Department of Geography and Environmental Studies

GEOG 4108 PERMAFROST FALL TERM 2020

This course will be delivered in 2020 as a BLENDED on-line course. Lectures and seminars will take place in a Zoom meeting. The course is being delivered this way following instructions from the Dean of Arts and Social Sciences due to the COVID pandemic.

Instructor: Dr C.R. Burn; A330 Loeb Building
520-2600 ex.3784; Christopher.burn@carleton.ca
Office Hours: Tuesday, Thursday 11:00-12:00 Via Zoom (and by appointment)
Lectures: Tuesday, Thursday 14:35-15:55 Via Zoom

Textbooks:

French, H.M. 2018. The Periglacial Environment. 4th edition. Wiley. 458 p.

This book is available as an ebook through Carleton library (currently 3rd ed). Four copies are available at any one time.

Williams, P.J. and Smith, M.W. 1989. The Frozen Earth: Fundamentals of Geocryology. Cambridge University Press. 323 p.

The first is recommended. However, if you are considering advanced study in permafrost and periglacial processes, I suggest you purchase:

Ballantyne, C.K. 2018. Periglacial Geomorphology. Wiley. 454 p.

Objectives:

To provide knowledge of the distribution, thermal characteristics, and properties of permafrost in Canada. To provide an understanding of the properties and behaviour of terrain underlain by permafrost. To discuss the origin of geomorphological features associated with permafrost aggradation and degradation. To examine hazards associated with the presence of permafrost that affect human activities. To consider the consequences of climate change for permafrost environments.

Programme: Lectures as per schedule; Reading as assigned or suggested; Exercises; Mid-term tests; Final examination

Evaluation:	Exercises	50
	Mid-term tests	20
	Examination	30
		100

Lectures and reading: The lectures in this course are designed to provide a framework for understanding the permafrost environment. The reading is assigned to provide examples and illustrations of the principles raised in the lectures.

Assignments

1) Ten sets of exercises will be distributed during the term. The exercises are due at the 11:59 pm five days after distribution. They must be sent in pdf format to the instructor by email. **If an assignment is not handed in on time it will not be accepted. The marks for the missed pieces of term work (exercises and mid-terms) will be loaded onto the final examination. If you miss handing in some work, the marks are NOT lost.**

   While you may collaborate with others in working through the assignments, you must prepare and submit your own separate report, written in your own words, which clearly demonstrates your understanding, interpretation and analysis of the assignment. Plagiarism is a serious academic offence and may lead to an F grade for the course or even expulsion from the University. If plagiarism is detected, the documents will be forwarded to the Dean's office, and the student will be contacted directly by the authorities, not the instructor.

2) **Mid-term tests** will be held on **October 8th** and **November 19th** in the class periods. You will receive your questions individually at the beginning of the class period by email. Please note that if you answer a different question from that sent to you for the mid-term you should not expect to receive any credit. You must return your answer by replying to the question email not more than 1 hr and 10 minutes after you receive it. i.e. if it is time-stamped 14:37, the response must be time-stamped 15:47 or earlier. Answers received after that time will not be marked. If you miss the deadline, the 10 marks will be assigned to the final examination.

3) A **take-home examination** will be assigned in the final examination period. The exam will comprise questions on textbook materials, lecture materials, and supplementary reading material **from the whole term**. The take-home examination questions will be released on December 11 at 16:00 Eastern time and will be due by December 23rd at 00.01. You will have to answer essay-type questions and interpret graphs for this take-home examination. Please note that if you do not answer the precise question posed on your examination paper there will be no credit for the answer. The work submitted in the take-home examination paper should be prepared and presented by you and you alone, without assistance from any other student or assistant.

4) Supplementary readings will be assigned for each topic. These are taken from journals and other literature that is in the library, especially the *Proceedings of the International Conferences on Permafrost*. These *Proceedings* are available through the web site of the International Permafrost Association. The essential supplementary reading for each week will be placed on Ares in the library unless it is available on the internet through the library's e-journals. Questions concerning the supplementary reading will appear on the final examination and in the exercises and assignments. There will not be much in Ares because almost all the material is available through these sources.

Plagiarism
The University Senate defines plagiarism as "*presenting, whether intentionally or not, the ideas, expression of ideas or work of others as one's own."* This can include:

- reproducing or paraphrasing portions of someone else's published or unpublished material, regardless of the source, and presenting these as one's own without proper citation or reference to the original source;
- submitting a take-home examination, essay, laboratory report or other assignment written, in whole or in part, by someone else;
- using ideas or direct, verbatim quotations, or paraphrased material, concepts, or ideas without appropriate acknowledgment in any academic assignment;
- using another's data or research findings;
- failing to acknowledge sources through the use of proper citations when using another's works and/or failing to use quotation marks;
- handing in "substantially the same piece of work for academic credit more than once without prior written permission of the course instructor in which the submission occurs."

Plagiarism is a serious offence which cannot be resolved directly with the course's instructor. The Associate Dean of the Faculty conducts a rigorous investigation, including an interview with the student, when an instructor suspects a piece of work has been plagiarized. Penalties are not trivial. They can include a final grade of "F" for the course.

Academic Accommodation
You may need special arrangements to meet your academic obligations during the term because of disability, pregnancy or religious obligations. Please review the course outline promptly and forward any requests for academic accommodation to the Instructor during the first two weeks of class, or as soon as possible after the need for accommodation arises.

Students with disabilities requiring academic accommodations in this course must register with the Paul Menton Centre for Students with Disabilities (PMC) for a formal evaluation of disability-related needs. Documented disabilities could include but are not limited to mobility/physical impairments, specific Learning Disabilities (LD), psychiatric/psychological disabilities, sensory disabilities, Attention Deficit Hyperactivity Disorder (ADHD), and chronic medical conditions. Registered PMC students are required to contact the PMC, 613-520-6608, every term to ensure that your Instructor receives your Letter of Accommodation, no later than two weeks before the first assignment is due or the first in-class test/midterm requiring accommodations. If you require accommodation for a formally scheduled exam, you must submit your request for accommodations to PMC by Nov. 13th, 2020.

You can visit the Equity Services website to view the policies and to obtain more detailed information on academic accommodation at http://carleton.ca/equity/accommodation.

The University policy on academic accommodation is at:
https://carleton.ca/edc/teachingresources/administrative-pedagogy/academic-accommodations/

Uploading of course materials

Classroom teaching and learning activities, including lectures, discussions, presentations, etc., by both instructors and students, are copy protected and remain the intellectual property of their respective author(s). All course materials, including PowerPoint presentations, outlines, and other materials, are also protected by copyright and remain the intellectual property of their respective author(s). All course notes taken by a student are the intellectual property of the student.

Students are not permitted to reproduce or distribute lecture notes and course materials presented to them publicly for commercial or non-commercial purposes without express written consent from the copyright holder(s). The instructor uses a white board for notes and diagrams. Power Point slides are used for illustrations only.

Class schedule

Week 1	S10	Introduction to the class and the course; definitions.
Week 2	S15	Climatic controls on permafrost distribution in Canada.
	S17	Permafrost thickness and the ground thermal regime.
Week 3	S22	Microclimatic controls on ground temperatures; surface energy balance.
	S24	The active layer and the thermal offset.
Week 4	S29	Thermal regime of near-surface permafrost. Temperature envelope.
	O01	The active layer and near-surface permafrost. Zero curtain.
Week 5	O06	The Growth of permafrost; Stefan solution.
	O08	**First mid-term test.** (material up to October 01)
Week 6	O13	Ground freezing. Basic principles for freezing of sand.
	O15	Pingos and seasonal frost mounds
Week 7	O20	Soil freezing. Unfrozen water content characteristic.
	O22	Ice segregation. Clausius-Clapeyron equation.
Week 8	O27	Fall term break
	O29	Fall term break
Week 9	N03	Frost heave
	N05	Freezing of the active layer and cryoturbation
Week 10	N10	Soil carbon and permafrost
	N12	Massive ice in Canada
Week 11	N17	The ice rich-zone at the top of permafrost.
	N19	**Second mid-term test.** (Material October 06-November 12)
Week 12	N24	Thermal contraction and ice-wedge development.
	N26	Ice-wedge polygons
Week 13	D01	Thermokarst processes.
	D03	Thermokarst features
Week 14	D08	Construction in permafrost terrain.
	D10	Climate change and permafrost

The course will adhere to this schedule as much as possible. The dates for the mid-term tests are fixed.

Important dates: September 10 is the first class; September 23 is the last day for registration in classes. October 26-30 is the Fall Break. No classes. December 10 is the last class. December 11 is the last day to withdraw from the course. The final examination period is December 12-23.

Exercise dates:

Number	Distributed on:	Due at 11:59 on:	Aiming to return by:
1	September 17	September 22	September 28
2	September 24	September 29	October 05
3	October 01	October 06	October 13
4	October 08	October 13	October 19
5	October 15	October 20	November 02
6	October 22	November 03	November 09
7	November 05	November 10	November 16
8	November 12	November 17	November 23
9	November 26	December 01	December 07
10	December 03	December 08	December 11

Exercises will be returned to students by email.

Final grade: Standing in a course is determined by the course instructor subject to the approval of the Faculty Dean. This means that grades submitted by the instructor may be subject to revision. No grades are final until they have been approved by the Dean.

Recording of classes: Elements of most classes will be available for viewing through CULearn. Every student will be asked to declare via email to the instructor if they wish to be recorded during class participation. If one student does not wish to be recorded we will not record the class and will not reveal their identity.

The class format will be discussed with students during the first class.

Principal sources

Textbooks

Andersland, O.B., and Ladanyi, B. 1994. An introduction to frozen ground engineering. Chapman and Hall. 352 p. (Library and Haithi)

French, H.M. 2018. The Periglacial Environment. 4th edition. Wiley. (3rd ed. 2007 available in library and via Haithi)

French, H.M. 1996. The Periglacial Environment. 2nd edition. Longman. (Print copy by curbside pickup)

Williams, P.J. and Smith, M.W. 1989. The Frozen Earth: Fundamentals of Geocryology. Cambridge University Press. 323 p. (Print copy by curbside pickup)

Williams, P.J. 1986. Pipelines and Permafrost: Science in a cold climate. Carleton University Press. 129 p. (also 1980) (Print copy by curbside pickup)

Journals - all available through Omni

Canadian Journal of Earth Sciences
Canadian Geotechnical Journal
Permafrost and Periglacial Processes
Arctic, Antarctic, and Alpine Research
Arctic
Journal of Geophysical Research
Geophysical Research Letters
The Cryosphere (Open access)

Conference Proceedings

International Conferences on Permafrost (available on-line at http://ipa.arcticportal.org/ look under Publications for Conference Proceedings.)

First, 1963, Lafayette, Indiana.
Second, 1973, Yakutsk, USSR.
Third, 1978, Edmonton, Canada.
Fourth, 1983, Fairbanks, USA.
Fifth, 1988, Trondheim, Norway.
Sixth, 1993, Beijing, China.
Seventh, 1998, Yellowknife, Canada.
Eighth, 2003, Zurich, Switzerland.
Ninth, 2008, Fairbanks, USA.
Tenth, 2012, Salekhard, Russia.

Canadian Permafrost Conferences: (up to 6th available on-line at http://www.aina.ucalgary.ca/cpc/)

Fourth, 1980, Edmonton, AB.
Fifth, 1990, Ste. Foy, QC.
Sixth, 2010, Calgary AB.
Seventh, 2015, Québec City, QC
Eighth, 2019, Québec City, QC

Maps

Heginbottom, J.A., Dubreuil, M.A., and Harker, P.A. 1995. Canada – Permafrost. In National Atlas of Canada, 5th edition. Plate 2.1 http://ftp.geogratis.gc.ca/pub/nrcan_rncan/raster/atlas_5_ed/eng/environment/land/mcr4177.jpg