NRSM 385 Watershed Hydrology

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Course Time & Location:
T/R 8:00 – 9:20
FOR 305

Office Hours:
Jencso: Tuesday 12:00 – 1:00

Course Description:

This course provides an introduction to watershed hydrology. We examine how rainfall and snowmelt become streamflow, evapotranspiration and groundwater with an emphasis on the hydrological processes in Western U.S. watersheds. Topical areas include: the hydrologic cycle and water balances, evapotranspiration and snow energy balances, vadose zone hydrology, hydrogeology, hyporheic zones, riparian zones, streamflow generation mechanisms, biogeochemical budgets, and field measurement techniques. Watershed hydrology is by nature an interdisciplinary science and linkages between physical hydrology and broader ecological and environmental sciences will be highlighted. **Mathematical analysis and writing assignments will be an integral part of this course.**

Learning Outcomes:

This course will introduce students to basic and emerging concepts in watershed hydrology. Students will obtain an understanding of: 1) the importance of water as a resource, both from a human perspective and in terms of its importance in the natural environment; 2) the water cycle, including the magnitude of the various above and below ground fluxes and storage; 3) the hydrologic processes that make up the water cycle, including precipitation, snowmelt, evapotranspiration, infiltration, percolation, groundwater recharge, discharge, and streamflow; 4) human impacts on water quantity and quality including effects of climate change, land use activities such as forest harvest, road construction, urban development, and natural disturbance events such as wildfire.

Grading:

1) Problem sets (40%)
2) 3 Exams (50%)
3) Quizzes and in class participation (10%)

The three midterm exams will test your knowledge of material covered up to that point (see schedule below). There are no cumulative exams for this course. All students must practice academic honesty.

Course Text:

The text for this course is Elements of Physical Hydrology by George Hornberger (2nd edition). I have ordered copies of the text and they are available at the bookstore. I have also provided two copies of the text at the library. Additional reading assignments from the recent scientific literature will also be selected to compliment the textbook and will be made available on Moodle.

A quick note on the text: I have assigned reading (below) related to the concepts we will cover in this course. I will highlight key concepts and equations from a process perspective within my lectures. Tests, homework assignments, and quizzes will focus on the material that I present within my lectures. The text is a supplement to my lectures.

Additional Course Information and Materials:

Additional course materials can be found at umonline.umt.edu. On the Moodle site, you will need to enter your Net ID and password to access the course lectures and supplemental readings. Lecture slides will be posted on the course Moodle page. Students will be expected to participate in class during discussions and in class exercises.

Computer Resources Needed:

To be successful in this class, at a minimum, all students need access to a computer that allows them to do the following things. If you do not have access to a computer with the following capabilities, please contact the CFC's technical support group at support@cfc.umt.edu.

1. Access all content and use all features in UM's Moodle platform.
2. Word processing capabilities, preferably MS Word.
3. Access, download, and open Powerpoint-based lectures uploaded to Moodle.
4. A working version of Excel. At least some of the homework will require students to learn and use Excel to manipulate data and produce graphs. Access to a current version of the Microsoft Office platform that includes Word, Excel, and Powerpoint should also be available via IT.
5. A working version of Adobe Acrobat (Reader), preferably with the ability to convert MS Office files to PDFs.

Course Schedule:

*Date	Topic	Reading	Assignment
1/17- 1/19	Course introduction: water in the 21st century; watershed management	Moodle Slides Hornberger pp. 1-18	Wagner paper
1/24- 1/26	Concepts in hydrology: Dimensional analysis and unit conversions; hydrologic cycle; watersheds; water balance	Hornberger pp. 297-304 Moodle Slides	Handout 1
1/31- 2/2	Meteorology and precipitation	Hornberger pp. 20-39 Moodle Slides	
2/7- 2/9	Watershed radiation balance	Hornberger pp. 40-54; Moodle slides	Handout 2
2/14- 2/16	Watershed energy balance	Hornberger pp. 40-54;Moodle Slides	
2/21 2/23	**Exam 1** ET: Evaporation & Transpiration	Hornberger pp. 40-54;Moodle Slides	Handout 3
2/28- 3/2	Soil & Water Properties	Hornberger pp. 305-307 Moodle Slides	
3/7- 3/9	Unsaturated Zone Hydrology	Hornberger pp. 210-222	
3/14- 3/16	Unsaturated Zone Hydrology & Infiltration	Hornberger pp. 222-237	Handout 4
3/20 – 3/24	**Spring Break**	Relax!	
3/28 3/30	**Exam 2**		
4/4 4/6	Groundwater Hydrology	Hornberger pp. 145-169	
4/11- 4/13	Groundwater – Surface Water Interactions	Moodle Slides	
4/18- 4/20	Streamflow	Hornberger pp. 118-122	Handout 5
4/25- 4/27	Stream Networks & Hydrographs Runoff Generation	Hornberger pp. 257-261 Moodle Slides	

5/2-5/4	Runoff Generation	Hornberger pp. 263-282 Moodle slides
5/11 from 8-10:00	**Exam 3**	

Assignments:
Problem sets will be assigned as handouts on the Moodle site and from the text. Homework assignments are due the following week. Late assignments will be accepted for up to three days from the due date, but 10% will be deducted for every late day. Assignments must be uploaded on the Moodle Course website under the assignments folder in a word document or PDF format. Homework will not be accepted via email. Occasionally, we may meet outside on campus (depending upon Covid-19's progression and our ability to socially distance) to demonstrate common hydrology measurements and place class lecture material in a Missoula 'watershed context.' I will notify you ahead of time so you can prepare accordingly (bring warm clothing).

Field Trip:
This course typically has a two-day field trip to investigate soil moisture, groundwater-surface water interactions and stream water quality. There are also multiple ongoing research projects focused on watershed hydrology and ecohydrology at Lubrecht and for the Montana Climate Office. If you are interested in gaining field and research experience please contact me.

Review Sessions:
From time to time and before exams, I will conduct review sessions to help with questions you have related to the course material. I am not required to host these and you are also not required to attend. I conduct review sessions because I care about your comprehension of the course material. You are responsible for coming prepared with questions and working through questions in groups.

Other, Warnings, Caveats, and University Considerations

You are expected to read the assigned material, and will be responsible for its content. Knowledge of the factors that influence watershed hydrology is integral to understanding a range of critical environmental issues the world now faces. Just like in many areas of science, to deal with those issues, you must first learn the basics of the discipline. And hopefully along the way you have some fun!

Students with Disabilities
The University of Montana assures equal access to instruction through collaboration between students with disabilities, instructors, and the Office for Disability Equity (ODE). If you anticipate or experience barriers based on disability, please contact the ODE at: (406) 243-2243, ode@umontana.edu, or

visit www.umt.edu/disability for more information. Retroactive accommodation requests will not be honored, so please, do not delay. As your instructor, I will work with you and the ODE to implement an effective accommodation, and you are welcome to contact me privately if you wish.

Course Withdrawal Deadlines and Drop/Add Policies

After registering and through the **first seven (7) instructional days of the semester**, students may use Cyberbear to add courses or change sections and credits; through the **first fifteen (15) instructional days of the semester**, students may use Cyberbear to drop courses. Fees are reassessed on the sixteenth day of the term. Added courses and credits may result in additional fees. For courses dropped by the fifteenth instructional day, no fees are charged and courses are not recorded. (For deadlines and refund policy for withdrawal from all courses, see the Withdrawal sections of the catalog.)

The Office of the Registrar has previously required paper forms for students to add, drop, or change classes after the 15th instructional day (or equivalent for summer). Workflow now allows students to collect the required permissions to complete a registration change without paper.

Beginning the sixteenth (16) instructional day of the semester through the forty-fifth (45) instructional day, students use the Course Add Change Drop link in Cyberbear under Student Services to drop or add a course, make changes of section, and change grade/credit options. For instructions on how a student submits a Course Add Change Drop request in Cyberbear go to: http://www.umt.edu/registrar/PDF/PaperlessDropsAddsChangesforStudents.pdf.

A $10.00 processing fee is charged for each drop/add request that is approved. Added courses and credits may result in additional fees. There are no refunds or reductions of fees for courses dropped and grades of W (withdrew) are recorded.

Beginning the forty-sixth (46) instructional day of the semester through the last day of instruction before scheduled final examinations, students use the Course Add Change Drop link in Cyberbear to drop or add a course, make changes of section, and change grade/credit options. However, if a student submits a request to drop a course after the 45th instructional day of the semester, Workflow requires approval not only from the instructor of the course and the student's advisor, but also from the Dean(designee) of the student's major. A $10.00 processing fee is charged for each approved request. There are no refunds or reductions of fees for courses dropped, and the instructor assigns a grade of WP (withdrew/passing) if the student's course work has been passing or a WF (withdrew/failing) if the course work has been failing. These grades do not affect grade averages but they are recorded on students' transcripts.

The opportunity to drop a course for the current term for such a course ends on the last day of instruction before scheduled final exams. Dropping a course taken

in a previous term or altering grading option or audit status for such a course is not allowed. The only exceptions are for students who have received a grade of NF (never attended).

Course withdrawal deadlines are published on the UM Website prior to the start of each semester.

Finally, the usual rules concerning academic honesty apply in this course. All students must adhere to UM policies on academic honesty. Academic misconduct is subject to an academic penalty by the course instructor and/or a disciplinary sanction by the University. All students need to be familiar with the Student Conduct Code. Academic misconduct includes plagiarism.