GEOG 303
Physical Hydrology

(Tentative Version)

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Calendar Description

Fundamental processes in physical hydrology are addressed. Components of the water balance are examined to determine the nature of their variation in time and space. Precipitation, interception, infiltration, groundwater and soil water processes, evapotranspiration, runoff and storage will be examined from a theoretical and practical viewpoint, and their linkages demonstrated by lab and fieldwork.

Objectives of the Course

This course has a strong field and lab component that will provide hands-on experience to familiarize students with techniques and methods that are employed in the workplace and in research. You will learn how to construct, measure and interpret a water budget, based on real measurements of water budget components, and understand the theory associated with each component. You will be able to read and understand technical report and journal articles on fundamental aspects of physical hydrology.

Format of the Course

- Lectures 2h/w 8:30-10:20 Monday EV1 350
- Lab 2h/w 8:30-10:20 Tuesday EV3 3412

Evaluation

Lab exercises	40% (15+15+10)
Term Assignment	30%
Tests (10% each)	30% (best 3 of 5)

Required Text

Hendriks, M.R. (2010) Introduction to Physical Hydrology. Oxford University Press, 331p.

Lectures

Lectures will follow the itinerary set out below as much as possible. Material will be drawn from a variety of sources, but mainly from the assigned text and readings provided. Additionally, there are links to web resources provided in the "Course Organization Table" below. This table will be updated weekly (on LEARN) as lecture materials, labs, etc. approach. Slides used in the lectures will be available before the lecture, so you may use them for taking notes, if you wish (strongly recommended). You are expected to read the relevant section of text in advance of the lecture.

Term Assignment and Labs

The Field Trip* and Labs will provide students an opportunity to see and measure some of the important hydrological processes. The objective is to collect samples and data that will be used in the Labs and ultimately for the Term Assignment**. You will be required to meet outside EV2 at the designated time for the bus. Students require appropriate dress, including rubber boots and miscellaneous items noted by the instructor in advance of the lab (e.g. field book). **Students who miss the fieldwork are required to organize their own visit to perform the designated tasks.** The Labs will be done and submitted in groups of two. The Term Assignment may also be submitted by the group, or individually if desired. **The penalty for late labs or the term assignment is 10% per day (including weekends).**

If you cannot attend the field trip you must submit a paper (~1500 words + diagrams and references) reviewing methodologies for measuring hydraulic conductivity (one of the important tasks you will be missing), and unsaturated hydraulic conductivity. You will be supplied data to complete the term assignment, but this must be done on your own (not in a group).

***Field Trip:** There will be an all-day field trip on **TBA** to Luther bog, near Arthur, Ontario. Travel time ~45 minutes. Field trip fees may be applicable.

****Term Assignment:** The Term Assignment is to write a report on the water budget of Luther bog. Instrumentation has been set up to continuously measure rainfall, (data to calculate) evapotranspiration, water table and soil moisture. On the field day you will measure water table, hydraulic conductivity and other characteristics of the system, to estimate groundwater discharge. The term assignment incorporates the data analysis and interpretation you have done in the labs, set into a technical report in the style of a research paper.

Students are expected to be proficient in the use of a spreadsheet (e.g. Excel).

Course Organization (Tentative – updated on LEARN)

Monday	Tuesday
Sept 12 Course Organization Overview of the Local Hydrological Environment.	**Sept 14** Global to Local Scale Water Budgets *Hendriks Sec. 1.3 and 1.4; Price and Maloney, 1994. Nordic Hydrol. 25, 313-330*
Sept 19 Introduction to Groundwater Processes *Hendriks p. 49-70* *Additional Reading: 1) Origin, Occurrence and Movement of Ground Water*	**Sept 21** Groundwater Systems: Measuring and Quantifying Flow in porous media. *Hendriks Sec. 3.11& 3.12* **Test 1 Groundwater Processes (online 1 week)**
Sept 26 Soil Water Processes *Hendriks Sec. 4.0 – 4.5;* *Additional Readings: 1) SW Basics, 2) SW Ret'n*	**Sept 28** Soil Water Movement. *Hendriks Sec. 4.6-4.8 (to p.170), 4.9. Additional Reading: 1) SW Movement.*
Saturday October 1 Field Trip	
Oct 3 Lab 1 Help Session (and labwork)	**Oct 5** *Groundwater Case Study* **Test 2 Soil Water Processes (online 1 week)**
Oct 17 (makeup day for Oct 12) Thanksgiving – no class (now Sat. Nov. 21)	**Oct 19** Soil Water Case Study Lab 1 Help
Oct 24 Lab 1 due Lab 2 Labwork	**Oct 26** Atmospheric Processes: Energy Balance and Evapotranspiration. *Hendriks Sec. 2.6&2.7; Box 2.12 (esp. p.39 on energy budget); and Box 2.13.*
Oct 31 Atmospheric Processes: Evapotranspiration (continued) Evaporation Case Study	**Nov 2** Lab 2 Help **Test 3 Atmospheric Processes (online 1 week)**
Nov 2 Lab 2 due Lab 3. Evaporation Analysis	**Nov 3** **Water Budget Assignment** Atmospheric Processes: Precipitation and Interception. *Hendriks Sec. 2.4&2.5; Box 5.10*
Nov 7 Snow Hydrology: *Reading TBA*	**Nov 9** Lab 3 & Water Budget Assignment Help Session
Nov 14 Lab 3 due Catchment and Hillslope: *Hendriks Sec. 5.5; TBA* **Test 4 Runoff processes (online 1 week)**	**Nov 16** Streamflow Character and Analysis. *Hendriks p.244; TBA* Runoff Case Study
Nov 21 Water Quality, Contaminant Hydrology *Reading TBA*	**Nov 23** Water Quality/Contamination Case Study
Nov 28 TBA **Test 5 Water Quality (online until Dec 5)**	**Nov 30** Water Budget Assignment Help Session
Dec 5 Water Budget (Term) Assignment due	

Academic Honesty

Academic Integrity: To create and promote a culture of academic integrity, the behaviour of all members of the University of Waterloo is based on honesty, trust, fairness, respect and responsibility.

Grievance: A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. Read Policy 70 - Student Petitions and Grievances, Section 4, http://www.adm.uwaterloo.ca/infosec/Policies/policy70.htm

Discipline: A student is expected to know what constitutes academic integrity, to avoid committing academic offenses, and to take responsibility for his/her actions. A student who is unsure whether an action constitutes an offense, or who needs help in learning how to avoid offenses (e.g., plagiarism, cheating) or about "rules" for group work/collaboration should seek guidance from the course professor, academic advisor, or the Undergraduate Associate Dean. When misconduct has been found to have occurred, disciplinary penalties will be imposed under Policy 71 – Student Discipline. For information on categories of offenses and types of penalties, students should refer to Policy 71 - Student Discipline, http://www.adm.uwaterloo.ca/infosec/Policies/policy71.htm

Appeals: A student may appeal the finding and/or penalty in a decision made under Policy 70 - Student Petitions and Grievances (other than regarding a petition) or Policy 71 - Student Discipline if a ground for an appeal can be established. Read Policy 72 - Student Appeals, http://secretariat.uwaterloo.ca/Policies/policy72.htm