

GEOG 2230B – Remote Sensing

Course Outline: Section 001 Winter 2022

Note: This course is intended to be delivered in person. However, due to the current COVID situation, from January 10-31, it will be delivered online. From February 1, the delivery mode will be determined by the University depending on the COVID situation.

1. Technical Requirements for online learning



Stable internet connection



Laptop or computer



Working microphone



Working webcam



Zoom application installed



You will also need external storage units (a USB key or an external hard drive) for backing up lab data.

Lectures and lab sessions are synchronous via Zoom and you will need a computer or laptop, stable internet connection, a microphone and webcam to participate in those sessions.

Recommended technical specifications: <https://registrar.uwo.ca/academics/timetables.html>

Western Zoom webpage, including privacy information: <https://wts.uwo.ca/zoom/index.html>.

2. Course Information



	Delivery Mode	Day/Time	Location
Lecture 001	Online in Jan. From Feb: TBD	Tuesday/2:30-4:30	Online in January/ In person, FNB-3210
Lab 002	Online in Jan. From Feb: TBD	Wednesday/1:30-3:30	Online in January/ In person, SSC-1059
Lab 003	Online in Jan. From Feb: TBD	Thursday/11:30-1:30	Online in January/ In person, SSC-1059

*Details about design and delivery of the course are listed below in Section 5

Classes Start	Spring Reading Week	Classes End	Study day	Exam Period
January 10	February 21-25	April 8	April 9	April 10-30

January 18, 2022: Last day to add a second-term half course

March 7, 2022: Last day to drop a second term half course without penalty



Course Instructor	Contact Information	Office Hours
Dr. Jinfei Wang	Email address: jfwang@uwo.ca	Monday 2:30-4:30 pm

Teaching Assistant(s)	Contact Information	Office Hours
Wed lab: Victoria Barlow	vbarlow@uwo.ca	Wed. 3:30-5:30 pm
Thur. lab: Marco Chiu	Mchiu52@uwo.ca	Thur. 9:30-11:30 am
Lab support: Kathy Tang	ktang28@uwo.ca	

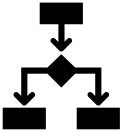


- For January 2022, drop in office hours will be held remotely using Zoom. You can find the Zoom links in OWL. From Feb., 2022, locations: TBA

3. 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 2142A/B](#), [Geography 2152F/G](#), [Geography 2153A/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."

4. 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)



5. Course Format

For Jan. 2022:

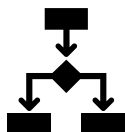
Mode	Dates	Time	Frequency
Virtual synchronous lectures	Tuesday	2:30-4:30 pm	weekly
Virtual synchronous lab session 002	Wednesday	1:30-3:30 pm	weekly
Virtual synchronous lab session 003	Thursday	11:30-1:30 pm	weekly

After Feb., 2022: TBD

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.

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. The penalty of a late assignment is 2^n percent of the maximum mark for the assignment, where n = number of days late. (i.e., If you are late one day, 2% off; two days, 4% off; three days, 8% off; four days, 16% off; five days, 32% off; six days, 64% off; seven days, 100% off).



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.

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.

6. 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...)
- Meteorological satellites (NOAA AVHRR, etc)
- and more ...

Tentative Schedule:

Week	Dates	Topic	Labs assigned	Lab due
1	Jan 10 – 14	Introduction to the course/ 1. Introduction to remote sensing	No lab	
2	Jan 17 – 21	1. Introduction to remote sensing	Lab #1	
3	Jan 24 – 28	2. Aerial photographs and photogrammetry	Lab #2	Lab #1 due
4	Jan 31 – Feb 4	2. Aerial photographs and photogrammetry	Lab #3	Lab#2 due
5	Feb 7 – 11	3. Digital image processing – image enhancement	Lab #4	Lab#3 due
6	Feb 14 – 18	4. Digital image processing – image classification	Lab #5	Lab #4 due
7	Feb 21 – 25	Reading Week	N/A	
8	Feb 28 - Mar 4	4. Digital image processing – image classification	Lab #6	Lab#5 due
9	Mar 7 – 11	4. Digital image processing – image classification	Lab #6	
10	Mar 14 – 18	5. Remote sensing image interpretation and applications 6. Remote sensing case studies	Lab #7	Lab #6 due
11	Mar 21 – 25	Student presentations		Lab#7 due
12	Mar 28 – Apr 1	Student presentations		
13	Apr 4 – 8	Student presentations		
14-15				Term paper due April 20



7. Communication



- Students should check the OWL site at least before lectures and labs.
- Students should email their instructor(s) and teaching assistant(s) using OWL “messages”
- For any other communication, the centrally administered **e-mail account** provided to students will be considered the individual’s official university e-mail address. It is the responsibility of the account holder to ensure that e-mail received from the University at his/her official university address is attended to in a timely manner. You can read about the privacy and security of the UWO email accounts [here](#).
- Emails will be monitored frequently; students will receive a response in 24 – 48 hours
- This course will use the OWL forum for discussions
- Students should post all course-related content on the discussion forum so that everyone can access answers to questions
- The discussion forums will be monitored by instructor or teaching assistants

8. Evaluation

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

Assessment	Format	Weighting	Due Date
Attendance and participation	Random attendance check	5%	Ongoing
Written and computer assignments	Written and computer labs	60%	See schedule table
Group presentation	Oral presentation Presentation ppt	10%	See schedule table
Final report	Written report	25%	In final exam period



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 (7%)
- Lab 2 Understanding spectral data collected by ASD spectrometer (7%)
- Lab 3 Photogrammetry and 3D reconstruction (10%)
- Lab 4 Satellite data downloading and displaying (8%)
- Lab 5 Digital image processing – Image enhancement (8%)
- Lab 6 Image classification I – Training data collection (10 %)
- Lab 7 Image classification II – Classification and accuracy assessment (10%)

Information about late or missed evaluations:

All assignments are due at the beginning of the next lab of your lab session: Wednesday labs are due at 1:30 pm on the due date. Thursday labs are due at 11:30 am on the due date. Presentation ppt and term papers are due at 11:55 pm EST on the due dates.

Late assignments without illness self-reports will be subject to a late penalty. The penalty of a late assignment is 2^n percent of the maximum mark for the assignment, where n = number of days late. (i.e., If you are late one day, 2% off; two days, 4% off; three days, 8% off; four days, 16% off; five days, 32% off; six days, 64% off; seven days, 100% off).

Late assignments with illness self-reports should be submitted within 24 hours of submission of the last illness self-report

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.

9. 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

Students will have up to two (2) opportunities during the regular academic year to use an on-line portal to self-report an absence during the term, provided the following conditions are met: the absence is no more than 48 hours in duration, and the assessment for which consideration is being sought is worth 30% or less of the student's final grade. Students are expected to contact their instructors within 24 hours of the end of the period of the self-reported absence, unless noted on the syllabus. Students are not able to use the self-reporting option in the following circumstances:

- for exams scheduled by the Office of the Registrar (e.g., December and April exams)
- absence of a duration greater than 48 hours,
- assessments worth more than 30% of the student's final grade,
- if a student has already used the self-reporting portal twice during the academic year

If the conditions for a Self-Reported Absence are *not* met, students will need to provide a Student Medical Certificate if the absence is medical, or provide appropriate documentation if there are compassionate grounds for the absence in question. Students are encouraged to contact their Faculty academic counselling office to obtain more information about the relevant documentation.

Students should also note that individual instructors are not permitted to receive documentation directly from a student, whether in support of an application for consideration on medical grounds, or for other reasons. **All documentation required for absences that are not covered by the Self-Reported Absence Policy must be submitted to the Academic Counselling office of a student's Home Faculty.**

For Western University policy on Consideration for Student Absence, see

[Policy on Academic Consideration for Student Absences - Undergraduate Students in First Entry Programs](#)

and for the Student Medical Certificate (SMC), see:

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/medicalform.pdf.

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](#).

10. 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.



11. Course delivery with respect to the COVID-19 pandemic

Although the intent is for this course to be delivered in-person, the changing COVID-19 landscape may necessitate some or all of the course to be delivered 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 assessments affected will be conducted online as determined by the course instructor.

12. Information on COVID-19

Masking Guidelines

Students will be expected to wear triple layer, non-medical, paper masks at all times in the classroom as per University policy and public health directives. Students who are unable to wear a mask must seek formal accommodation through Western Accessible Education, and present medical documentation.

Students are not permitted to eat or drink while in class to ensure masks stay in place. Students will be able to eat and drink outside of the classroom during scheduled breaks.

Students unwilling to wear a mask as stipulated by Western policy and public health directives will be referred to the Dean, and such actions will be considered a violation of the student Code of Conduct.

Course Absences due to Daily COVID Screening Questionnaire

Missed assessments (e.g., presentations, essays, quizzes, tests, midterms, etc.) require formal academic considerations (typically self-reported absences and/or academic counselling).

13. 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>).

14. 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.

15. 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 for more information on mental health resources.

16. Support Services

Western's Support Services
Student Development Centre

17. Important Dates

January 10: Classes resume

January 18: Last day to add a second term half course

February 21: Family Day – Department Office Closed

February 21-25: Spring Reading Week (No classes; Department Office open)

March 7: Last day to drop a first term half course without penalty

April 8: Classes end

April 9: Study day

April 10-31: Examination Period (excluding Fri Apr 15 thru Sun Apr 17)