University of Victoria

GEOGRAPHY 491 – A02
UNIVERSITY OF VICTORIA
Spring TERM 2020
Dr. Randy Scharien

COURSE OUTLINE
Dynamics of the Cryosphere
Lecture: Elliot Building ELL 161 2:30pm-5:20pm Mondays

Office Hours: Tuesdays 12:00-14:00 or by appointment
Office Location: DTB B122
Contact: randy@uvic.ca

COURSE DESCRIPTION

Snow and ice dominate the Canadian landscape. There is virtually no area in Canada which escapes the influence of snow and ice. We skate on frozen ponds, ski down snow laden mountains, drive through snow blizzards and watch how ice jams in rivers cause rivers to swell and floods to occur. The duration and the thickness of snow and ice increase rapidly northwards, and glaciers are found in mountainous areas and in large parts of the Arctic region. Given that snow and ice impact heavily on the Canadian way of life, this course seeks to understand the dynamics of snow and ice in physical, climatological, and hydrological contexts. This course will examine snow properties, snow cover distribution, glacier hydrology, melt runoff, and ice in its many forms (lake ice, river ice, sea ice, and ground ice). The application of remote sensing and other remote observing systems to understanding the cryosphere will be examined. This course will also examine the implications of climate change on the cryosphere in Canada and beyond.

CLASS MEETINGS

Class meetings will typically comprise discussions around a topic as initiated by the instructor or used for term project work. Topics covered include:

- Components of the cryosphere
- State of the cryosphere and climate change
- Material properties of water, ice, and snow
- Energy exchanges
- Snow, freshwater ice, and water availability
- Glaciers and Ice Sheets
- Melt runoff and floods
- Sea ice
- Permafrost
- Climate interactions and climate change

There will also be 1-2 guest speakers at different points throughout the term. They will provide unique and interesting perspectives on cryosphere research, with linkages to industry applications where applicable.

TAKE HOME EXERCISES

Two take home exercises will be given during the course. Further details, including evaluation criteria, will be provided in the class.

TOPIC REVIEW PAPER

Each student is required to conduct a critical review of one peer-reviewed, published, journal article that addresses some aspect of the cryosphere (e.g. techniques or applications). The review will comprise a written component, assessing the article within the context of the literature. It will also comprise a presentation component, where the critical review is presented to the class and followed by a discussion led by the reviewer. You are encouraged to use Power Point or other preferred media to communicate your review and lead your discussion. Students should consider choosing a journal article and related references which align with their chosen (or anticipated) term project topics. Further details and evaluation criteria will be provided in class.

TERM PROJECT

A group term project (3-4 people) will address an interesting aspect of the cryosphere. Groups are expected to develop a proposal in early January, and to design a scientific experiment which spans the length of the term. Students will have to consider logistical constraints, available data, software and manpower in the design of the project. Guidance and feedback will be provided by the course instructor.

The choice of your topic for your project is up to you and your group but a one page proposal is due in class on January 27, 2020. The final class meeting will be used for term project presentations, to be given in a conference style format. The final term project report is due on the last day of classes for the term.

Required format, evaluation criteria, and suggested topics will be provided in class.

Sample topics, from which focused projects may be derived.

Hydrologic cycle in the Arctic
Environmental factors influencing glacier runoff
Ice growth and decay
Role of climate on the distribution of permafrost
Role of permafrost in northern hydrology
Northern snow re-distribution and change
Role of snow in the northern water budgets
Role of snow in the terrestrial energy budget
Role of lake ice in the climate system
Role of sea ice in the climate system
Snow metamorphosis
Factors affecting the timing of snowmelt
Cryosphere evidence for climate change in northern environments
Factors driving the variability in sea ice extent
The influence of ice sheets and glaciers on sea level change
The relationship between sea ice and ocean current circulation
Ocean-ice interactions
The Freshwater budget of the Arctic

Thermal properties of snow covers
Snow water equivalent (SWE) patterns of snowcovers in British Columbia
Water chemistry of evolving snowpacks
Reflectivity of snow and ice with application to remote sensing
Remote sensing approaches
Glacier snowline detection
Ground based measurements
Modeling runoff

REQUIRED TEXT(S)

None. For project and seminar-based work you will be expected to make additional use of texts, journal articles, other material in the university libraries, & web-based information to support your work. Readings will also be provided by your instructor.

EVALUATION

Exercises (2 at 15% each)	30%
Topic Review Paper	20%
Project Presentation	10%
Project Report	40%

There is no final exam in this course.

GRADING SYSTEM

As per the Academic Calendar:

Grade	Grade point value	Grade scale	Description
A+ **A** **A-**	9 8 7	90-100% 85-89% 80-84%	**Exceptional**, **outstanding** and **excellent** performance. Normally achieved by a minority of students. These grades indicate a student who is self-initiating, exceeds expectation and has an insightful grasp of the subject matter.
B+ **B** **B-**	6 5 4	77-79% 73-76% 70-72%	**Very good**, **good** and **solid** performance. Normally achieved by the largest number of students. These grades indicate a good grasp of the subject matter or excellent grasp in one area balanced with satisfactory grasp in the other area.
C+ **C**	3 2	65-69% 60-64%	**Satisfactory**, or **minimally satisfactory**. These grades indicate a satisfactory performance and knowledge of the subject matter.
D	1	50-59%	**Marginal** Performance. A student receiving this grade demonstrated a superficial grasp of the subject matter.
F	0	0-49%	**Unsatisfactory** performance. Wrote final examination and completed course requirements; no supplemental.
N	0	0-49%	Did not write examination or complete course requirements by the end of term or session; no supplemental.

GEOGRAPHY DEPARTMENT INFO

- Geography Department website: uvic.ca/socialsciences/geography
- Undergraduate Advising: geogadvising@uvic.ca

COURSESPACES

Lectures materials, assigned readings, and general course communications will be via CourseSpaces. You are required to come prepared for each lecture. This means you should have read and considered the assigned readings.

POLICY ON LATE ASSIGNMENTS

Late lab assignments are subject to significant penalties: 20% per day following the due date and time. Exceptions are not permitted except for circumstances involving medical or compassionate reasons. Written verification as proof may be requested at the discretion of the instructor.

ACADEMIC INTEGRITY

It is every student's responsibility to be aware of the university's policies on academic integrity, including policies on **cheating, plagiarism**, **unauthorized use of an editor**, **multiple submission**, and **aiding others to cheat**. **Policy on Academic Integrity**:
http://web.uvic.ca/calendar/undergrad/info/regulations/academic-integrity.html

If you have any questions or doubts, talk to me, your course instructor. For more information, see http://www.uvic.ca/learningandteaching/students/resources/expectations/. The instructor reserves the right to use plagiarism detection software programs to detect plagiarism in written assignments.

ACCESSIBILITY

Students with diverse learning styles and needs are welcome in this course. In particular, if you have a documented disability or health consideration that may require accommodations, please feel free to approach me and/or the Centre for Accessible Learning (CAL as soon as possible https://www.uvic.ca/services/cal/). The CAL staff is available by appointment to assess specific needs, provide referrals, and arrange appropriate accommodations. The sooner you let us know your needs, the quicker we can assist you in achieving your learning goals in this course.

POSITIVITY AND SAFETY

The University of Victoria is committed to promoting, providing and protecting a positive and safe learning and working environment for all its members.

COURSE EXPERIENCE SURVEY (CES)

I value your feedback on this course. Towards the end of term, as in all other courses at UVic, you will have the opportunity to complete an anonymous survey regarding your learning experience (CES). The survey is vital to providing feedback to me regarding the course and my teaching, as well as to help the department improve the overall program for students in the future. The survey is accessed via MyPage

and can be done on your laptop, tablet, or mobile device. I will remind you and provide you with more information nearer the time but please be thinking about this important activity during the course.

WEEKLY CALENDAR

WEEK	DATE	
1	**M 6 Jan**	**Course Introduction**
2	**M 13 Jan**	***Topic*: State of the Cryosphere (I); Project Scoping**
3	**M 20 Jan**	***Topic*: State of the Cryosphere (II); Discussion; Project Scoping**
4	**M 27 Jan**	**Project Definition Presentations; Project Scoping**
5	**M 3 Feb**	***Topic*: Energy Balance and Glacier Mass Balance; Discussion**
6	**M 10 Feb**	***Topic*: Snow Observations and Problems; Discussion**
7	**M 17 Feb**	**READING BREAK, NO CLASS**
8	**M 24 Feb**	**Group Project Updates, Discussion, and Troubleshooting**
9	**M 2 Mar**	**Guest Lecture; Group Project Work**
10	**M 9 Mar**	***Topic*: Ice Sheets and Sea Leve Rise; Discussion**
11	**M 16 Mar**	***Topic*: Sea Ice and Climate Change; Discussion**
12	**M 23 Mar**	**Group Project Work**
13	**M 30 Mar**	**Class Project Presentations**

DISCLAIMER

The above schedule, policies, procedures, and assignments in this course are subject to change in the event of extenuating circumstances.

POSSIBLE FIELD TRIP

Depending on student interest and the occurrence of ideal conditions, we may augment our course experience with a short (2 day maximum) field trip. The field trip would include a demonstration of snow sampling protocols and examination of the influence of forcing mechanisms on snow pack properties. The field trip would occur outside of the normal course schedule. More details will be provided during the course.