UNIVERSITY OF SASKATCHEWAN

COURSE SYLLABUS

COURSE TITLE:	Fundamentals of Hydrology (Basic)		
COURSE CODE:	GEOG 427.3	**TERM:**	Fall
COURSE CREDITS:	3 CU	**DELIVERY:**	Lecture
CLASS SECTION:	NA	**START DATE:**	September 16th – 27th, 2019
CLASS LOCATION:	TBA	**LAB LOCATION:**	Beijing Normal University
CLASS TIME:	8.30am-12.30pm	**LAB TIME:**	NA
WEBSITE:	NA		

Course Description

Water quantity and water quality are two of the most pressing environmental issues of the 21st Century. This course is designed to provide an introduction to the field of hydrology and will cover the fundamentals from an earth science perspective. We will focus on hydrological processes and the resulting spatial and temporal patterns of precipitation, evaporation, and runoff at scales ranging from the plot to hillslope to watershed scale. Since hydrology is a quantitative discipline, weekly lab exercises will complement text readings and lectures by providing an introduction to hydrological analysis. Your TA and I will strive to get to know you as best we can. We will be available after class to answer questions or address concerns

Prerequisites

A 100 level math, a 100 level Physics or 200 level General Engineering or Geography.

Learning Outcomes

By the completion of this course, students will be expected to understand:

1. The empirical and theoretical development of hydrological process research
2. The catchment water balance and each of its components
3. Tracing the water cycle at the hillslope and catchment scale
4. Linking field experiments with modelling approches

Information on literal descriptors for grading at the University of Saskatchewan can be found at: https://students.usask.ca/academics/grading/grading-system.php#GradingSystem Please note: There are different literal descriptors for undergraduate and graduate students.
More information on the Academic Courses Policy on course delivery, examinations and assessment of student learning can be found at:
http://policies.usask.ca/policies/academic-affairs/academic-courses.php
The University of Saskatchewan Learning Charter is intended to define aspirations about the learning experience that the University aims to provide, and the roles to be played in realizing these aspirations by students, instructors and the institution. A copy of the Learning Charter can be found at: http://www.usask.ca/university_secretary/LearningCharter.pdf

University of Saskatchewan Grading System (for graduate courses)

The following describes the relationship between literal descriptors and percentage scores for courses in the College of Graduate Studies and Research:

90-100 Exceptional

A superior performance with consistent strong evidence of

- a comprehensive, incisive grasp of subject matter;
- an ability to make insightful, critical evaluation of information;
- an exceptional capacity for original, creative and/or logical thinking;
- an exceptional ability to organize, to analyze, to synthesize, to integrate ideas, and to express thoughts fluently;
- an exceptional ability to analyze and solve difficult problems related to subject matter.

80-89 Very Good to Excellent

A very good to excellent performance with strong evidence of

- a comprehensive grasp of subject matter;
- an ability to make sound critical evaluation of information;
- a very good to excellent capacity for original, creative and/or logical thinking;
- a very good to excellent ability to organize, to analyze, to synthesize, to integrate ideas, and to express thoughts fluently;
- a very good to excellent ability to analyze and solve difficult problems related to subject matter.

70-79 Satisfactory to Good

A satisfactory to good performance with evidence of

- a substantial knowledge of subject matter;
- a satisfactory to good understanding of the relevant issues and satisfactory to good familiarity with the relevant literature and technology;
- a satisfactory to good capacity for logical thinking;
- some capacity for original and creative thinking;
- a satisfactory to good ability to organize, to analyze, and to examine the subject matter in a critical and constructive manner;
- a satisfactory to good ability to analyze and solve moderately difficult problems.

60-69 Poor

A generally weak performance, but with some evidence of

- a basic grasp of the subject matter;
- some understanding of the basic issues;
- some familiarity with the relevant literature and techniques;
- some ability to develop solutions to moderately difficult problems related to the subject matter;
- some ability to examine the material in a critical and analytical manner.

<60 Failure

An unacceptable performance.

Program Requirements

- Percentage scores of at least 70% are required for a minimal pass performance in undergraduate courses taken by graduate students;
- Percentage scores of at least 70% are required for a minimal pass performance for each course which is included in a Ph.D. program;
- Percentage scores of at least 70% are required for a minimal pass performance in all courses used toward JSGS Public Policy and Public Administration programs and all core courses for Master of Public Health students, whether included in a Ph.D. program or a Master's program;
- For all other graduate courses, percentage scores of at least 60-69% are required for a minimal pass performance for each course which is included in a Master's program, provided that the student's Cumulative Weighted Average is at least 70%;
- Graduate courses for which students receive grades of 60-69% are minimally acceptable in a Postgraduate Diploma program, provided that the Cumulative Weighted Average is at least 65%;
- Students should seek information on other program requirements in the Course & Program Catalogue and in academic unit publications.

Course Overview
Class Schedule

Day 1: 8.30am-12.30pm

1.0 Introduction

1.1 Learning objectives of the course
1.2 Why the headwaters; why now?
1.3 Wither field hydrology
1.4 Beyond the water balance: flowpaths, flow sources and residence times
1.5 Why a largely non-quantitative treatment?
1.6 Critical zone science
1.7 Key points

Day 2: 8.30am-12.30pm

2.0 Hillslope and catchment hydrology: The basics

2.1 The catchment water balance
2.2 Hillslopes as the basic landscape building block
2.3 Drainage basin form and process
2.4 Soil physics essentials
2.5 Groundwater hydrology
2.6 The chemistry and ecohydrology of hillslopes
2.7 Solutes and weathering
2.8 Evaporation and plant physiology
2.9 Key points

Day 3: 8.30am-12.30pm

3.0 Runoff process conceptualization: Historical development to the ~1980s

3.1 Pre-Horton runoff studies
3.2 Horton's contributions to overland flow theory
3.3 Partial area concept
3.4 Subsurface stormflow recognition in forested catchments
3.5 Variable source area concept
3.6 Major developments in understanding subsurface water transfers to the stream
3.7 Saturation excess overland flow
3.8 An early conceptual framework for runoff conceptualization
3.9 Key points

Day 4: 8.30am-12.30pm

4.0 Isotope tracers in catchment hydrology
4.1 A brief introduction to isotope hydrology
4.2 The two component hydrograph separation and how it changed the field
4.3 The early search for mechanisms to explain rapid gw effusion
4.4 The Mai-Mai controversy: The poster child for a revolution in thinking
4.5 Soil water residence times and streamwater transit time analysis
4.6 Transit time links to hillslope and catchment properties and scale and groundwater
4.7 Key points

Day 5: 8.30am-12.30pm

5.0 Headwater catchment case studies
5.1 Pacific Rim steep and wet
5.2 Piedmont
5.3 Coastal plain
5.4 China Loess Plateau
5.5 Glaciated catchments with till
5.6 Glaciated catchments without till
5.7 Wet tropics
5.8 Organic soils dominated catchments
5.9 Cold steppe prairie
5.10 Key points
5.11 Mid-course exam

Day 6: 8.30am-12.30pm

6.0 Hillslope runoff generation: A modern synthesis
6.1 Plot scale
6.2 Hillslope scale
6.3 Headwater catchment scale
6.4 Mesoscale catchment
6.5 Fill and spill as a working hypothesis for runoff at different scales
6.6 Storage excess and the role of bedrock and bedrock permeability
6.7 A new framework for storage and release of water: Beyond the Dunne and Leopold diagram
6.8 Lab exercise: Performing a hydrograph separation with stable isotope data
6.9 Key points

Day 7: 8.30am-12.30pm

7.0 Evapotranspiration in the headwaters: the un-runoff
7.1 Evaporation in the uplands
7.2 Interception
7.3 Transpiration

7.4 Rooting depth patterns
7.5 Tracing tree water sources
7.6 The two water worlds hypothesis
7.7 Extraction issues for isotope interpretation
7.8 Lab exercise: Working with mixing models of plant water uptake
7.9 Key points

Day 8: 8.30am-12.30pm
8.0 Catchment modeling
8.1 Early catchment models
8.2 Simple conceptual models
8.3 Calibration and validation
8.4 Parameter identifiability
8.5 Distributed models
8.6 Lab exercise: Model calibration
8.7 Key points

Day 9: 8.30am-12.30pm
9.0 Putting hillslope hydrology knowledge into practice
9.1 Catchment model structure: process knowledge as soft data
9.2 Process knowledge and virtual experiments
9.3 Putting hillslope hydrology in LSMs and GCMs
9.4 Beyond the black box of paired watershed studies
9.5 Mine cover design
9.6 Green roof design
9.7 Ag hillslope irrigation and fertilizer application
9.8 Key points

Day 10: 8.30am-12.30pm
10.0 Catchment Hydrology Summary: The big challenges going forward
10.1 Making sense of paired watershed studies
10.2 Towards an age based theory of the catchment water cycle
10.3 The need for a formal catchment classification system
10.4 Gauging the ungauged catchment: Where should our shovels be digging?
10.5 Getting to grips with macropores: From nuisance to co-evolution theory
10.6 Harmonizing MTT information across stable isotopes, tritium and 13C
10.7 The critical zone: co-evolution and thinking bigger
10.8 Measurement and extraction needs
10.9 Key points
10.10 Final exam

Midterm and Final Examination Scheduling

Midterm and final examinations must be written on the date scheduled.

Final examination is scheduled for **September 27th, 2019**; students should therefore avoid making prior travel, employment, or other commitments for this period. If a student is unable to write an exam through no fault of his or her own for medical or other valid reasons, documentation must be provided and an opportunity to write the missed exam may be given. Students are encouraged to review all examination policies and procedures: https://students.usask.ca/academics/exams.php

Instructor Information

Contact Information

e-mail: jeffrey.mcdonnell@usask.ca

Office Hours

Available for discussion before and after daily lecture.

Instructor Profile

Dr. McDonnell is Associate Director of the Global Institute for Water Security at the University of Saskatchewan. Jeff's work focuses on new ways to measure, understand and model streamflow generation processes. He has co-authored >300 articles on watershed hydrology. A full profile of Dr. McDonnell can be found at: https://sens.usask.ca/people/faculty/core-faculty/mcdonnell-jeffrey.php#ResearchProfile

Required Resources

Readings/Textbooks

There is no required textbook for the class but a good reference text is:
Davie, T., 2008. Fundamentals of Hydrology. Routledge. The text is available free at:

https://the-eye.eu/public/WorldTracker.org/Geology/Fundamentals%20of%20Hydrology%202nd%20ed%20-%20T.%20Davie%20%28Routledge%2C%202002%29%20WW.pdf

Textbooks are available from the University of Saskatchewan Bookstore:
http://www.usask.ca/bookstore/

Other Required Materials

Laptop would be an asset in the class and exercises.

Electronic Resources

Downloads

Supplementary Resources

Grading Scheme

Class participation	5%
Lab exercises (3 exercises, 15% each)	45%
Mid-term exam	10%
Final exam	40%

Total	100%

Evaluation Components

Assignment 1: Hydrograph Separation

Value: 15% of final grade
Due Date: 5pm on day 6 of the course
Description: Performing a hydrograph separation with stable isotope data. This lab will introduce students to the two component hydrograph separation technique. Students will use stable isotope data for precipitation and runoff to identify the relative amounts of event and pre-event water comprising the storm hydrograph.

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Assignment 2: Mixing Models of Plant Water Uptake

Value: 15% of final grade
Due Date: 5pm on day 7 of the course
Description: Working with mixing models of plant water uptake. Students will work with dual isotope data (oxygen and hydrogen) to quantify the source apportionment of plant water uptake. Students will use data for tree xylem water, soil water, groundwater and precipitation to learn the principles of plant water uptake and source depth selection.

Assignment 3: Model Calibration

Value: 15% of final grade
Due Date: 5pm on day 8 of the course
Description: Model calibration. Students will work with the HBV model (a widely used conceptual rainfall-runoff model) to simulate a runoff time series and then calibrate the model to measured data.

Class Participation

Value: 5% of final grade
Description: Daily class attendance. Contributes to class discussion offering insightful ideas and asking clarifying and meaningful questions to extend understanding. Initiating discussion and asserting opinions. Listens actively to others both in groups and in class discussions. Respects others opinions. Incorporates or builds off ideas of others. Consistently exhibits a positive, supportive attitude towards classmates and the subject matter. Takes an active role in own learning.

Midterm Exam

Value: 10% of final grade
Date: September 20th, 2019
Length: 1 hour
Type: Comprehensive
Description: The midterm will be written in class and no computers will be allowed during the exam.

Final Exam

Value: 40% of final grade

Date: September 27th, 2019
Length: 2 hours
Type: Comprehensive
Description: The final exam will be written in class and no computers will be allowed during the exam.

Submitting Assignments

Assignments will be handed in to the instructor personally.

Late Assignments

The lab exercises are due at 5pm on the day they are given out. Late lab submissions will be allowed until 5pm on the last day of class, September 27th, 2019.

Criteria That Must Be Met to Pass

All class assignments and exams (mid-term and final) must be complete, and attendance must exceed 75%.

Attendance Expectations

Attendance is mandatory.

Student Feedback

Integrity Defined (from the Office of the University Secretary)

The University of Saskatchewan is committed to the highest standards of academic integrity and honesty. Students are expected to be familiar with these standards regarding academic honesty and to uphold the policies of the University in this respect. Students are particularly urged to familiarize themselves with the provisions of the Student Conduct & Appeals section of the University Secretary Website and avoid any behavior that could potentially result in suspicions of cheating, plagiarism, misrepresentation of facts and/or participation in an offence. Academic dishonesty is a serious offence and can result in suspension or expulsion from the University.

All students should read and be familiar with the Regulations on Academic Student Misconduct (https://secretariat.usask.ca/documents/student-conduct-appeals/StudentAcademicMisconduct.pdf) as well as the Standard of Student Conduct in Non-Academic Matters and Procedures for Resolution of Complaints and Appeals (http://www.usask.ca/secretariat/student-conduct-appeals/StudentNon-AcademicMisconduct.pdf)

For more information on what academic integrity means for students see the Student Conduct & Appeals section of the University Secretary Website at: http://www.usask.ca/secretariat/student-conduct-appeals/index.php

Examinations with Access and Equity Services (AES)

Students who have disabilities (learning, medical, physical, or mental health) are strongly encouraged to register with Access and Equity Services (AES) if they have not already done so. Students who suspect they may have disabilities should contact AES for advice and referrals. In order to access AES programs and supports, students must follow AES policy and procedures. For more information, check www.students.usask.ca/aes, or contact AES at 306-966-7273 or aes@usask.ca.

Students registered with AES may request alternative arrangements for mid-term and final examinations. Students must arrange such accommodations through AES by the stated deadlines. Instructors shall provide the examinations for students who are being accommodated by the deadlines established by AES.

Student Supports

Student Learning Services

Student Learning Services (SLS) offers assistance to U of S undergrad and graduate students. For information on specific services, please see the SLS web site http://library.usask.ca/studentlearning/.

Student and Enrolment Services Division

The Student and Enrolment Services Division (SESD) focuses on providing developmental and support services and programs to students and the university community. For more information, see the students' web site http://students.usask.ca.

Financial Support

Any student who faces challenges securing their food or housing and believes this may affect their performance in the course is urged to contact Student Central (https://students.usask.ca/student-central.php).

Aboriginal Students Centre

The Aboriginal Students Centre (ASC) is dedicated to supporting Aboriginal student academic and personal success. The centre offers personal, social, cultural and some academic supports to Métis, First Nations, and Inuit students. The centre is also dedicated to intercultural education, brining Aboriginal and non-Aboriginal students together to learn from, with and about one another in a respectful, inclusive and safe environment. Students are encouraged to visit the ASC's Facebook page (https://www.facebook.com/aboriginalstudentscentre/) to learn more.

International Student and Study Abroad Centre

The International Student and Study Abroad Centre (ISSAC) supports student success in their international education experiences at the U of S and abroad. ISSAC is here to assist all international undergraduate, graduate, exchange and English as a Second Language students and their families in their transition to the U of S and Saskatoon. ISSAC offers advising and support on all matters that affect international students and their families and on all matters related to studying abroad. Please visit students.usask.ca for more information.

Acknowledgements and Class Contributors

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