

EARTH FROM SPACE USING REMOTE SENSING WINTER 2023

GEOG 271

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CLASS SCHEDULE

Section	Location	Time	Instructor(s)
GEOG 271 001 [LEC]	RCH 307	Thursdays 10:30 a.m. - 12:20 p.m.	Justin Murfitt jmurfitt@uwaterloo.ca
GEOG 271 101 [LAB]	EV1 240	Wednesdays 10:30 a.m. - 12:20 p.m.	
GEOG 271 102 [LAB]		Wednesdays 12:30 p.m. - 2:20 p.m.	
GEOG 271 103 [LAB]		Thursdays 2:30 p.m. - 4:20 p.m.	
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INSTRUCTOR / TA INFORMATION

Instructor: Justin Murfitt (email: jmurfitt@uwaterloo.ca ; office hours Thursday 12:30 to 2:30pm); in person (Office: EV-1, room 309) and via Teams.

MAD staff: Mike Lackner (email: mlackner@uwaterloo.ca ; by appointment)

Teaching assistants (TAs):

Name	Yusof Ghaisi	Connor McRae-Pharo
Lab Section(s)	Section 102 - Wednesdays 12:30 - 2:20 PM Section 103 - Thursdays 2:30 - 4:20 PM	Section 101 - Wednesdays 10:30 - 12:20 PM
Office Hours	Wednesdays 2:30 - 3:30 PM (EV2-1014)	Wednesdays 9:30 - 10:30 AM (EV2-1014)
Email	syghiasi@uwaterloo.ca (mailto:syghiasi@uwaterloo.ca)	cmcraeph@uwaterloo.ca (mailto:cmcraeph@uwaterloo.ca)

COURSE DESCRIPTION

Calendar Description for GEOG 271

Remote sensing of the Earth's systems (atmosphere, land, and oceans) is introduced. The course covers the principles, physics, sensor technology, processing, and applications of remote sensing in the electromagnetic spectrum.

Prereq: GEOG 165 or 181 or 187

This undergraduate course will present an introduction to the basic scientific principles and techniques involved in remote sensing, and some of the applications to studies of the Earth's surface process. This shall cover examining the basic physics of electromagnetic radiation and the complex interactions of radiation with the surface and atmosphere. The theoretical background and examples in the lectures will provide the basis for examining various remote sensing applications with data obtained in different parts of the electromagnetic spectrum. The applications will include uses of spaceborne remote sensing data for observing vegetation, soils and minerals, ice and snow, water resources and quality, and urban landscapes. The laboratory section will cover hands-on experience with the Catalyst (formerly Geomatica) image analysis software package, the SNAP Toolbox for radar data processing, various satellite image datasets, and some basic coding using Python within the Catalyst environment.

LEARNING OUTCOMES

By the end of this course students should be able to:

Relate and use various radiation laws.

Explain the cause of different spectral responses and the significance of spectral signatures in optical, thermal infrared and microwave remote sensing.

Carry out basic digital processing including spectral ratios, histogram stretching, filtering, supervised and unsupervised classification, and user defined algorithms.

Outline an optimal plan for data acquisition for various environmental applications.

TENTATIVE COURSE SCHEDULE

Wee k	Date	Format	Topic
1	Jan 12	Lecture	Introduction (No lab this week)
2	Jan 19	Lecture	Basic Physics of Radiation, Definitions, and Fundamental Laws
		Lab Assignment #1A Lab Assignment #1B	PCI Geomatica Intro Python Programming Primer

3	Jan 26	Lecture Quiz #1	Displaying and Interpreting Remote Sensing Images
		Lab Assignment #2	Basics of Electromagnetic Radiation (EMR) and Image Properties
4	Feb 2	Lecture	Visible to Mid-infrared Spectral Signatures
		Lab Assignment #3	Spectral Properties
5	Feb 9	Lecture Quiz #2	Visible to Mid-infrared: Sensors, Platforms, and Applications
		Lab Assignment #4	Image Corrections
6	Feb 16	Lecture Quiz #3	Thermal Infrared: Spectral Signatures, Sensors, Platforms and Applications
		Lab Assignment #5A	Image Enhancements and Classification
7	Feb 23	Reading Week (No Classes!)	
8	March 2	Lecture	Active Microwave: Spectral Signatures I
		Lab Assignment #5B	Classification Part 2
9	March 9	Lecture	Active Microwave: Spectral Signatures II
		Lab Assignment #6A	Thermal infrared Part 1

10	March 16	Lecture	Active Microwave: Sensors, Platforms and Applications
		Lab Assignment #6B	Thermal infrared Part 2
11	March 23	Lecture Quiz #4	Passive Microwave: Spectral Signatures, Sensors, Platforms and Applications
		Lab Assignment #7A (last assignment)	Active Microwave Part 1
12	March 30	Lecture	Other Remote Sensing Platforms + Topics
		No new assignment this week	Active Microwave Part 2
13	April 6	Lecture	Review

TEXTS / MATERIALS

Title / Name	Notes / Comments	Required
Jensen, J.R., 2007. Remote Sensing of the Environment: An Earth Resource Perspective. Second Edition, Pearson, NJ, 592 p.	Optional	No
Jensen, J.R., 2016. Introductory Digital Image Processing: A Remote Sensing Perspective. Fourth Edition, Pearson, NJ, 623 p.	Optional	No
Canada Centre for Mapping and Earth Observation (formerly Canada Centre for Remote Sensing) - Remote Sensing Tutorials at https://www.nrcan.gc.ca/maps-tools-publications/satellite-imagery-air-photos/tutorial-fundamentals-remote-sensing/9309	Available freely online	No

Title / Name	Notes / Comments	Required
European Space Agency - EO Education and Training at https://earth.esa.int/web/guest/eo-education-and-training	Available freely online	No

Hardcopies of the books by Jensen are expensive (about \$190.00 each). Second-hand copies may also be available in the Used Bookstore in the Student Life Centre or via the web. There is also the option of acquiring a digital version (eText) of the Jensen (2016) book for about \$50.00.

STUDENT ASSESSMENT

Component	Value
Lab Assignments	50%
Quizzes (4 x 5% each)	20%
Final exam (final examinations period, April 13 - 28)	30%

Lab Assignments: Assignments are to be turned in during the lab sections on the specified dates (in “Dropbox” folders). No late assignments will be accepted. Consultation and discussion of lecture/lab material with classmates is acceptable BUT all assignments are to be completed individually.

Quizzes: Quizzes (multiple-choice questions format) will be administered through the LEARN course webpage. You will have a two day window to write the quizzes. Once you begin writing you will have 30 minutes to complete/submit. Each quiz will contain a suite of questions that will cover materials presented during online lectures.

Final Exam: The final exam (2-hour long) is cumulative. It will assess your understanding of all material presented in the course (Week 1 to Week 12) and consist of both short and long answer questions. The final exam will normally be administered in-person during the Final Examination Period (April 13 - 28).

ASSIGNMENT SCREENING

Text matching software (Turnitin) will be used to screen assignments in this course. This is being done to verify that use of all material and sources in assignments is documented. In the first week of the term, details will be provided about the arrangements for the use of Turnitin and alternatives in this course. See Administrative Policy below for more information and links.

ADMINISTRATIVE POLICY

Intellectual Property: For further information on IP related to teaching, please see https://uwaterloo.ca/legal-and-immigration-services/sites/ca.legal-and-immigration-services/files/uploads/files/volume_1_issue_3_winter_2018.pdf (https://uwaterloo.ca/legal-and-immigration-services/sites/ca.legal-and-immigration-services/files/uploads/files/volume_1_issue_3_winter_2018.pdf) and the

Guidelines for Faculty, Staff and Students Entering Relationships with External Organizations Offering Access to Course Materials, <https://uwaterloo.ca/secretariat/faculty-staff-and-students-entering-relationships-external> (<https://uwaterloo.ca/secretariat/faculty-staff-and-students-entering-relationships-external>) . The following text is recommended:

Students should be aware that this course contains the intellectual property of their instructor, TA, and/or the University of Waterloo. Intellectual property includes items such as:

- Lecture content, spoken and written (and any audio/video recording thereof);
- Lecture handouts, presentations, and other materials prepared for the course (e.g., PowerPoint slides);
- Questions or solution sets from various types of assessments (e.g., assignments, quizzes, tests, final exams); and
- Work protected by copyright (e.g., any work authored by the instructor or TA or used by the instructor or TA with permission of the copyright owner).

Course materials and the intellectual property contained therein, are used to enhance a student's educational experience. However, sharing this intellectual property without the intellectual property owner's permission is a violation of intellectual property rights. For this reason, it is necessary to ask the instructor, TA and/or the University of Waterloo for permission before uploading and sharing the intellectual property of others online (e.g., to an online repository).

Permission from an instructor, TA or the University is also necessary before sharing the intellectual property of others from completed courses with students taking the same/similar courses in subsequent terms/years. In many cases, instructors might be happy to allow distribution of certain materials. However, doing so without expressed permission is considered a violation of intellectual property rights.

Please alert the instructor if you become aware of intellectual property belonging to others (past or present) circulating, either through the student body or online. The intellectual property rights owner deserves to know (and may have already given their consent).

Co-op interviews and class attendance: Co-op students are encouraged to try and choose interview time slots that result in the least amount of disruption to class schedules. When this is challenging, or not possible, a student may miss a portion of a class meeting for an interview. Instructors are asked for leniency in these situations; but, a co-op interview does not relieve the student of any requirements associated with that class meeting.

When a co-op interview conflicts with an in-class evaluation mechanism (e.g., test, quiz, presentation, critique), class attendance takes precedence and the onus is on the student to reschedule the interview. CEE provides an interview conflict procedure to manage these situations.

Students will be required to provide copies of their interview schedules (they may be printed from WaterlooWorks) should there be a need to verify class absence due to co-op interviews.

Mental Health: The University of Waterloo, the Faculty of Environment and our Departments/Schools consider students' well-being to be extremely important. We recognize that throughout the term students may face health challenges - physical and / or emotional. **Please note that help is available.** Mental health is a serious issue for everyone and can affect your ability to do your best work. Counselling Services <https://uwaterloo.ca/campus-wellness/> (<https://uwaterloo.ca/campus-wellness/>) is an inclusive, non-judgmental, and confidential space for anyone to seek support. They offer confidential counselling for a variety of areas including anxiety, stress management, depression, grief, substance use, sexuality, relationship issues, and much more.

All students are encouraged to download the WatSAFE app which is available free through the google and iOS app stores. The WatSAFE app provides on- and off-campus contacts for students in distress, including international students, and other information related to campus safety and security.

Religious Observances: Students need to inform the instructor at the beginning of term if special accommodation needs to be made for religious observances that are not otherwise accounted for in the scheduling of classes and assignments.

Communications with Instructor and Teaching Assistants: All communication with students must be through either the student's University of Waterloo email account or via LEARN. If a student emails the instructor or TA from a personal account they will be requested to resend the email using their personal University of Waterloo email account.

Recording lecture: Use of recording devices during lectures is only allowed with explicit permission of the instructor of the course. If allowed, video recordings may only include images of the instructor and not fellow classmates. Posting of videos or links to the video to any website, including but not limited to social media sites such as: facebook, twitter, etc., is strictly prohibited.

UNIVERSITY POLICY

Academic integrity: In order to maintain a culture of academic integrity, members of the University of Waterloo community are expected to promote honesty, trust, fairness, respect and responsibility. [Check [the Office of Academic Integrity](https://uwaterloo.ca/academic-integrity/) (<https://uwaterloo.ca/academic-integrity/>) for more information.]

Grievance: A student who believes that a decision affecting some aspect of their university life has been unfair or unreasonable may have grounds for initiating a grievance. Read [Policy 70, Student Petitions and Grievances, Section 4](https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-70) (<https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-70>) . When in doubt, please be certain to contact the department's administrative assistant who will provide further assistance.

Discipline: A student is expected to know what constitutes academic integrity to avoid committing an academic offence, and to take responsibility for their actions. [Check [the Office of Academic Integrity](https://uwaterloo.ca/academic-integrity/) (<https://uwaterloo.ca/academic-integrity/>) for more information.] A student who is unsure whether an action constitutes an offence, or who needs help in learning how to avoid offences (e.g., plagiarism, cheating) or about "rules" for group work/collaboration should seek guidance from the course instructor, academic advisor, or the undergraduate associate dean. For information on categories of offences and types of penalties, students should refer to [Policy 71, Student Discipline](https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-71) (<https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-71>) . For typical penalties, check [Guidelines for the Assessment of Penalties](https://uwaterloo.ca/secretariat/guidelines/guidelines-assessment-penalties) (<https://uwaterloo.ca/secretariat/guidelines/guidelines-assessment-penalties>) .

Appeals: A decision made or penalty imposed under [Policy 70, Student Petitions and Grievances](https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-70) (<https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-70>) (other than a petition) or [Policy 71, Student Discipline](https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-71) (<https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-71>) may be appealed if there is a ground. A student who believes they have a ground for an appeal should refer to [Policy 72, Student Appeals](https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-72) (<https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-72>) .

Note for students with disabilities: [AccessAbility Services](https://uwaterloo.ca/disability-services/) (<https://uwaterloo.ca/disability-services/>) , located in Needles Hall, Room 1401, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with AccessAbility Services at the beginning of each academic term.

Turnitin.com: Text matching software (Turnitin®) may be used to screen assignments in this course. Turnitin® is used to verify that all materials and sources in assignments are documented. Students' submissions are stored on a U.S. server, therefore students must be given an alternative (e.g., scaffolded assignment or annotated bibliography), if they are concerned about their privacy and/or security. Students will be given due notice, in the first week of the term and/or at the time assignment details are provided, about arrangements and alternatives for the use of Turnitin in this course.

It is the responsibility of the student to notify the instructor if they, in the first week of term or at the time assignment details are provided, wish to submit alternate assignment.