



**UNIVERSITY OF MANITOBA**  
**CLAYTON H. RIDDELL FACULTY OF ENVIRONMENT, EARTH, AND RESOURCES**  
**DEPARTMENT OF ENVIRONMENT AND GEOGRAPHY**

## **GEOG 3200 A01: INTRODUCTION TO REMOTE SENSING**

**COURSE SYLLABUS: FALL 2023**

### **Territory Acknowledgement**

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*The University of Manitoba campuses are located on original lands of Anishinaabeg, Cree, Oji-Cree, Dakota and Dene peoples, and on the homeland of the Métis Nation. We respect the Treaties that were made on these territories, we acknowledge the harms and mistakes of the past, and we dedicate ourselves to move forward in partnership with Indigenous communities in a spirit of reconciliation and collaboration.*

## TABLE OF CONTENTS

TERRITORY ACKNOWLEDGEMENT .....	1
COURSE DETAILS.....	3
INSTRUCTOR CONTACT INFORMATION.....	3
COURSE DESCRIPTION .....	3
COURSE LEARNING OUTCOMES .....	4
TEXTBOOK, READINGS, MATERIALS .....	4
WHAT YOU CAN EXPECT FROM ME.....	4
WHAT I CAN EXPECT FROM YOU .....	4
COURSE ASSESSMENTS .....	5
DUE DATES .....	6
EXTENSION AND LATE SUBMISSION POLICY .....	6
VOLUNTARY WITHDRAWAL DATE.....	7
GRADE DISTRIBUTION.....	7
REFERENCING STYLE .....	7
LECTURE AND READING SCHEDULE.....	8
COURSE TECHNOLOGY.....	10
CLASS COMMUNICATION.....	10
USING COPYRIGHTED MATERIAL .....	10
ACADEMIC INTEGRITY.....	11
UM POLICIES AND RESOURCES .....	12

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## Course Details

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<b>Course Title &amp; Number:</b>	GEOG 3200 A01
<b>Number of Credit Hours:</b>	3 credit hours
<b>Class Times &amp; Days of Week:</b>	MWF 8:30 – 9:30 am
<b>Lab Times &amp; Days of Week:</b>	M 2:30 – 5:30 pm Room 321 Wallace
<b>Prerequisites:</b>	(GEOG 1200) or GEOG 1201 (053.120) (C), or GEOG 1290 or GEOG 1291 (053.129) (C), and [PHYS 1020 or PHYS 1021 (016.102) (C), or PHYS 1050 or PHYS 1051 (016.105) (C), or MATH 1300 or MATH 1301 (136.130) (C), or MATH 1500 or MATH 1501 (136.150) (C), or permission of department head.

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## Instructor Contact Information

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<b>Instructor(s) Name:</b>	Dr. John Iacozza (he/him)
<b>Preferred Form of Address:</b>	John or Dr. Iacozza
<b>Office Location:</b>	250 Wallace Building
<b>Office Hours or Availability:</b>	Monday 10:30 – 11:30 am or by appointment
<b>Office Phone No.</b>	204-474-8483
<b>Email:</b>	John.Iacozza@umanitoba.ca
<b>Contact:</b>	I will respond to emails or phone calls between 9 am and 4 pm, Monday to Friday. All efforts will be made to respond within 48 hours, excluding weekends

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## Course Description

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*Calendar Description:* The course is an introduction to the principles of optical, active and passive microwave remote sensing. A review of satellite and sensors and their geographic applications will be presented, along with digital image analysis techniques. Laboratory assignments will provide hands-on experience in dealing with remote sensing data.

Remote sensing is defined as any technique used to obtain an observation or measurement from a distance. Numerous techniques fit this definition, ranging from aerial photographs to satellite-based systems. This course will introduce the remote sensing systems, as well as the general theory and principles of electromagnetic interaction. Applications including geological, geomorphological, climatological and environmental monitoring will also be discussed throughout this course. Upon completion, students will be able to advise on the various types of remote sensing data that are available and on various processing procedures for extracting information from remote sensing data (developed through computer laboratory assignments).

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## Course Learning Outcomes

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This course aims to increase your understanding of the various components of the remote sensing process, and how you can apply them to a specific geographical or environmental issue of interest. Specifically, the learning outcomes of this course are to:

- define and describe the remote sensing process and its history;
- explain the basics of electromagnetic spectrum and how radiation interacts with different surfaces;
- describe various types of sensors that are used in remote sensing, including the geometric and spectral characteristics;
- analyze remote sensing products using a variety of methods developed for different media; and
- identify the various systems and sensors available to address a geographic/environmental issue, including the advantages and limitations of these systems.

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## Textbook, Readings, Materials

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Lillesand T.M., R.W. Kiefer and J. Chipman. 2015. Remote Sensing and Image Interpretation. (7th Ed.) John Wiley and Sons. ISBN: 978-1-118-34328-9

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## What You Can Expect From Me

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- I will listen actively and be respectful ([Respectful Work and Learning Environment Policy.](#))
- I will keep conversations confidential, sharing ideas but not specific stories or names.
- I will be punctual for all class times and meetings.
- I will be available for meetings outside of class times to discuss course material and assignments/tests. Please feel free to make an appointment through email if you are not available during office hours.
- I will have assignments (normally) graded within 2 weeks of submission. Grades are provided through UMLearn, and will consist of both formative (i.e. comments) and summative (i.e. grade) assessment.

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## What I Can Expect From You

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- You will treat me, and other students with respect ([Respectful Work and Learning Environment Policy.](#))
- You will accept that it is OK not to know, both for yourselves and others, and ask questions when you need to.
- You will attend lectures and take notes, as well as participating in class discussions.
- You will make every effort to read the assigned chapters of the textbook *prior to the unit*. Not all the textbook will be covered in the lectures but may be covered on the quiz or exam.
- You will complete the necessary assignments individually and on time, unless otherwise stated. Students may consult with other students; however, it is expected that all assignments will be submitted in the student's own words. (See section of course outline on Academic Integrity).

## Course Assessments

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The final grade will be based on three assessments categories: assignments, tests, and class participation. The following is a breakdown of the weighting of the assessments with respect to the final grade:

<i>ASSESSMENT</i>	<i>PERCENTAGE</i>
Assignments (5 in total @ 10% each)	50%
Midterm (2 hours)	20%
Final Test (2 hours)	20%
Class Participation	10%
TOTAL	100%

### Assignments

Because remote sensing is a tool not only for analysis but also communication, students will be required to prepare graphical and written materials, much as would be expected in a professional setting with the same quality. Computer-based assignments will focus on the practical application of remote sensing principles discussed in class to real-world data. Five assignments will be distributed through the term, focusing on a particular unit in the course. Assignments must be submitted as a SINGLE WORD DOCUMENT and electronically through UMLearn. Submission of assignment in any other format (including PDF or pages) will be given a grade of 0, unless the Instructor grants permission prior to the deadline. An unlimited number of assignments can be submitted but only the most recent submission will be graded. Answers to questions must be provided in complete sentences, or hand-written answers will be graded as 0. Emailed assignments WILL NOT be accepted at any time for any reason and therefore will not be graded. Assignment grades will be posted in UMLearn.

### Midterm and Final Exam

There is a midterm and final test for this course; each are 2 hours. Both will be composed of definitions and/or short answer questions based on the lectures and assigned readings. Questions will be theoretical and therefore no calculations will be tested. The midterm will cover material from Unit 1: Introduction and History to Unit 3: Aerial Photography and Photogrammetry (inclusive); final test from Unit 4: Optical Remote Sensing to Unit 7: Introductory Image Processing (inclusive).

### Class Participation

The knowledge and skills you will gain in this course highly depend on your participation in class learning activities. I plan to track class attendance to help me understand how and when students are engaging in the course. Participation grade will be based on class attendance and participation in class discussions. The grade will be assessed through the Mentimeter website (menti.com), with an access code provided in class. No grade will be given if student is late for class or did not enter their UM email in menti.com at beginning of class. If login page is not available, students are required to restart the web browser. It is the responsibility of the student to login at the start of each class; grades will not be retroactive if the student has not provided an email at the start of the class. If you are ill or have another valid reason for missing, please contact me by email in advance of the absence and include the reason for missing the class. This will be taken into consideration when assessing participation grade.

## Due Dates

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The following table lists the tentative dates for the assignments and tests (midterm and final) for the course. Please note that the dates may be extended if required; students will be advised of any changes in advance of the deadline. Assignments are due by **2:30 pm**.

<i>ASSIGNMENT</i>	<i>DUE DATE</i>
Assignment #1	September 25, 2023
Assignment #2	October 16, 2023
Midterm (@2:30 pm)	October 23, 2023
Assignment #3	October 30, 2023
Assignment #4	November 20, 2023
Assignment #5	December 4, 2023
Final Test (@2:30 pm)	December 11, 2023

## Extension and Late Submission Policy

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Assignments must be handed in on time – by **2:30 pm** on due date. Late assignments will be assessed a penalty of 10% per day unless the student has obtained Instructor approval in advance of the deadline to submit a late assignment. It is the student's responsibility to contact the Instructor through email prior to the deadline. Any request after the deadline will not be accommodated.

If the student has missed a test, it is the responsibility of the student to contact the Instructor within 24 hours. If a deferred test is granted (see below for acceptable reasons), the midterm will be written on October 27 at 2:30 pm, the final test on December 12 at 2:30 pm. No further extensions will be provided for any reason. The test questions for the deferred tests may be different and therefore any study guidance provided in class may not apply.

Reasons for granting an extension (assignments) or deferral (tests): a death in your immediate family, an illness in either yourself or in a dependent, religious observance, and student is required to travel for work.

Reasons for not granting an extension: having another assignment or midterm on the same day, being away from the university for a personal reason (i.e. holiday or personal vacation), being too busy with other course work (i.e. having a midterm that same day or week), not attending the lectures due to personal or compassionate reasons, car broke down and could not submit assignment on time, computer is not working properly and you lost the assignment, or any other reason deemed inappropriate by the Instructor. This is not an exhaustive list.

Students who are unable to meet a course requirement due to medical circumstances are currently not required to submit medical notes. However, students are required to contact their Instructor by email to inform of the missed work and to make arrangements for extensions.

## Voluntary Withdrawal Date

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The voluntary withdrawal date is the last date for withdrawing from this course without academic penalty. The voluntary withdrawal date for this course is **November 21, 2023**. Evaluative feedback will be provided prior to this date.

## Grade Distribution

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<i>LETTER GRADE</i>	<i>PERCENTAGE RANGE</i>	<i>DESCRIPTION</i>
A+	90-100	Exceptional
A	80-89.9	Excellent
B+	75-79.9	Very Good
B	70-74.9	Good
C+	65-69.9	Satisfactory
C	60-64.9	Adequate
D	50-59.9	Marginal
F	0-49.9	Failure

**NOTE:** All final grades are subject to departmental review.

## Referencing Style

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Assignments should use the APA reference style as outlined in the text:  
American Psychological Association. (2009). Publication manual of the American Psychological Association (6th ed.). Washington, DC: Author. Information can also be found on the UM Libraries website: <http://libguides.lib.umanitoba.ca/c.php?g=298394>. If you use the course lectures to answer any questions in the assignments, you must properly cite the course notes. This can be found in the APA reference style

## Lecture and Reading Schedule

The following table lists the dates for each unit and associated readings for this course.

<i>LECTURE TOPIC</i>	<i>READINGS</i>
Unit 1: Introduction and History (Sept 6 – 13)	pp. 1-4; 30-49; 86-88

Learning Objectives:

- define what is meant by 'remote sensing' in the context of image acquisition and interpretation;
- describe the broad components and characteristics of the remote sensing process;
- explain the various types of resolution as applied to remote sensing products;
- interpret the steps involved in the application of remote sensing products into research; and
- discuss the technological and theoretical advances over the past 1000 years as pertaining to remote sensing.

Unit 2: Electromagnetic Energy (Sept 15 – 22)	pp. 4-30
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Learning Objectives:

- describe the concept and major divisions of the EM spectrum;
- calculate the properties of EM energy using physical laws;
- examine the outcome of solar energy as it passes through the atmosphere and interacts with the surface; and
- discuss the atmosphere and geometric influences on the spectral response of surface features as related to remote sensing products

Unit 3: Aerial Photography and Photogrammetry (Sept 25 – Oct 13)	pp. 59-78; 85; 89-140; 146-217
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Learning Objectives:

- discuss the characteristics of aerial photographic systems, including cameras filters;
- examine photographic basics associated with exposure, geometric factors, and spatial resolution;
- explain the different generic types of aerial photographs and the factors and elements associated with vertical photographs;
- calculate basic photogrammetric properties that can be estimated from aerial photographs; and
- identify features in an aerial photograph based on image interpretation factors.

Unit 4: Optical Remote Sensing (Oct 16 – Oct 27)	pp. 218-242; 283-88
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Learning Objectives:

- explain the characteristics of satellite-based remote sensing;
- describe the orbital and spectral properties of optical remote sensors including LandSat, SPOT and EOS satellites;
- describe high resolution satellite remote sensing systems; and
- discuss optical remote sensors designed for ocean monitoring and meteorology.



<i>LECTURE TOPIC</i>	<i>READINGS</i>
Unit 5: Microwave Remote Sensing (Oct 30 – Nov 10)	pp. 385-425; 441-464; 466-471

## Learning Objectives:

- differentiate between microwave and optical remote sensing systems, and the various types of passive and active microwave systems;
- calculate the basic geometric properties of microwave systems, including resolution and distortion;
- describe the geometric and image characteristics of generic radar and radiometer systems;
- interpret radar images based on factors including the surface roughness, incidence angles and scattering; and
- discuss the orbital and sensor characteristics of specific active and passive satellite microwave systems.

Unit 6: Other Systems (Nov 20 – Dec 1)	pp. 271-282; 243-269; 471-484
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## Learning Objectives:

- describe the basic operational structure of hyperspectral, Lidar and thermal remote sensors;
- explain the thermal radiation properties as applied to remote sensing; and
- discuss the remote sensing of the planetary boundary layer (PBL) and the different systems used to measure variables near the surface.

Unit 7: Introductory Image Processing (Dec 4 – 8)	pp. 485-512
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## Learning Objectives:

- list the seven categories of digital image processing techniques in remote sensing;
- explain radiometric and geometric image rectification and restoration techniques;
- apply correction techniques to a remote sensing image;
- discuss the various contrast manipulation tools that can be used to enhance an image; and
- describe the methods available to enhance a spatial feature in an image.

The schedule is subject to change at the discretion of the Instructor and/or based on the learning needs of the students but such changes are subject to Section 2.8 of the – [ROASS-Procedure](#)).

## Course Technology

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It is the general University of Manitoba policy that all technology resources are to be used in a responsible, efficient, ethical and legal manner. The student can use all technology in classroom setting only for educational purposes approved by Instructor and/or the University of Manitoba Disability Services. Student should not participate in personal direct electronic messaging / posting activities (e-mail, texting, video or voice chat, wikis, blogs, social networking (e.g., Facebook), online and offline “gaming”) during scheduled class time. If student is on call (emergency) the student should switch his/her cell phone on vibrate mode and leave the classroom before using it. Your computer or device, and internet connection must meet the UM minimum requirements. You should be familiar with Zoom, the video conferencing system, as well as UMLearn, the course management software used by the University of Manitoba. You can access online resources for UMLearn through [Centre For The Advancement Of Teaching & Learning](#).

All students have access to Office365 through the university. You are encouraged to save your assignments to the cloud using this program to ensure material is not lost through technological issues. This will not be considered a reason for granting an extension.

## Class Communication

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Ensure that the course name and number are included in the subject line for all emails. Please make sure emails are written in a professional manner, including complete sentences and do not use text language. Emails must be sent from University of Manitoba email accounts; emails from other accounts (such as gmail) will not be responded to.

Electronic Communication with Student Policy:

[http://umanitoba.ca/admin/governance/governing\\_documents/community/electronic\\_communication\\_with\\_students\\_policy.html](http://umanitoba.ca/admin/governance/governing_documents/community/electronic_communication_with_students_policy.html).

## Using Copyrighted Material

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John Iacozza and the University of Manitoba hold copyright over the course materials, presentations and lectures which form part of this course. No audio or video recording of lectures or presentations is allowed in any format, openly or surreptitiously, in whole or in part without written permission by John Iacozza. This includes taking pictures of the slides during the lectures. Course materials (both paper and digital) are for the participant’s private study and research. If recording needs to be done for accessibility or accommodation reasons, please contact the Instructor.

Please respect copyright. I will use copyrighted content in this course. I have ensured that the content I use is appropriately acknowledged and is copied in accordance with copyright laws and University guidelines. Copyrighted works, including those created by me, are made available for private study and research and must not be distributed in any format without permission. For more information, see the University’s Copyright Office website at <http://umanitoba.ca/copyright/> or contact [um\\_copyright@umanitoba.ca](mailto:um_copyright@umanitoba.ca).

## Academic Integrity

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**Academic Integrity:** Academic dishonesty (plagiarism, cheating) is a very serious matter in any academic institution and is dealt with severely at the University of Manitoba.

*Plagiarism* or any other form of cheating in examinations, quizzes or academic work is subject to serious academic penalty (e.g., suspension or expulsion from the faculty or university).

Cheating in examinations or tests may take the form of copying from another student or bringing unauthorized materials into the exam room (e.g., crib notes, pagers or cell phones).

Exam cheating can also include exam personation (see below). A student found guilty of contributing to cheating in examinations or term assignments is also subject to serious academic penalty, including a grade of zero on the assignment/exam, a final grade of F in the course or expulsion from the University (based on severity of offense).

To plagiarize is to take ideas or words of another person and pass them off as one's own. In short, it is stealing something intangible rather than an object. Plagiarism applies to any written work, in traditional or electronic format, as well as orally or verbally presented work. Obviously, it is not necessary to state the source of well-known or easily verifiable facts, but students are expected to appropriately acknowledge the sources of ideas and expressions they use in their written work, whether quoted directly or paraphrased. This applies to diagrams, statistical tables and the like, as well as to written material, and materials or information from Internet sources. **Students must use APA style to properly reference work. Students will be penalized 20% if another style or footnotes are used.**

To provide adequate and correct documentation is not only an indication of academic honesty but is also a courtesy, which enables the reader to consult these sources with ease. Failure to provide appropriate citations constitutes plagiarism. It will also be considered plagiarism and/or cheating if a student submits an assignment or exam written in whole or in part by someone other than him/herself, or copies the answer(s) of another student in any assignment or exam.

Working with other students on assignments, when not permitted by the Instructor, can constitute Inappropriate Collaboration and may be subject to penalty under the Student Discipline By-Law.

An assignment that is prepared and submitted for one course should not be used for a different course. This is called "duplicate submission" and represents a form of cheating because course requirements are expected to be fulfilled through original work for each course.

Please familiarize yourself with the University policy on academic dishonesty found on the following website: <https://umanitoba.ca/student-supports/academic-supports/academic-integrity>. When in doubt about any practice, ask your Instructor.

Students are encouraged to review the University policy on Responsibilities of Academic Staff with Regards to Students (ROASS):

<https://catalog.umanitoba.ca/undergraduate-studies/policies-procedures/responsibilities-academic-staff-regard-students-policy/>

## **UM Policies and Resources**

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Students should familiarize themselves with the policies and resources at the University of Manitoba under ROASS (Responsibilities of Academic Staff with Regard to Students). A document has been prepared and is available in UMLearn under the Content Tab. If you have any questions about the policies or resources, please contact the Instructor. I would be happy to help guide you through anything listed in the document.