties such as requiring the student to withdraw from the program in which they are enrolled in.

Cheating:

University policy states that cheating is a scholastic offence. The commission of a scholastic offence is attended by academic penalties that might include expulsion from the program. If you are caught cheating, there will be no second warning.

For more information on scholastic offenses, please see:

http://www.uwo.ca/univsec/handbook/appeals/scholastic_discipline_undergrad.pdf

Attendance:

Any student who, in the opinion of the instructor, is absent too frequently from class or tutorial periods will be reported to the Dean (after due warning has been given). On the recommendation of the Department concerned, and with the permission of the Dean, the student will be debarred from taking the regular final examination in the course.

Information regarding iClicker Cloud:

Classroom Polling: We will be using iClicker Cloud, a cloud-based student response software, in class this semester. This will help me understand what you know, give everyone a chance to participate in class, and provide more interaction on concepts and example questions. We will also use this software to keep track of attendance. At the start of every class you will register your attendance; only after you do this will you be able to answer any poll questions posted.

You are required to bring a device connected to the university Wi-Fi to participate in iClicker Cloud during class, including a smartphone, tablet, laptop or iClicker remote. You will need to create an iClicker Reef Student account to participate in class.

Creating Your iClicker Reef Student Account: Go to iclicker.com/students or download the iClicker Reef Student app for your Apple or Android device to sign up for a Reef account. You should use your university email address and your University ID (e.g., “cpower24” for student cpower24@uwo.ca) in the Student ID field. You can edit your email address, password, or student ID from your account profile. Do not create and use more than one Reef account as you will only receive credit from a single account.

You do not need to purchase anything – iClicker Cloud is fully supported by Western and is free to all its students. Make sure you choose Western University Ontario when signing up.

Add This Course to Your Reef Account

Search with the following information to find this course and add it to your Reef account:

Institution: **Western University Ontario**

Course: **CEE 9870 GW_Flow_Cont_Transport**

Use of laptop computers, tablets or smart mobile phones:

Use of laptop computers, tablets or smart mobile phones is expected to be for the purpose of participating in the lecture explicitly. They can be used to fill in the gapped notes, participate in class polls, and to register your attendance. Students using the devices for activities not related to this class may be asked to leave.

Accessibility:

Please contact the course instructor if you require material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at (519) 661-2111 x82147 for any specific question regarding an accommodation.

Conduct:

Students are expected to arrive at lectures on time, and to conduct themselves during class in a professional and respectful manner that is not disruptive to others. Late comers may be asked to wait outside the classroom until being invited in by the Instructor. Please turn off your cell phone before coming to a class, tutorial, quiz or exam.

On the premises of the University or at a University-sponsored program, students must abide by the Student Code of Conduct: <http://www.uwo.ca/univsec/board/code.pdf>

Sickness and Other Problems:

Students should immediately consult with the Instructor or Department Chair if they have any problems that could affect their performance in the course. Where appropriate, the problems should be documented (see attached). The student should seek advice from the Instructor or Department Chair regarding how best to deal with the problem. Failure to notify the Instructor or Department Chair immediately (or as soon as possible thereafter) will have a negative effect on any appeal.

For more information concerning medical accommodations, please see:

http://www.uwo.ca/univsec/handbook/appeals/accommodation_medical.pdf

There will be no make-up midterm exam nor assignments. If you are unable to write a test for medical or compassionate reasons, you must provide the appropriate documentation to the CEE Graduate Coordinator (SEB 3118). Upon recommendation from the service office, the weighting of the final exam will be adjusted accordingly. Failure to provide the adequate documentation will result in a mark of 0 for the missed exam/assignment.

Graduate Student Health and Wellness:

As part of a successful graduate student experience at Western, we encourage students to make their health and wellness a priority. Western provides several on campus health-related services to help you achieve optimum health and engage in healthy living while pursuing your graduate degree. For example, to support physical activity, all students, as part of their registration, receive membership in Western's Campus Recreation Centre. Numerous cultural events are offered throughout the year. Please check out the Faculty of Music web page <http://www.music.uwo.ca/>, and our own McIntosh Gallery <http://www.mcintoshgallery.ca/>. Information regarding health- and wellness-related services available to students may be found at <http://www.health.uwo.ca/>.

Students seeking help regarding mental health concerns are advised to speak to someone they feel comfortable confiding in, such as their faculty supervisor, their program director (graduate chair), or other relevant administrators in their unit. Campus mental health resources may be found at http://www.health.uwo.ca/mental_health/resources.html. To help you learn more about mental health, Western has developed an interactive mental health learning module, found here: http://www.health.uwo.ca/mental_health/module.html. This module is 30 minutes in length and provides participants with a basic understanding of mental health issues and of available campus and community resources. Topics include stress, anxiety, depression, suicide and eating disorders.

After successful completion of the module, participants receive a certificate confirming their participation.

Or contact your Departmental Graduate Coordinator, or the Course Instructor. If you feel you need help of some kind, do not hesitate to reach out. We are all here to help you overcome challenges and be healthy and successful. We can only help if you let us know.

Student Accessibility Services:

Western is committed to achieving barrier-free accessibility for all its members, including graduate students. As part of this commitment, Western provides a variety of services devoted to promoting, advocating, and accommodating persons with disabilities in their respective graduate program.

Graduate students with disabilities (for example, chronic illnesses, mental health conditions, mobility impairments) are encouraged to register with Student Accessibility Services, a confidential service designed to support graduate and undergraduate students through their academic program. With the appropriate documentation, the student will work with both SAS and their graduate programs (normally their Graduate Chair and/or Course instructor) to ensure that appropriate academic accommodations to program requirements are arranged. These accommodations include individual counselling, alternative formatted literature, accessible campus transportation, learning strategy instruction, writing exams and assistive technology instruction. For more information, see <http://www.sdc.uwo.ca/ssd/>

Notice:

Students are responsible for regularly checking their email, course website (<https://owl.uwo.ca>) and notices posted outside the Civil and Environmental Engineering Department Office.