

Dalhousie University is located in Mi'kma'ki, the ancestral and unceded territory of the Mi'kmaq. We are all Treaty people.

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Lab Instructor: Beau Ahrens (BeauAhrens@dal.ca)

Marker / Demonstrator: Madeline Healey (mhealey@dal.ca)

Lectures (In-Person): M, W, F from 11:35 am to 12:25 pm (LSC-8007-BIO-ERTH)

Weekly Laboratories: F from 2:35 to 5:25 pm (Elizabeth May GIS Teaching Lab, LSC-2012-BIO-ERTH)

Virtual Office Hours: Two by-appointment sessions per week (TU, TH) from 10:30 to 11:30 am.

All times listed are in the Atlantic Time Zone. Scheduling of Office Hours may be modified to improve effectiveness if the Teaching Team identifies conflicts or low demand early in the semester.

Course Description

The goal of this course is to introduce students to the role of remote sensing as a technique provide environmental and geologic information. Particular emphasis will be placed on examining the potential and limitations of remote sensing methods and data in this context. The lectures discuss the fundamentals of remote sensing with an emphasis on multi-spectral satellite systems. In the lab, students use computerized techniques of digital image enhancement and thematic information extraction to process images derived from optical, radar, and hyperspectral remote-sensing systems. The integration of remote-sensing information with GIS (Geographic Information Systems) is stressed in both the labs and lectures.

Course Prerequisites

PREREQUISITES: GEOG 3500, ENVS 3500, ERTH 3500; ERTH 5600, or SCIE 3600

CROSS-LISTING: GEOG 4530, ERTH 5530

Learning Objectives

With successful completion of the course, students will be able to:

- Recognize and explain the basic principles of remote sensing (RS);
- Identify, compare, and contrast common remote sensing collection systems;
- Explain the difference between the correction and enhancement of remotely sensed data;
- Apply these procedures to extract thematic information from remotely sensed data; and
- Recognize, explain, and demonstrate how error in information extraction is calculated.

Course Materials

Recommended Textbook: Jensen, J. (2016). *Introductory Digital Image Processing: A Remote Sensing Perspective*. Pearson.

Other: A dedicated USB drive with a minimum of 16 gigabytes of storage formatted to the NTFS file management system. **Recommended is a USB 3.0 or USB-C drive or with 64 gigabytes** of storage formatted to the NTFS file management system.

Software: Access to both **PCI Catalyst™ (formerly Geomatica) and ArcGIS Pro™ 2.7 is required**. The primary remote sensing software has limited seats and is installed only in the Elizabeth May Teaching Lab (LSC-2012-ERTH-BIO) and the Dalhousie GIS Centre (5th Floor Killam Library). If you have a computer running a Windows 10 operating system, we may be able to arrange a temporary license for course use (details will be provided separately).

ArcGIS Pro™ 2.7.3 is installed on all Dalhousie campus machines (e.g., the Elizabeth May Teaching Lab, the Wallace McCain Learning Common, Killam Library). The software may also be available to you on your own computer through two alternative methods¹:

- 1) The first is by **downloading ArcGIS Pro™** through the Dalhousie Software resources (<https://software.library.dal.ca/>) to run on a Windows Operating System. It is important to double-check the hardware requirements for the software if using this option (<https://bit.ly/3jGbk4k>). This option requires the Dalhousie Virtual Private Network to be installed and active while running ArcGIS Pro™.
- 2) The second method for accessing the software off campus is through **a strong, stable broadband connection in a virtual lab environment** (<https://apps.vlab.dal.ca/>, use: VLAB2). This method can be used by Windows or Mac operating systems through a downloadable client, or through the browser. The first week's lab provides an example of using the virtual lab environment.

Brightspace Learning Management System (LMS): Lecture slides, assignment instructions, data delivery, assignment submission, important course announcements, and discussion forums are delivered through the Brightspace Learning Management System.

Virtual Office Hours: For the Fall semester, office hours will be virtual and by appointment only. Appointment times can be self-selected through the MS-BOOKINGS interface (<https://bit.ly/3CKb2RB>).

¹ If using either of these options, students are responsible for ensuring they have either an appropriate Windows capable machine at home and / or a stable broadband internet connection.

Course Assessment (Undergraduate)

Category	Component	Weight (% of Final Grade)	Category Weight	Date
Theory	Module Assessments	5	50	Completed in Class
	Test 1 ¹	15		September 29 th , 2021
	Test 2	15		November 3 rd , 2021
	Test 3	15		December 6 th , 2021
Applied	Workshop Deliverables	10	50	Beginning of following week's lab section.
	Lab Project 1 ²	20		October 25 th , 2021
	Lab Project 2	20		December 7 th , 2021
Total			100	

¹Tests will be delivered in the classroom setting. There is no final exam for this course.

²Students will be responsible for identifying study locations and appropriate imagery for each Lab Project, in most cases through the USGS Earth Explorer portal (<https://earthexplorer.usgs.gov/>). This portal will require students to create an account.

Course Assessment (Graduate)

Category	Component	Weight (% of Final Grade)	Category Weight	Date
Theory	Module Assessments	5	50	Completed in Class
	Test 1 ¹	15		September 29 th , 2021
	Test 2	15		November 3 rd , 2021
	Test 3	15		December 6 th , 2021
Applied	Workshop Deliverables	10	50	Beginning of following week's lab section.
	Project Proposal ²	10		October 15 th , 2021
	Project Update	5		November 19 th , 2021
	Project Report	25		December 7 th , 2021
Total			100	

¹Tests will be delivered in the classroom setting. There is no final exam for this course.

²While there is no deliverable for lab projects for graduate students, you are still expected to complete the processing for these lab project to inform how you will execute your independent research project.

Conversion of numerical grades to Final Letter Grades follows the Dalhousie Common Grade Scale

Grade	Range	Definition and Expectations
A+	90-100	Excellent: Considerable evidence of original thinking; demonstrated outstanding capacity to analyze and synthesize; outstanding grasp of subject matter; evidence of extensive knowledge base.
A	85-89	
A-	80-84	
B+	77-79	Good: Evidence of grasp of subject matter, some evidence of critical capacity and analytical ability; reasonable understanding of relevant issues; evidence of familiarity with the literature.
B	73-76	
B-	70-72	
C+	65-69	Satisfactory: Evidence of some understanding of the subject matter; ability to develop solutions to simple problems; benefitting from his/her university experience.
C	60-64	
C-	55-59	
D	50-54	Marginal Pass: Evidence of minimally acceptable familiarity with subject matter, critical and analytical skills (except in programs where a minimum grade of 'C' is required).
F	<50	Inadequate: Insufficient evidence of understanding of the subject matter; weakness in critical and analytical skills; limited or irrelevant use of the literature.

Course Policies

COVID-19 Safety for the Milligan Room and the Elizabeth May Teaching Lab

In this class students will be attending in-person lectures and labs. We begin the semester with Nova Scotia in Phase 4 of its reopening plan (<https://novascotia.ca/coronavirus/working-during-covid-19/>), with some public health restrictions are still in effect (e.g., wearing masks, physical distancing where possible). Everyone in lecture and lab is expected to adhere to the Department and University's safety plans, including wearing a mask properly over the nose and mouth while in the lab. Moreover, as a computer lab the Elizabeth May GIS Teaching Lab has more restrictive policies in place generally students should be aware of (e.g., no food or drink in the lab; access restricted to students scheduled in the lab section; keeping noise low to minimize distraction). An updated policy document for lab operations will be made available to students through the Learning Management System.

Contingency Plan

This class has not been offered as an online-only delivery in past offerings apart from the partial semester shutdown in Winter of 2020. However, in most cases we expect to be able to provide remote access to the software and allow for completion of structured workshops should you need to self-isolate, or if the university is required to transition again to an online delivery model.

Course Completion

To successfully complete the course, **students must receive 50% of the total possible points or higher for both the theoretical and applied portions of the course.** Not meeting this minimum threshold will result in a grade of F for the course, even if an overall score of 50% or greater is achieved.

Communications

Students are required to use discussion boards in the Learning Management System for a large proportion of communications, especially if related to course management and assessments that have applicability to the class. If the Instructor or Teaching Assistants receive an email and feel the question should go to the discussion boards, they will ask the student to replicate their question there for a full response or to ask the question in the next scheduled synchronous session.

Discussion boards will be set to allow anonymous posting to increase the comfort level of students posting publicly. Please note that **even with anonymous posting the moderator (i.e., the instructor or teaching assistant) will know the identity of the user posting.** Please endeavour to be courteous in all communications, including discussion boards.

Due to the volume of emails received during the semester, I am unable to guarantee immediate responses to email enquiries. Typically, students should expect an average of one business day for turnaround of responses to emailed questions.

Course Variations

The course will be taught as close to the listed schedule as possible; however, some deviation from this schedule may be required as the term progresses. Content in the course schedule below are broad descriptors and do not provide the number or name of individual lectures as these are being edited as the course progresses.

Learning Management System (LMS)

Important information is posted to the LMS daily. It is the responsibility of each student to check the LMS and their Dalhousie email on a regular basis to ensure they are not missing any important materials, updates, announcements, etc.

Materials posted to the Learning Management System are for personal use only and are not to be shared (see Copyright Disclaimer in the LMS Course Shell). Sharing class materials with other students (registered in the class, not in the class, or outside the institution) is not permitted. Posting class materials to course sharing sites is also not permitted and could be considered both a copyright issue as well as a breach of academic integrity.

Student Absence Declaration

This course has opted into the student declaration of absence in lieu of sick notes. Please refer to <https://bit.ly/2NJS8jw> for specific details about the use of the Student Declaration of Absence. This mechanism is meant to substitute for sick notes from a doctor related to short absences (less than three days) and does not provide an automatic exemption from any missed assessments. Accommodating the absence whether by exemption or makeup assessment is at the discretion of the course instructor. The SDA process can only be used twice in the course.

Missed Small Deliverables (Module-Related Exercises and Structured Workshops)

For both the module related exercises and the structured workshops, the lowest individual item for each will be dropped from the total score. If a student does not submit an item, that item is assigned a 0 and will count as the lowest score item.

Missed Tests & Exams

If accommodations are granted for a missed tests or final exam, one of the following options will be provided after consultation (to inform instructor decision) with the student:

- a. A make-up test or exam offered on another date
- b. An alternate assignment that can be completed in lieu of the exam
- c. A re-weighting of assessment components that applies to students who miss the final

Submission of Work

To reduce the carbon footprint related to class delivery, most work will be submitted and graded electronically in the Brightspace LMS to reduce paper use. All written work will be subject to evaluation using a plagiarism detection service (see Academic Integrity Policy for further detail).

Late penalties for written work without accommodation from the instructor are -20% per calendar day. Late penalties begin to accrue after the time of the deadline has been reached. For example, if an assignment is due on September 4th at 12:00 pm, submissions past that time (plus a brief “grace period”) are subject to the first application of a -20% late penalty.

All students are responsible for ensuring the product they submit to the LMS is the one they intended to submit. There has been an emerging trend of “I submitted the wrong draft” as a justification for high similarity in originality detection, or as an effort to buy time to avoid late penalties from submitting after the scheduled due date. If a resubmission is permitted, that submission will be subject to a grade penalty unless there is timely notification from the student to the instructor that the wrong draft was submitted.

Unless otherwise noted by the instructor, independent work is required for each student. General discussion and peer tutoring are acceptable and encouraged; however, assessments with highly similar structure and flow of ideas is not acceptable and could be submitted to the faculty academic integrity officer for review.

Course Structure and Assessment Schedule

Week	Start	End	Topic	Workshop	Assessment Due
1	7-Sep-21	12-Sep-21	Overview, Intro to Remote Sensing	SWS-1 ¹	
2	13-Sep-21	19-Sep-21	Intro to Remote Sensing,	SWS-2	
3	20-Sep-21	26-Sep-21	Data Collection, Image Quality	SWS-3	
4	27-Sep-21	3-Oct-21	Classification I	SWS-4	Test 1
5	4-Oct-21	10-Oct-21	Error Analysis, Accuracy Estimation	SWS-5	
6	11-Oct-21	17-Oct-21	Electromagnetic Radiation, Correction	Working	
7	18-Oct-21	24-Oct-21	<i>Buffer Week Contingency</i>		
8	25-Oct-21	31-Oct-21	Geometric Correction	Working	Lab Project 1
9	1-Nov-21	7-Nov-21	Image Enhancement	SWS-6	Test 2
10	8-Nov-21	14-Nov-21	Reading Week		
11	15-Nov-21	21-Nov-21	Classification II	SWS-7	
12	22-Nov-21	28-Nov-21	Change Detection	Working	
13	29-Nov-21	5-Dec-21	Artificial Intelligence	Working	
14	6-Dec-21	7-Dec-21	-	Working	Test 3, Lab Project 2

¹ As noted earlier in the course syllabus, Structured Workshop deliverables are due the following week at the start of your scheduled lab section.

The timing of these topics is approximate. Some shifting of topics will occur depending on total timing of narrated lectures. Names of narrated lectures will be longer and more refined than provided in this course overview.

Faculty of Science Course Syllabus (Section B)
Fall/Winter 2021-22**University Policies and Statements**

This course is governed by the academic rules and regulations set forth in the University Calendar and by Senate

Academic Integrity

At Dalhousie University, we are guided in all of our work by the values of academic integrity: honesty, trust, fairness, responsibility and respect (The Center for Academic Integrity, Duke University, 1999). As a student, you are required to demonstrate these values in all of the work you do. The University provides policies and procedures that every member of the university community is required to follow to ensure academic integrity.

Information: https://www.dal.ca/dept/university_secretariat/academic-integrity.html

Accessibility

The Advising and Access Services Centre is Dalhousie's centre of expertise for student accessibility and accommodation. The advising team works with students who request accommodation as a result of a disability, religious obligation, or any barrier related to any other characteristic protected under Human Rights legislation (Canada and Nova Scotia).

Information: https://www.dal.ca/campus_life/academic-support/accessibility.html

Student Code of Conduct

Everyone at Dalhousie is expected to treat others with dignity and respect. The Code of Student Conduct allows Dalhousie to take disciplinary action if students don't follow this community expectation. When appropriate, violations of the code can be resolved in a reasonable and informal manner—perhaps through a restorative justice process. If an informal resolution can't be reached, or would be inappropriate, procedures exist for formal dispute resolution.

Code: https://www.dal.ca/dept/university_secretariat/policies/student-life/code-of-student-conduct.html

Diversity and Inclusion – Culture of Respect

Every person at Dalhousie has a right to be respected and safe. We believe inclusiveness is fundamental to education. We stand for equality. Dalhousie is strengthened in our diversity. We are a respectful and inclusive community. We are committed to being a place where everyone feels welcome and supported, which is why our Strategic Direction prioritizes fostering a culture of diversity and inclusiveness

Statement: <http://www.dal.ca/cultureofrespect.html>

Recognition of Mi'kmaq Territory

Dalhousie University would like to acknowledge that the University is on Traditional Mi'kmaq Territory. The Elders in Residence program provides students with access to First Nations elders for guidance, counsel and support. Visit or e-mail the Indigenous Student Centre (1321 Edward St) (elders@dal.ca).

Information: https://www.dal.ca/campus_life/communities/indigenous.html

Important Dates in the Academic Year (including add/drop dates)

https://www.dal.ca/academics/important_dates.html

University Grading Practices

https://www.dal.ca/dept/university_secretariat/policies/academic/grading-practices-policy.html

Faculty of Science Course Syllabus (Section C)
Fall/Winter 2021-22**Student Resources and Support****Advising**

General Advising https://www.dal.ca/campus_life/academic-support/advising.html

Science Program Advisors: <https://www.dal.ca/faculty/science/current-students/academic-advising.html>

Indigenous Student Centre: https://www.dal.ca/campus_life/communities/indigenous.html

Black Students Advising Centre: https://www.dal.ca/campus_life/communities/black-student-advising.html

International Centre: https://www.dal.ca/campus_life/international-centre/current-students.html

Academic supports

Library: <https://libraries.dal.ca/>

Writing Centre: https://www.dal.ca/campus_life/academic-support/writing-and-study-skills.html

Studying for Success: https://www.dal.ca/campus_life/academic-support/study-skills-and-tutoring.html

Copyright Office: <https://libraries.dal.ca/services/copyright-office.html>

Fair Dealing Guidelines <https://libraries.dal.ca/services/copyright-office/fair-dealing.html>

Other supports and services

Student Health & Wellness Centre: https://www.dal.ca/campus_life/health-and-wellness/services-support/student-health-and-wellness.html

Student Advocacy: <https://dsu.ca/dsas>

Ombudsperson: https://www.dal.ca/campus_life/safety-respect/student-rights-and-responsibilities/where-to-get-help/ombudsperson.html

Safety

Biosafety: <https://www.dal.ca/dept/safety/programs-services/biosafety.html>

Chemical Safety: <https://www.dal.ca/dept/safety/programs-services/chemical-safety.html>

Radiation Safety: <https://www.dal.ca/dept/safety/programs-services/radiation-safety.html>

Scent-Free Program: <https://www.dal.ca/dept/safety/programs-services/occupational-safety/scent-free.html>

Dalhousie COVID-19 information and updates: <https://www.dal.ca/covid-19-information-and-updates.html>