GEOG 2230B – Remote Sensing
Course Outline: Section 001 Winter 2024

1. Course Information

Classes Start	Spring Reading Week	Classes End	Study day(s)	Exam Period
January 8	February 19-23	April 8	April 9 & 10	April 11-30

January 16, 2024: Last day to add a second-term half course
February 19, 2024: Family Day
March 7, 2024: Last day to drop a second term half course without academic penalty

Course Instructor	Contact Information	Office Hours
Dr. Jinfei Wang	Email address: jfwang@uwo.ca	TBD on Zoom; Zoom link in OWL

| Teaching Assistant(s)	Contact Information	Office Hours
Wed lab: Nafiseh Ghasemian Sorboni	nghasem2@uwo.ca	TBD, SSC 1316A
Thur. lab: Mohammad Rokhafrouz	mrokhafr@uwo.ca	TBD, SSC 1316A
Lab support: Kathy Tang	ktang28@uwo.ca	

☒ My office hours will be held remotely using Zoom. You can find the Zoom links in OWL. TA's office hours will be held in the computer lab SSC 1316A (or SSC 1059).

2. Calendar Description

Introduction to the principles, techniques, and geographic applications of remote sensing systems. Computer processing of remote sensing digital data. Interface of remote sensing data with geographic information systems.

Prerequisite(s): 1.0 from Geography 1100, Geography 1200A/B, Geography 1300A/B, Geography 1400F/G, Geography 1500F/G, Geography 2131A/B, Geography 2132A/B, Geography 2133A/B, Geography 2152F/G, Geography 2153A/B, Geography 2160A/B, Environmental Science 1021F/G; or registration in a module in Science or in Engineering, in the Major in Physical Geography and Environment, in the Certificate in Geographic Information Science, or in the Commercial Aviation Management program in MOS.
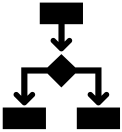
Extra Information: 2 lecture hours, 2 laboratory hours.

Course Weight: **0.50**

Prerequisite checking is the student's responsibility

Senate Regulations state, "unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you will be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites."

3. Textbook

Primary Textbook:
Lillesand, T.M., Kiefer, R.W. and Chipman, J.W., 2015, "Remote Sensing and Image Interpretation", 7th Edition, John Wiley & Sons. (ISBN : 978-1-118-34328-9 (print); 978-1-118-91947-7 (e-book)).

Other recommended Readings:
Jensen, J.R., 2016, "Introductory Digital Image Processing – A Remote Sensing Perspective", 4rd Edition, Prentice Hall. (ISBN-10: 0-13-405816-X; ISBN-13: 978-0-13-405816-0)

Richards,A. J. 2013, "Remote Sensing Digital Image Analysis", 5th edition, Springer. (ISBN: 978-3-642-30061-5 (Print); 978-3-642-30062-2 (Online)).

Jensen, J.R., 2007. "Remote sensing of the Environment – An Earth Resource Perspective", 2nd edition, Prentice Hall. (ISBN 978-0-13-188960-7)

4. Course Format

⊠ Attendance and participation: Each student is required to attend all lectures, in order to understand the course material and the theoretical parts of the labs.

⊠ Students are responsible for material covered in the lectures as well as the assigned chapters/sections in the text. The principles and theory in the labs will be explained in the lectures. You need this information to answer the questions in the labs.

⊠ Required for all computer labs: One or two USB memory key, or a portable hard drive for storing data and results. I suggest that you double backup your work on two USBs, in case one USB has problems.

⊠ Each student will participate in a group presentation about remote sensing data (4 students per group). You will choose from a list of topics, conduct research and prepare a power point presentation.

⊠ Each student will write and submit a term paper involving a review of current development in a specific research and/or application area in remote sensing. You will choose your own topic that you are interested in.
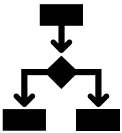
All course material will be posted to OWL: http://owl.uwo.ca . Any changes will be indicated on the OWL site and discussed with the class.

Google Chrome or Mozilla Firefox are the preferred browsers to optimally use OWL; update your browsers frequently. Students interested in evaluating their internet speed, please click here.

If students need assistance, they can seek support on the OWL Help page. Alternatively, they can contact the Western Technology Services Helpdesk. They can be contacted by phone at 519-661-3800 or ext. 83800.

5. Course Content and Schedule

Course Content and readings:

Introduction to Remote Sensing
    Readings: *Lillesand and Kiefer, (7th Ed.): Chapter 1, pp. 1-58.*
- Remote sensing
- Electromagnetic radiation (EM wave, Stefan-Boltzmann Law, Wien's Displacement Law)
- Data acquisition (energy source, the atmosphere, energy interactions at the Earth's surface, the sensor)
- Data analysis (data interpretation, information products, applications).
- Field measurements - ASD spectrometer

Aerial analog / digital images and Photogrammetry

> ***Readings:*** *Lillesand and Kiefer, (7th Ed.): Chapter 2, pp. 85-145 3, pp.146-217.*

- Introduction
- Stereoscopy with aerial photographs
- Photo scale
- Relief displacement
- Image parallax
- Height measurement
- Structure from Motion and UAV data collection

Digital Image Processing - Image Enhancement

> ***Readings:*** *Lillesand and Kiefer, (7th Ed.): Chapter 7, pp.485-537.*

- Digital image concept
- Contrast manipulation (linear stretch, histogram equalization)
- Spatial feature manipulation (low pass filters, high pass filters)
- Multi-image manipulation (false colour composites, Principle Components Analysis)

Digital Image Processing - Image Classification

> ***Readings:*** *Lillesand and Kiefer, (7th Ed.): Chapter 7, 537-608.*

- Supervised classification (minimum-distance-to-means classifier, parallelepiped classifier, maximum likelihood classifier)
- Unsupervised classification (k-means clustering)
- Accuracy assessment

Remote sensing image interpretation and applications

> ***Readings:*** *Lillesand and Kiefer, (7th Ed.): Chapter 1, pp.59-84; Chapter 8, pp. 609-698.*

- Land use/land cover mapping
- Agricultural application
- Forestry application
- Water resource application
- Urban application
- Terrain analysis; Geologic/Geomorphic application

Remote sensing case studies

Remote Sensing Data (Student Presentations)

> ***Readings:*** *Lillesand and Kiefer, (7th Ed.): Chapters 4, pp. 218-282; Chapter 5, 283-382; and Chapter 6, 385-484 .*

> *Additional readings (search by students)*

- Landsat satellites; SPOT satellites; ASTER, IRS, etc.
- Fine resolution land satellites (IKONOS-2, Quickbird, etc.)
- Hyperspectral satellite systems (MODIS, CHRIS/PROBA, Hyperion, etc.)
- Radar satellites (ERS-1, ENVISAT, RadarSat, etc…)
- Meterological satellites (NOAA AVHRR, etc)
- and more …

Tentative Schedule:

Week	Dates	Topic	Labs assigned	Lab due (by 11:55pm on the previous day of your lab)
1	Jan 8 – 12	Introduction to the course/ 1. Introduction to remote sensing	No lab	
2	Jan 15 – 19	1. Introduction to remote sensing	Lab #1	
3	Jan 22 – 26	2. Aerial photographs and photogrammetry	Lab #2	Lab #1 due
4	Jan 29 – Feb 2	2. Aerial photographs and photogrammetry	Lab #3	Lab#2 due
5	Feb 5 – 9	3. Digital image processing – image enhancement	Lab #4	Lab#3 due
6	Feb 12 – 16	4. Digital image processing – image classification	Lab #5	Lab #4 due
	Feb 19 – 23	Reading Week	N/A	
7	Feb 26 - Mar 1	4. Digital image processing – image classification	Lab #6 (mini project)	Lab#5 due
8	Mar 4 – 8	4. Digital image processing – image classification	Lab #6	Presentation Sign up due Mar 8 (after this date you will be assigned a topic)
9	Mar 11 – 15	5. Remote sensing image interpretation and applications 6. Remote sensing case studies	Lab #6	
10	Mar 18 – 22	Student presentations		Lab#6 due
11	Mar 25 – Mar 29	Student presentations		
12	Apr 3 – 5	Student presentations		
13	Monday Apr 8			Term paper due April 9

6. Communication

☒ Students should pay attention to the OWL announcements and check the OWL site at least every 24-48 hours and before lectures and labs.

☒ In addition to the lab hours, students may attend their teaching assistants' in-person office hours or email their teaching assistants with questions related to the lab assignments and other parts of the course. They may also join instructor's Zoom office hours with general questions.

☒ Students should use the provided google sheet to sign up for presentation groups by a given deadline (March 8, 2024). You are responsible to join a group and discuss your presentations with your group. Please be collaborative and respectful to your team and rehearse your presentations in advance.

7. Evaluation

Below is the evaluation breakdown for the course. Any deviations will be communicated.

Assessment	Format	Weighting	Due Date
Written and computer lab assignments	Written and computer labs	65%	See schedule table
Group presentation	Oral presentation Presentation ppt	10%	See schedule table
Final report	Written report	25%	April 9, 2023

Students are responsible for material covered in the lectures as well as the assigned chapters/sections in the text.

Lab assignments:
Lab 1   Fundamentals of Remote Sensing (5%)
Lab 2   Understanding spectral data collected by an ASD spectrometer (10%)
Lab 3   Photogrammetry and 3D reconstruction (10%)
Lab 4   Satellite data downloading and displaying (10%)
Lab 5   Digital image processing – Image enhancement (10%)
Lab 6   Image classification – Training data collection, classification and accuracy assessment (20 %)

Information about late or missed evaluations:

☒ All assignments are due at 11:55 pm EST on the previous day of the next lab of your lab session: Wednesday labs are due at 11:55 pm on Tuesday. Thursday labs are due at 11:55 pm on Wednesday.

Presentation ppt and term papers are due at 11:55 pm EST on the due dates.

☒ Lab assignments: You must attend all labs. You should observe all the due dates/times for assignments. Plagiarism or copying is unacceptable. If there are two identical answers to a lab. or parts of the lab., both students will be given a mark of 0 for that lab. Late assignments will be accepted for up to four days after the due date. After that the late work is no longer accepted regardless of whether the OWL assignment submission is open or not. **The late penalty in percentage of the total mark of the assignment is 5% for one day late, 25% for two days late, 45% for three days late, 65% for four days late.** Lateness is based on the time the assignment is received through OWL, not on the time it was created on student's own computer.

☒ Written assignments will be submitted to Turnitin.

☒ An assignment cannot be submitted after it has been returned to the class.

☒ After an assessment is returned, students should wait 24 hours to digest feedback before contacting their evaluator; to ensure a timely response, reach out within 7 days

Click here for a detailed and comprehensive set of policies and regulations concerning examinations and grading. The table below outlines the University-wide grade descriptors.

A+	90-100	One could scarcely expect better from a student at this level
A	80-89	Superior work which is clearly above average
B	70-79	Good work, meeting all requirements, and eminently satisfactory
C	60-69	Competent work, meeting requirements
D	50-59	Fair work, minimally acceptable
F	below 50	Fail

Grades will not be adjusted on the basis of need. It is important to monitor your performance in the course. Remember: *You* are responsible for your grades in this course.

8. Accommodation Policies

Students with disabilities work with Accessible Education (formerly SSD) which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. The accommodation policy can be found here: Academic Accommodation for Students with Disabilities.

Academic Consideration for Student Absence

In arranging accommodation, the students should contact the instructor and TAs for any work less than 10% of the total course grade.

In all cases where accommodation is being sought for work totalling 10% or more of the final grade in a course, students should contact Faculty of Social Science Dean's office and provide proper documentation. In the case of assignments, presentation files and final paper, extension

will be given according to the number of days approved by the academic counsellor. So when you contact the academic counsellor please specify how many days extension you request.

The University recognizes that a student's ability to meet their academic responsibilities may, on occasion, be impaired by medical illness. Illness may be acute (short term), or it may be chronic (long term), or chronic with acute episodes. The University further recognizes that medical situations are deeply personal and respects the need for privacy and confidentiality in these matters. However, in order to ensure fairness and consistency for all students, academic accommodation for work representing 10% or more of the student's overall grade in the course shall be granted only in those cases where there is documentation indicating that the student was seriously affected by illness and could not reasonably be expected to meet their academic responsibilities.

Policy on Academic Consideration for Medical Illness - Undergraduate Students

Student Medical Certificate (SMC)

Religious Accommodation

Students should consult the University's list of recognized religious holidays, and should give reasonable notice in writing, prior to the holiday, to the Instructor and an Academic Counsellor if their course requirements will be affected by a religious observance. Additional information is given in the [Western Multicultural Calendar](#).

9. How to Be Successful in this Class:

Students enrolled in this class should understand the level of autonomy and self-discipline required to be successful.

1. Invest in a planner or application to keep track of your courses. Populate all your deadlines at the start of the term and schedule time at the start of each week to get organized and manage your time.
2. Make it a daily habit to log onto OWL to ensure you have seen everything posted to help you succeed in this class.
3. Follow weekly checklists created on OWL or create your own to help you stay on track.
4. Take notes as you go through the lesson material. Keeping handwritten notes or even notes on a regular Word document will help you learn more effectively.
5. Connect with others. Try forming a study group and try meeting on a weekly basis for study and peer support.
6. Do not be afraid to ask questions. If you are struggling with a topic, check the online discussion boards or contact your instructor(s) and or teaching assistant(s).
7. Reward yourself for successes. It seems easier to motivate ourselves knowing that there is something waiting for us at the end of the task.

10.   Continuity of Education Plan

In the event of a COVID-19 resurgence during the course that necessitates the university to direct courses move away from face-to-face interaction, all remaining course content will be delivered entirely online, either synchronously (i.e., at the times indicated in the timetable) or asynchronously (e.g., posted on OWL for students to view at their convenience). The grading

scheme will **not** change. Any remaining assessments will also be conducted online as determined by the course instructor.

11. Academic Offences

Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence.

All required papers may be subject to submission for textual similarity review to the commercial plagiarism detection software under license to the University for the detection of plagiarism. All papers submitted for such checking will be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between The University of Western Ontario and Turnitin.com (http://www.turnitin.com).

Please refer to the Western webpage on the use of AI such as ChatGPT.
Within this course, students are permitted to use AI tools exclusively for information gathering and preliminary research purposes. These tools are intended to enhance the learning experience by providing access to diverse information sources. However, it is essential that students critically evaluate the obtained information, exercise independent thinking, and engage in original research to synthesize and develop their own ideas, arguments and perspectives. The use of AI tools can serve as a starting point for exploring a topic, with students expected to uphold academic integrity by appropriately attributing all sources of information and avoiding plagiarism. Essays, written assignments and/or lab reports should reflect the student's own thoughts and independent written work. Students should also generate their own figures (e.g., graphs, diagrams) rather than using AI generated ones. By adhering to these guidelines, students contribute to a responsible and effective learning environment that promotes critical thinking, independent inquiry and all them to produce original written contributions. The same principles also apply to the use of translation software to support the writing the essays and other written assessments.

12. Western's Commitment to Accessibility

The Department of Geography and Environment strives at all times to provide accessibility to all faculty, staff, students and visitors in a way that respects the dignity and independence of people with disabilities.

Please contact the course instructor if you require material in an alternate format or if you require any other arrangements to make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 519-661-2147 for any specific question regarding an accommodation. Information regarding accommodation of exams is available on the Registrar's website.

More information about "Accessibility at Western" is available.

13.   Mental Health

If you or someone you know is experiencing distress, there are several resources here at Western to assist you. Please visit Western's Health and Wellness website (https://www.uwo.ca/health/) for more information on mental health resources.

14.   Support Services

Western's Support Services
Student Development Centre

Western is committed to reducing incidents of gender-based and sexual violence and providing compassionate support to anyone who has gone through these traumatic events. If you have experienced sexual or gender-based violence (either recently or in the past), you will find information about support services for survivors, including emergency contacts at https://www.uwo.ca/health/student_support/survivor_support/get-help.html.
To connect with a case manager or set up an appointment, please contact support@uwo.ca.

15.   Important Dates

Monday January 8: Classes resume
Tuesday January 16: Last day to add a second term half course
Monday February 19: Family Day – Department Office Closed
February 17 to February 25: Spring Reading Week (No classes; Department Office open)
Thursday March 7: Last day to drop a second term half course without academic penalty
Friday March 29: Good Friday – Department Office Closed
Monday April 8: Classes end
April 9 and 10: Study days
April 11-30: Examination Period