

GEOGRAPHY 2230A

REMOTE SENSING

Fall 2013

Course Information:

Lecture: Wednesday 10:30 am - 12:30pm SSC 2333
Lab: Wednesday 4:30 pm - 6:30pm SSC 1316A

Instructor Information:

Instructor: Dr. Jinfei Wang, Professor, Department of Geography
Contact: Office: SSC.2402; Tel: 661-2111 ext.85017, E-mail: jfwang@uwo.ca
Office hours: Thursday 4:30 - 6:30 pm, or by appointment

Teaching Assistant: Bo Shan,

Office: SSC 2410; Tel: 226-919-9302; Email: boshan02@gmail.com
Office Hours: Wednesday 2:30 pm - 4:30 pm

Course 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.

Antirequisite(s): The former Geography 307a/b and 209a/b.

Prerequisite(s): 1.0 course from [Geography 1100](#), [1300A/B](#), [1400F/G](#), [1500F/G](#), [2131A/B](#), [2153A/B](#) (taken after [September 2012](#)), or the former Geography 020E; or completion of the second year of the Civil and Environmental Engineering, International Development Option; or enrollment in the Major in Physical Geography or in an Honors Earth Science Program for Professional Registration.

Adequate mathematical background is needed to be successful.

2 lecture hours, 2 laboratory hours, 0.5 course.

Prerequisite checking - the student's responsibility:

You are responsible for ensuring that you have successfully completed all course prerequisites, and that you have not taken an anti-requisite course. Lack of prerequisites may not be used as a basis for appeal. "Unless you have either the prerequisites for this course or written special permission from your Dean to enroll in it, you may 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."

Required Text:

Lillesand, T.M., Kiefer, R.W. and Chipman, J.W., 2008, "Remote Sensing and Image Interpretation", 6th Edition, John Wiley & Sons. (ISBN 978-0-470-05245-7).

Recommended Readings:

Jensen, J.R., 2005, "Introductory Digital Image Processing – A Remote Sensing Perspective", 3rd Edition, Prentice Hall. (ISBN 978-0-13-145361-0).

Berlin, G.L. and Avery, T.E., 2003, "Fundamentals of Remote Sensing and Airphoto Interpretation", 6th Ed., Prentice Hall. (ISBN 978-0-13-861006-7).

Richards, A. J. and Jia, X., 2006, "Remote Sensing Digital Image Analysis", 4th edition, Springer. (ISBN 978-3-540-25128-6).

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

Method of evaluation:

Lab. Assignments (6 labs)	40%
Attendance and participation	5%
Class Presentation	5%
Midterm test (Wed., Oct.30, 10:30am - 12:20pm, SSC 2333)	20%
Final exam (3 hours)	30%

Course Requirements:

1. Attendance: Each student is required to attend all the lectures and labs. Attendance can be taken randomly during any lecture and lab session.
2. Exams: All students are required to take the close-book midterm test and final exam. During the tests, basic calculators are permitted and no other electronic devices are allowed. There will be no make-up test for the midterm test. If you will miss the mid-term test under extreme circumstances, you must obtain permission from the Dean's office and provide sufficient documentation. When I receive the permission from the Dean's office, your final exam will account for 50%. If you miss the midterm with no good reason, you will receive no mark for the midterm. Make-up exams will be given for the final exam only under extreme circumstances. If you consider that you have grounds to write the final exam on an alternate date, you must follow the procedure established by the Dean's Office and complete the appropriate forms. You must obtain permission from the Dean's office and provide sufficient documentation, such as a Doctor's note. In addition, you must inform the instructor at least 2 days in advance before the final exam.
3. Lab assignments: You must attend all labs. You should observe all the due dates for assignments. Assignments are due during the lab hours of the assignment due dates. 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).
4. Missed assignment will receive no mark. In case of extreme circumstances and you need accommodation of less than 10% of the total grade, the instructor may allow extension provided that you submit proper documentation. If you need accommodation of more than 10% of the total grade, you must obtain permission from the Dean's office and provide sufficient documentation.
5. "For UWO Policy on Accommodation for Medical Illness and a downloadable SMC see: http://www.uwo.ca/univsec/handbook/appeals/accommodation_medical.pdf. Downloadable Student Medical Certificate (SMC): <https://studentservices.uwo.ca> under the Medical Documentation heading. Students seeking academic accommodation on medical grounds for any missed tests, exams, participation components and/or assignments worth 10% or more of their final grade must apply to the Academic Counselling office of their home Faculty and provide documentation. Academic accommodation cannot be granted by the instructor or department."
6. For both the exams and lab assignments, plagiarism or copying is unacceptable. Plagiarism is a major academic offence (see Scholastic Offence Policy in the Western Academic Calendar). Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of

what constitutes a Scholastic Offence, at the following Web site:

http://www.uwo.ca/univsec/handbook/appeals/scholastic_discipline_undergrad.pdf

7. Required for Labs 4, 5 and 6: 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. Please note: do not insert your USB with the data from the Windows system to a Mac computer, since this may cause errors on your data.
8. Each student will participate in a group presentation about remote sensing data. You will choose from a list of topics, conduct research and prepare a power point presentation.
9. Print credits: You will be given a limited number of free print credits for this course. If you need, you may purchase more credits for printing using the B/W laser printer(s) and colour laser(s) printer in the SDAL lab. So make sure you check your print balance often. Consult your TAs for details.

Additional information:

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 661-2111 x 82147 (<http://www.sdc.uwo.ca/>) for any specific question regarding an accommodation.

If you or someone you know is experiencing distress, there are several resources here at Western to assist you. Please visit <http://www.uwo.ca/uwocom/mentalhealth/> for more information on these resources and on mental health.

Lab assignments:

- Lab 0 Fundamentals of Remote Sensing (optional)
- Lab 1 Remote Sensing Field Work (7%)
- Lab 2 Aerial photographs (7%)
- Lab 3 Introduction to digital images (5%)
- Lab 4 Digital image processing using PCI Geomatica (7%)
- Lab 5 Image classification I using PCI Geomatica (7%)
- Lab 6 Image classification II using PCI Geomatica (7%)

Topics and Readings

1 Introduction to Remote Sensing

Readings: Lillesand and Kiefer, (6th Ed.): Chapter 1, pp. 1-51.

- 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

2 Aerial Photographs and Photogrammetry

Readings: Lillesand and Kiefer, (6th Ed.): Chapter 3, pp.123-188.

- Introduction
- Stereoscopy with aerial photographs
- Photo scale
- Relief displacement
- Image parallax
- Height measurement

3 Digital Image Processing - Image Enhancement

Readings: Lillesand and Kiefer, (6th Ed.): Chapter 7, pp.482-545.

- 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)

4 Digital Image Processing - Image Classification

Readings: Lillesand and Kiefer, (6th Ed.): Chapter 7, 545-610.

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

5 Remote sensing image interpretation and applications

Readings: Lillesand and Kiefer, (6th Ed.): Chapter 4, pp. 189-323.

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

6 Remote sensing case studies

7 Satellite Imagery (Student Presentations)

Readings: Lillesand and Kiefer, (6th Ed.): Chapters 6 and 8, pp. 392-481; 626-726.

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)
- Thermal images

Tentative Lecture/lab Schedule:

	Date	Lecture topics	Labs assigned	Lab due (at the beginning of the lab)
Week 1	Sept. 11	Introduction to the course		
			No lab	
Week 2	Sept. 18	1. Introduction to remote sensing		
			Lab #0 / Lab #1	
Week 3	Sept. 25	1. Introduction to remote sensing / Lab #1		
			Lab #1	
Week 4	Oct. 2	2. Aerial photographs and photogrammetry		
			Lab #1	(field camp)
Week 5	Oct. 9	2. Aerial photographs and photogrammetry		
			Lab #2	Lab#1 due Part of Lab#2 due
Week 6	Oct. 16	3. Digital image processing– image enhancement		
			Lab #3	Part of Lab#2 due
Week 7	Oct. 23	4. Digital image processing – image classification		
			Lab #4	Lab #3 due
Week 8	Oct. 30	Midterm test - October 30		
			Lab #5	
Week 9	Nov. 6	4. Digital image processing – image classification		
			Lab #5	Lab #4 due
Week 10	Nov. 13	5. Remote sensing image interpretation and applications		
			Lab #6	Lab #5 due
Week 11	Nov. 20	6. Remote sensing case studies; Final review.		
			Lab#6	Lab#6 due
Week 12	Nov. 27	Student presentations		
			Student presentations	
Week 13	Dec. 4	Student presentations		
Dec.	Check online	Final exam		

Last day of class: Dec. 6, 2013.