

Geology 4440a/b, Fundamentals of Ground Water Flow and Contaminant Transport – Winter 2015 –

Description: Occurrence, distribution, movement, chemistry and composition of ground water as a function of the geological environment; water quality and ground water contamination; collection and evaluation of hydrogeologic data; modeling ground water flow and advective transport; case histories. A strong linkage between theory and practice will be maintained and a quantitative approach will be used. The study of ground water is interdisciplinary in nature and is pertinent to many fields including geological sciences, hydrology, soil science, geography, ecology, and agricultural, geotechnical, mining and petroleum engineering.

Prerequisites: Earth Science 3340a/b, or CEE 3326, or 80% in Geography 3342a/b, or permission of the department. (0.5 course)

- *Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.*
- *Accessibility Statement: Please contact the course instructor if you require material in an alternate format or if you require any other arrangements to make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 x 82147 for any specific question regarding an accommodation.*

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Course Outline: Lecture Topics

- 1) Ground water and the hydrologic cycle
- 2) Principles of ground water flow
- 3) Geology and ground water
- 4) Hydrostratigraphy, aquifers and confining units
- 5) Field mapping of hydraulic head and flow
- 6) Theory of ground water flow - equations
- 7) Theory of ground water flow – boundary conditions & flownets
- 8) Flow in unsaturated zones and fractured media
- 9) Hydrogeologic site investigation tools and techniques
- 10) site investigations – drilling techniques
- 11) site investigations – water sampling techniques
- 12) Flow system delineation and regional ground water flow
- 13) Regional ground water flow – case studies
- 14) Ground water – surface water interactions
- 15) Ground water flow to wells – storage, aquifer types
- 16) Response of confined aquifers to pumping
- 17) Response of leaky aquifers to pumping
- 18) Response of unconfined aquifers to pumping
- 19) Slug and step testing of aquifers and aquitards
- 20) Ground water geochemistry – dissolved mass & data analysis
- 21) Key reactions influencing ground water chemistry
- 22) Basics of mass transport – advection
- 23) Basics of mass transport – dispersion and diffusion
- 24) Intro. to contaminant hydrogeology – dissolved mass
- 25) Intro. to contaminant hydrogeology – NAPL's
- 26) Mass transport: economic mineral deposits & petroleum hydrogeology

Laboratory Exercises

- basic flow calculations
- determining permeability
- mapping flow; piezometers
- flownets
- demonstration exercises
- case study flow delineation
- well hydraulics lab 1
- well hydraulics lab 2
- well analysis software
- ground water modelling

Text: Fundamentals of Ground Water, Schwartz and Zhang, Wiley, 2003, ISBN 978-0-471-13785-6

Text is required and should be brought to class as text readings, figures, and example problems will be gone over in class on a regular basis.

Lectures/Lab: 2 lecture hours and 2 laboratory hours per week
lectures (SSC 3010) – Mon. 9:30 to 11:20 a.m.
laboratory – Mon. 2:30 to 4:30 p.m. - BGS 0184

Marking Scheme: Hand-in assignments & presentation 40%
Midterm* (110 min) 30% Feb. 23 in-class
Final Exam* (2 hrs) 30%

Lecture Material: The text portion of the lecture presentation slides will be made available on OWL. Figures used in the lectures come from the textbook, various web links, government sources, or various consulting reports. Text figures, or material with disclosure issues (e.g. consulting reports), will not be posted on OWL. You are expected to attend lectures and make additional notes to augment the text provided. The main purpose of the lectures is to help you understand key hydrogeological parameters & processes and the techniques used to quantify these. The labs are where you apply the techniques. Case studies / consulting reports give you the real world application of these techniques.

Assignments: Assignments are directly tied to lecture topics; usually a given lab assignment involves material discussed during the previous week(s) in lecture. Help with assignments and some lecture material on assignments will be given during laboratory session. Assignments will be available on OWL along with lecture notes. Many of the exercises will involve spread sheet programs (MS Excel) or aquifer analysis software. Any assignments handed in past the due date will be subject to a penalty of 20% per late day (if you have exceptional circumstances contact Dr. Schincariol prior to due date via email). NOTE: The majority of marks for questions are given for problem setup, assumptions, solution approach, and proper use of significant figures and units. Simply writing down a formula (or providing an Excel output) and giving the answer, even if correct, will not result in full marks.

Labs 1 to 4 are one week labs and worth 4% each. Lab 5 is a two week lab and worth 8%. Lab 6 is a major group assignment (three week lab with interim hand-in & presentation requirements) and worth 16%. Problems may also be assigned either during the lab or lecture for which answers will be posted on-line or provided in textbook (note: while these problems will not be marked it is very important they are completed as they provide for the practical application of lecture material). You should use your time in the lab to both complete the assigned problems and go over any difficulties you had with the previous week's labs. Students who do not use the assigned lab times for inquiries should not expect additional help from the teaching assistant and/or professor.

* Exams & tests will be closed book (definitions; short answer; calculations). Bring pencil, ruler, eraser, and basic calculator (basic math & geometry functions; but no extensive non-volatile memory capability). A calculator is to be used for calculations only and not storage of information - any recall of such stored information will be considered a scholastic offense (cheating). Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site: http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf

➤ If you are unable to meet a course requirement due to illness or other serious circumstances, you must provide valid medical or other supporting documentation to the Dean's office as soon as possible and contact your instructor immediately. It is the student's responsibility to make alternative arrangements with their instructor once the accommodation has been approved and the instructor has been informed. In the event of a missed final exam, a "Recommendation of Special Examination" form must be obtained from the Dean's Office immediately. For further information please see the Policy on Accommodation for Medical Illness at: <https://studentservices.uwo.ca/secure/index.cfm>

➤ For work worth less than 10% (e.g. individual assignments) if accommodation is required for medical or non-medical reasons email the instructor. In these cases either an extension will be given or a re-weighting to other components of the course – at the instructors discretion – will be done.