UNIVERSITY OF SASKATCHEWAN
School of Environment and Sustainability

ENVS 824.3
River Science

November/December 2019

Course Coordinator:	Karl-Erich Lindenschmidt, Room 1018 National Hydrology Research Centre, karl-erich.lindenschmidt@usask.ca, 306-966-6174	
Course Schedule:	weekdays 8:30 – 12:30, 20 November – 3 December 2019	
Class location:	BNU	
Assessment:	Assignments	75%
	Presentation	25%
Prerequisites:	Undergraduate degree in natural sciences or engineering, or special permission from the instructors	
Enrolment:	Capped at 20	

Calendar description

This course will teach students the fundamentals of biophysical science as applied in riverine and lacustrine settings. It will examine physical and biological processes that naturally occur in rivers and lakes. These concepts will be reinforced by computer modelling exercises to increase understanding on how these concepts can be integrated to ultimately guide river and lake water quality management.

Learning Outcomes

Upon completion of the course, students will have attained the:

- skills needed to work in river and lake management (government and NGO), river-dependent industry, or to conduct interdisciplinary research in river basins
- understanding on how the physical arrangements of rivers and lakes affect aquatic ecosystem structure and function, conceptualize the numerous interactions of physical and biological processes that occur in dynamic river basins, and determine the data and information needed for the management of rivers and lakes.

Course Schedule

Date	***Topic***	***format***	***Assignment (handed out)***	***% of total grade***
20-Nov	Hydraulics & sediments	lecture	(1) flood/stage frequency analysis	15
21-Nov	HEC-RAS modelling exercise	hydraulic modelling	(2) backwater level profile simulation	15
22-Nov	Surface water quality	lecture		

25-Nov	Nutrient-algal dynamics	systems dynamic modelling	(3) systems dynamic model of algal-zooplankton interaction	15
26-Nov	River water quality modelling	water-quality modelling		
27-Nov	Lake2K modelling	modelling	(4) eutrophication simulation	15
28-Nov	River ice	lecture		
29-Nov	RIVICE modelling	hydraulic modelling	(5) ice-jam simulation	15
2-Dec	Flood forecasting	stochastic modelling		
3-Dec	Presentations	oral presentations by students		25

Readings

There is no required textbook for this course. Readings will be drawn from the following list:

Physical processes

Charlton, R. 2008. Fundamentals of fluvial geomorphology. Routledge.

Gordon, ND, McMahon, TA and Finlayson BL. 2004. Stream hydrology: an introduction for ecologists. Wiley & Sons.

Lick, W. 2010. Sediment and contaminant transport in surface waters. CRC Press.

Knighton, DA. 1998. Fluvial forms and processes – a new perspective. Arnold, London.

Lindenschmidt, K-E. 2019. River ice processes and ice flood forecasting – a guide for practitioners and students. Springer-Nature. New York.

Miller, JR. and Orbock Miller, SM. 2007. Contaminated rivers - a geomorphological-geochemical approach to site assessment and remediation. Springer.

Robert, A. 2003. River processes: an introduction to fluvial dynamics. Arnold, London.

Biological processes and water quality management

Allan, JD. 2001. Stream Ecology: Structure and function of running waters. Kluwer Academic Publishers

Chapra, SC. 1997. Surface water-quality modeling. McGraw-Hill.

Heathcote, I.W. 1998. Integrated watershed management: principles and practice. John Wiley and Sons.

Locke, A. et al. 2008. Integrated approaches to riverine resource management: Case studies, science, law, people, and policy. Instream Flow Council, Cheyenne, WY. 430 pp.

Naiman RJ, Decamps H, McLain ME. 2005. Riparia: ecology, conservation, and management of streamside communities. Elsevier.

Human influences

Allan JD. 2004. Landscapes and riverscapes: the influence of land use on stream ecosystems. Annual Review of Ecology and Systematics 35: 257-284.

Arthington AH et al. 2006. The challenge of providing environmental flow rules to sustain river ecosystems. Ecological Applications 16: 1311-1318.
Bernhardt ES, et al. 2005. Synthesizing U.S. river restoration efforts. Science 308: 636-638.
Bunn SE, Arthington AH. 2002. Basic principles and ecological consequences of altered flow regimes for aquatic biodiversity. Environmental Management 30: 492-507.
Carpenter SR, et al. 1998. Nonpoint pollution of surface waters with phosphorus and nitrogen. Ecological Applications 8: 559-568.
Karr JR. 1991. Biological integrity: a long-neglected aspect of water resource management. Ecological Applications 1: 66-84.
Karr JR. 1999. Defining and measuring river health. Freshwater Biology 41: 221-234.
Naiman RJ et al. 2012. Developing a broader scientific foundation for river restoration: Columbia River food webs. Proceedings of the National Academy of Sciences USA 109: 21201-21207.
Nilsson C, et al. 2005. Fragmentation and flow regulation of the world's large river systems. Science 308: 405-408.
Poff NL, et al. 1997. The natural flow regime. BioScience 47: 769-784.
Pringle CM. 2001. Hydrologic connectivity and the management of biological reserves: a global perspective. Ecological Applications 11: 981-998.
Richter BD et al. 1996. A method for assessing hydrologic alteration within ecosystems. Conservation Biology 10: 1163-1174.
Tockner KT, Bunn SE, Gordon C, Naiman RJ, Quinn GP, Stanford JA. 2008. Floodplains: critically threatened ecosystems. In Polunin N. (ed), Aquatic Ecosystems, Cambridge University Press.

Assessment

Assignments

All assignments must be completed and the presentation must be carried out to pass the course. Each assignment will be due 48 hours after they are handed out. Late submission of assignments will be penalized at 10% per day.

Assignments will be graded by the instructor. Detailed guidance on the assignment topics will be provided by the instructor via a handout. Each assignment will consist of 1 to 3 questions and will be 2-4 pages (including figures) in length, not including references.

Assignment 1 (15%): Topic: Discharge/stage frequency calculations; students will examine hydrometric gauge data and calculate flow statistics commonly used in hydrology using an Excel template provided by the instructor.

Assignment 2 (15%): Topic: simulating backwater level profile using the HEC-RAS model; students will extend a modelling exercise stepped through in class to calculate the water level profile along a river reach with a certain discharge.

Assignment 3 (15%): Topic: systems dynamic model of algal-zooplankton interaction; students will use the systems dynamic model STELLA to simulate two components, algae and zooplankton, and the predator-prey interactions between them.

Assignment 4 (15%): Topic: eutrophication simulation; students will extend an established model of Lake2K to model and calibrate nutrients and algal dynamics in a lake.
Assignment 5 (15%): Topic: ice-jam simulation; students will use and extend an established modelling exercise set up using RIVICE to simulate an ice jam and its backwater effects.

Presentation

The 15 minute presentations (10 minutes oral + 5 minutes questions/discussion) will allow the students to demonstrate their ability to integrate a variety of concepts and processes in river/lake science and to prepare them for their future role in the research and management of large rivers. It will integrate the information the students learned through the modules and assignments by requiring them to view a river basin in a holistic way and to appreciate the value of interdisciplinary approaches to research and management. Students will practice these integration approaches in class through the development of conceptual models of river processes. Students will choose a component of a river basin management topic in consultation with the course instructor.

Grading rubric

In all assignments and the final project, the key skill that students will be expected to acquire and demonstrate is an ability to integrate and link different spatial components, disciplinary expertise and processes within river systems. Recognition of these linkages promotes interdisciplinary thinking and improves prospects for management. These linkages can be viewed both conceptually (e.g. high flows deliver sediment) and mechanistically (e.g. a 10% increase in nutrients yields a 25% increase in primary production).

Rubric: assignments

Criteria	Very good to excellent (80-100%)	Average (60-79%)	Poor to below average (0-59%)
Integration (50% of total score)	Both conceptual and mechanistic linkges among processes identified; may include summary tables or figures	Linkages identified are conceptual or mechanistic	Single process, rate or feature examined in isolation
Content (25% of total score)	Key papers and texbooks cited; information cited directly (e.g. formulas, rates, etc.); calculation (when required) are done correctly	Some reference to literature but citations may be vague; formulas correct but errors made in calculations	No reference to literature; incorrect use of formulas
Style (25% of total score)	Well written with paragraphs organized around single central ideas; consistent use of formatting	Some paragraphs organized around central ideas; some inconsistencies and typos but not enough to be distracting	Paragraphs wander through multiple ideas or topics; inconsistent use of formatting; many typos; poor grammar

Rubric: presentation

Criteria	Very good to excellent (80-100%)	Average (60-79%)	Poor to below average (0-59%)
Integration (50% of total score)	Both conceptual and mechanistic linkges among processes identified; may include summary tables or figures	Linkages identified are conceptual or mechanistic	Single process, rate or feature examined in isolation
Content (25% of total score)	Key papers and texbooks cited; information cited directly (e.g. formulas, rates, etc.); calculation (when requried) are done correctly	Some reference to literature but citations may be vague; formulas correct but errors made in calculations	No reference to literature; incorrect use of formulas
Style (25% of total score)	Visually appealing; figures and text in appropriate font; language appropriate for multi-disciplinary audience	Some graphics hard to read; some inconsistencies in slide design/color/font; mix of plain language and jargon	Unreadable fonts, dull graphics, jargon

School and University policy statements

1. Grading System Description

SENS uses the following grading system as adopted by 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.

2. Midterm and Final Examination Scheduling

Midterm and final examinations must be written on the date scheduled. Final examinations may be scheduled at any time during the examination period; 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: http://www.usask.ca/calendar/exams&grades/examregs/

3. Assessment Issues and Grade Disputes

A student shall be permitted to see any examination unless otherwise stated at the beginning of the course. Students dissatisfied with the assessment of their work in any aspect of course work, including midterm or final examination should consult the University policy '*Student Appeals or Evaluation, Grading and Academic Standing'* found at the Office of the University Secretary (http://www.usask.ca/university_secretary/policies/student/policy-on-student-appeals-of-evaluation,-grading-and-academic-standing.php).

4. Disability Services for Students (DSS)

Students who have disabilities (learning, medical, physical, or mental health) are strongly encouraged to register with Disability Services for Students (DSS) if they have not already done so. Students who suspect they may have disabilities should contact DSS for advice and referrals. In order to access DSS programs and supports, students must follow DSS policy and procedures. For more information, check http://www.students.usask.ca/disability/ , or contact DSS at 966-7273 or dss@usask.ca. Students registered with DSS may request alternative arrangements for mid-term and final examinations. Students must arrange such accommodations through DSS by the stated deadlines. Instructors shall provide the examinations for students who are being accommodated by the deadlines established by DSS.

4. University Learning Centre (ULC)

The ULC offers academic support to UofS students, including: workshops, writing help, math help, community service-learning, learning communities, study skills support, technology help and Peer Mentor Programs. More information can be found at http://www.usask.ca/ulc/

5. Academic Honesty

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 (http://www.usask.ca/university_secretary/honesty/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/university_secretary/honesty/StudentNon-AcademicMisconduct2012.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/university_secretary/pdf/dishonesty_info_sheet.pdf

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Academic Integrity Checklist

Honesty and integrity are expected of every student at the University of Saskatchewan. There are many forms of academic misconduct; perhaps the most common is plagiarism. According to the University of Saskatchewan Guidelines for Academic Conduct:

"Plagiarism is the theft of the intellectual creation of another person without proper attribution. It is the use of someone else's words or ideas or data without proper documentation or acknowledgment. Quotations must be clearly marked, and sources of information, ideas, or opinions of others must be clearly indicated in all written work. This applies to paraphrased ideas as well as to direct quotations. A student must acknowledge and fairly recognize any contributions made to their personal research and scholarly work by others, including other students."

There are many resources on campus to assist you with proper citation and paraphrasing.

- For guidance on when and how to quote from other documents and how to properly paraphrase information in other documents, see http://library.usask.ca/howto/honesty.php.
- To learn about different styles of citation and how to properly cite a variety of different sources including statistics, archival materials, maps, legal documents and government reports, see http://libguides.usask.ca/citation.

When in doubt about a citation requirement or your approach to paraphrasing, ask your librarian or your course instructor or your academic supervisor for assistance.

Before you submit any written work, review it against the following checklist:[1]

- ❒ I have acknowledged the use of all ideas with accurate citations.
- ❒ I have used the words of another author, instructor, information source, etc., and I have properly acknowledged this and used proper citation.
- ❒ In paraphrasing the work of others, I have put the idea into my own words and did not just change some words or rearrange the sentence structure.
- ❒ I have checked my work against my notes to be sure that I have correctly referenced all quotes or ideas.
- ❒ When using direct quotations I have used quotation marks (or other means to clearly identify the quoted text) and provided full citations.
- ❒ Apart from material that is a direct quotation, everything else in the work is presented in my own words.
- ❒ When paraphrasing the work of others I have acknowledged the source or the central idea.
- ❒ I have checked all citations for accuracy (e.g. page numbers, journal volume, dates, web page addresses).
- ❒ I have used a recognized reference style (i.e. APA, MLA, Chicago etc.) consistently throughout my work.
- ❒ My list of references/ bibliography includes all of the sources used to complete the work.
- ❒ I have accurately and completely described any data or evidence I have collected or used.
- ❒ I fully understand all of the content (e.g., terms, concepts, theories, data, equations, ideas) of the work that I am submitting.
- ❒ The content of the work has not been shared with another student, unless permitted by the instructor.
- ❒ The content of the work reflects wholly my own intellectual contribution or analysis and not that of another student(s), unless the instructor approved the submission of group or collaborative work.
- ❒ If another person proofread my work it was for the sole purpose of indicating areas of concern, which I then corrected myself.
- ❒ This work has not been submitted, whole or in part, for credit in another course or at another institution, without the permission of the current course instructor(s).
- ❒ I understand the University of Saskatchewan's policy and expectations concerning academic honesty and the consequences of plagiarism or other forms of academic misconduct.

[1] Compiled based on York University (http://www.yorku.ca/tutorial/academic_integrity/acadintechecklist.html), Curtin University (http://academicintegrity.curtin.edu.au/global/checklist.cfm, University of Toronto (http://www.utoronto.ca/academicintegrity/resourcesforstudents.html), and Skidmore College (http://cms.skidmore.edu/advising/integrity/checklist.cfm) checklists for academic integrity.