

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

**CEE 9870 – Groundwater Flow and Contaminant Transport
Course Outline – Winter 2021**

DESCRIPTION

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

PREREQUISITIES

It is expected that students will have basic understanding of hydrogeology and contaminant hydrology. Students without a suitable background in these topics must consult with the instructor prior to registering for the course.

CONTACT INFORMATION

Course instructor: Dr. Christopher Power

Email address: cpower24@uwo.ca

Contact policy:

- Contact instructor via email (above) or through messages in OWL
- Weekly 2-hour tutorials are held via Zoom
- A general FAQ section on the ‘forums’ section of OWL will be used for students to pose course-related questions so that all have the same information.

Teaching assistant: Angelos Almpanis

Email address: aalmpani@uwo.ca

Contact policy:

- Contact instructor via email (above) or through messages in OWL
- Weekly 2-hour tutorials are held via Zoom
- A general FAQ section on the ‘forums’ section of OWL will be used for students to pose course-related questions so that all have the same information.

Administrative support: Eduard Sviridenko

Email address: esviride@uwo.ca

LECTURE AND TUTORIAL HOURS

3 lecture hours: Wednesday (9:30AM–11:30AM) and Thursday (9:30AM–10:30AM)

Lectures will be delivered synchronously through Zoom each week during the scheduled hours. All lectures will be recorded and posted to the course OWL site. Lectures will be organized into learning modules which students should review on a weekly basis. Review of lecture material and self-study should take approximately 5 hours per week. **Completion of this course will require you to have a reliable internet connection.**

2 tutorial hours: Thursday (10:30AM–12:30PM).

Tutorials will be delivered synchronously through Zoom on selected weeks during the scheduled hours.

COURSE MATERIALS

Prepared class notes will be provided on the course OWL site.

No textbook is required but the following list are suggested 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.

COMPUTING

One of the assignments will require the use of PMWIN 5.3.1 (pre-processor for MODFLOW and MT3DMS). PMWIN 5.3.1 is freely available to download from

<http://www.pmwin.net/pmwin5.htm>. It will also be available on Western computer laboratories, which can be accessed remotely through Western Engineering Virtual Private Network (VPN) (<https://www.eng.uwo.ca/itg/software/virtual-private-network.html>).

ASSESSMENTS

The final course mark will be determined as follows:

Participation	5%
Assignments	20%
Midterm	20%
Project	15%
<u>Final Examination</u>	<u>40%</u>
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. 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 and/or the forums on OWL.

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 Thursday (10:30AM–12:30PM). 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 the course instructor. 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. Midterm and Final Examinations:

One midterm examination (2 hours) will be held during the lecture/tutorial period on February 25, 2021. The final examination (3 hours) will be held sometime during the week starting April 12, 2021.

The examinations will be **OPEN BOOK**. **The midterm and final examinations will be conducted synchronously through Zoom, with the course instructor and teaching assistant performing remote proctoring via webcam. You must ensure you have a webcam and microphone to meet this requirement.** See below for more information on Online Proctoring.

4. Project

Students will conduct a project on a specialized topic relevant to the course. They will present their findings through an annotated bibliography, summary sheet and oral presentation (via Zoom) to the class. **You must ensure you have a webcam and microphone to meet this requirement.**

Activities in which collaboration is permitted:

- Assignments: students are encouraged to ask their questions or provide hints to solve given problems using the forums on OWL, or in tutorials. Students are not allowed to copy assignments, which will be considered plagiarism.
- Projects: students within each group are encouraged to closely collaborate on their projects.

Activities in which students must work alone (collaboration is not permitted):

- Midterm exam
- Final exam

UNITS

SI units will be used in lectures and examinations.

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**

COURSE CONTENT

The lecture notes and online lecture videos are copyrighted to the instructor and legally protected. Do not post these videos and lecture notes on any other website or online forums. The recording of the live/synchronous sessions of the course without the permission from the instructor is prohibited. The illegal posting and sharing of the copyrighted course content could be subjected to legal actions.

ONLINE PROCTORING NOTICE

The midterm and final examination in this course will be conducted using Zoom. You will be required to keep your camera on for the entire session, hold up your student card for identification purposes, and share your screen with the invigilator if asked to do so at any time during the exam. The exam session will not be recorded.*

More information about the use of Zoom for exam invigilation is available in the Online Proctoring Guidelines at the following link: <https://www.uwo.ca/univsec/pdf/onlineproctorguidelines.pdf>

Completion of this course will require you to have a reliable internet connection and a device that meets the system requirements for Zoom. Information about the system requirements are available at the following link: <https://support.zoom.us/hc/en-us>

* Please note that Zoom servers are located outside Canada. If you would prefer to use only your first name or a nickname to login to Zoom, please discuss this with your instructor in advance of the test or examination.

CHEATING, PLAGIARISM/ACADEMIC OFFENCES

Academic integrity is an essential component of learning activities. Students must have a clear understanding of the course activities in which they are expected to work alone (and what working alone implies) and the activities in which they can collaborate or seek help; see information above under “Assessments” and ask instructor for clarification if needed. Any unauthorized forms of help-seeking or collaboration will be considered an academic offense. University policy states that cheating is an academic offence. If you are caught cheating, there will be no second warning. Students must write their essays and assignments 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. Plagiarism is a major academic offence. Academic offences are taken seriously and attended by academic penalties which may include expulsion from the program. Students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence (see Western's scholastic discipline regulations for graduate students).

SYNCHRONOUS LEARNING ACTIVITIES

Students are expected to participate in synchronous learning activities as outlined in the course syllabus and/or described by the instructor. If you have issues that will impede your ability to participate in synchronous activities, please discuss with the course instructor at the beginning of the course.

CONDUCT

Students are expected to follow proper etiquette during synchronous and asynchronous activities to maintain an appropriate and respectful academic environment. Any student who, in the opinion of the instructor, is not appropriately participating in the synchronous and asynchronous learning activities and/or is not following the rules and responsibilities associated with the online learning activities, will be reported to the Associate Dean (Graduate) (after due warning has been given). On the recommendation of the Department concerned, and with the permission of the Associate Dean (Graduate), the student could be debarred from completing the assessment activities in the course as appropriate.

HEALTH/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 health and wellness related services (remotely accessible) to help you achieve optimum health and engage in healthy living while pursuing your graduate degree. 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 or <https://www.uwo.ca/health/psych/index.html>

SICKNESS

Students should immediately consult with the Instructor (for a particular course) or Associate Chair (Graduate) (for a range of courses) if they have problems that could affect their performance. The student should seek advice from the Instructor or Associate Chair (Graduate) regarding how best to deal with the problem. Failure to notify the Instructor or the Associate Chair (Graduate) immediately (or as soon as possible thereafter) will have a negative effect on any appeal. Obtaining appropriate documentation (e.g., a note from the doctor) is valuable when asking for accommodation due to illness.

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 Accessible Education at 661-2111 x 82147 or http://academicsupport.uwo.ca/accessible_education/index.html, for any specific question regarding an accommodation.