1. **Course Information**

   1.1. Classroom Location:
   
   Class Location and Time:
   
   Lecture:  Tuesday  2:30-4:30  UC 2110
   Lab 003: Wednesday  2:30-4:30  SSC 1059
   Lab 002: Thursday  12:30-2:30  SSC 1059

   1.2. Contact Information:
   
   Instructor: Dr. Jinfei Wang, Professor, Department of Geography
   Office: SSC 2402
   Office Hours: Monday 2:30-4:30
   Phone: 661-2111 x85017
   Email: jfwang@uwo.ca

   1.3. TA Information:
   
   Wednesday lab: Jody Yu, MSc. student. Office: SSC 2434; Email: jyu466@uwo.ca
   Office hours: TBA

   Thursday lab: Vali Vakhshoori, PhD student. Office: SSC 2417; Email: svakhsho@uwo.ca
   Office Hours: TBA

2. **Calendar Description**

   2.1. 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.
   
   2 lecture hours, 2 laboratory hours, 0.5 course

   Prerequisite(s):
   
   1.0 from Geography 1100, 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, or in the Commercial Aviation Management program in MOS.

   Adequate mathematical background is needed to be successful.

   Prerequisite checking is the student’s responsibility.

   2.2. Senate Regulations

   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**

**Required Text:**

**Recommended Readings:**

4. **Evaluation**

<table>
<thead>
<tr>
<th>Evaluation Components</th>
<th>Percentage of Course Grade</th>
<th>Assignment Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lab. Assignments (6 labs)</td>
<td>40%</td>
<td>See Schedule table</td>
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<tr>
<td>Attendance and participation</td>
<td>5%</td>
<td>Ongoing</td>
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<tr>
<td>Class presentation</td>
<td>10%</td>
<td>TBA</td>
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<tr>
<td>Midterm test</td>
<td>15%</td>
<td>Tue., Oct. 22, 2:30pm-4:20pm, UC 2110</td>
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<tr>
<td>Final Exam</td>
<td>30%</td>
<td>TBA</td>
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</tbody>
</table>

**Lab assignments:**
- Lab 0  Fundamentals of Remote Sensing (optional)
- Lab 1  Remote Sensing Field Work (7%)
- Lab 2  Anaglyph 3D and Photogrammetry (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%)

5. **Course requirements**

Students are responsible for material covered in the lectures as well as the assigned chapters/sections in the text.
a. Attendance and participation: Each student is required to attend all the lectures and labs. Attendance can be taken randomly during any lecture and lab session. Participation includes in class exercises (non-graded).

b. Exams: All students are required to take the close-book midterm test and final exam. During the tests, scientific 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 45%. 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.

c. 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 $n = \text{number of days late}$. (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).

d. 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.

e. 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.

f. Each student will participate in a group presentation about remote sensing data (2 students per group). You will choose from a list of topics, conduct research and prepare a power point presentation.

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. Requesting Academic Consideration

Students who experience an extenuating circumstance (illness, injury, or other extenuating circumstance) sufficiently significant to temporarily render them unable to meet academic requirements may submit a request for academic consideration through the following routes:

(i) Submitting a Self-Reported Absence form provided that the conditions for submission are met;
(ii) For medical absences, submitting a Student Medical Certificate (SMC) signed by a licensed medical or mental health practitioner in order to be eligible for Academic Consideration; or
(iii) For non-medical absences, submitting appropriate documentation (e.g., obituary, police report, accident report, court order, etc.) to Academic Counselling in their Faculty of registration in order to be eligible for academic consideration. Students are encouraged to contact their Academic Counselling unit to clarify what documentation is appropriate.

Students seeking academic consideration:

- are advised to consider carefully the implications of postponing tests or midterm exams or delaying handing in work;
- are encouraged to make appropriate decisions based on their specific circumstances, recognizing that minor ailments (upset stomach) or upsets (argument with a friend) are not normally an appropriate basis for a self-reported absence;
- must communicate with their instructors no later than 24 hours after the end of the period covered by either the self-reported absence or SMC, or immediately upon their return following a documented absence.

Academic consideration is not normally intended for the following circumstances:

- **Students who require academic accommodation based on an ongoing physical or mental illness (recurring or chronic) or an existing disability.** Students with an ongoing physical illness or mental disorder (recurring or chronic) or an existing disability are responsible, in consultation with their doctors or other health professionals, to determine if they are capable of pursuing their studies and, if so, with what accommodations. Students are expected to seek and arrange reasonable accommodations with Student Accessibility Services (SAS) as soon as possible in accordance with the Policy on Academic Accommodation for Students with Disability. Students with pre-existing accessibility plans arranged through SAS may not need to provide additional documentation when seeking academic consideration where such request for consideration relates to their disability and where their accessibility plans allow for coursework deferral or deadline extensions.
- **Students who experience high levels of stress related to academic performance** (including completing assignments, taking part in presentations, or writing tests or examinations). Students with academic or exam stress should access supports through Student Health and Wellness and Learning Skills Services in order to deal with this stress in a proactive and constructive manner.
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.

7. Make-up Examinations
Makeups will be granted with approved documentation only. All documentation for missed exams must be provided to the Academic Counselling Office and Instructor within 48 hours of the scheduled exam. For missed exams, you must take your documentation to Academic Counselling within 48 hours of the exam. Otherwise, the instructor will assign a grade of zero. The format and content of make-ups may differ substantially from the scheduled test or examination.

8. Use of Electronic Devices
During the tests, scientific calculators are permitted and no other electronic devices are allowed.

9. 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).

Computer-marked multiple-choice tests and/or exams may be subject to submission for similarity review by software that will check for unusual coincidences in answer patterns that may indicate cheating.

10. Western’s Commitment to Accessibility
The Department of Geography 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.

11. Medical Issues
The University recognizes that a student’s ability to meet his/her academic responsibilities may, on occasion, be impaired by medical illness. The Student Services website provides greater detail about the University’s policy on medical accommodation. This site provides links the necessary forms. In the event of illness, you should contact Academic Counselling as soon as possible. The Academic Counsellors will determine, in consultation with the student, whether or not accommodation should be requested. They will subsequently contact the instructors in the
relevant courses about the accommodation. Once the instructor has made a decision about whether to grant an accommodation, the student should contact his/her instructors to determine a new due date for tests, assignments, and exams.

Students must see the Academic Counsellor and submit all required documentation in order to be approved for certain accommodation.

12. 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.

13. Support Services
   - Student Support Services
   - Student Development Services

14. Important Dates

   September 5: Classes resume
   September 13: Last day to add a first term half course
   October 14: Thanksgiving Holiday – Department Office Closed
   November 4 to November 10: Fall Reading Week (No classes; Department Office open)
   November 12: Last day to drop a first term half course without penalty
   November 30: Last day to drop a full course without penalty
   December 5: Classes end
   December 6 and 7: Study days
   December 8-19: Examination Period

15. Topics

1. Introduction to Remote Sensing
   **Readings:** Lillesand and Kiefer, (7th Ed.): Chapter 1, pp. 1-58.
   (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 analog / digital images and Photogrammetry
   (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
   (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
   (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, (7th Ed.): Chapter 1, pp.59-84; Chapter 8, pp. 609-698.
   (Lillesand and Kiefer, (6th Ed.): Chapter 4, pp. 189-323.)
   • Land use/land cover mapping
   • Agricultural applicatinon
   • Forestry application
   • Water resource application
   • Urban application
   • Terrain analysis; Geologic/Geomorphiic application

6. Remote sensing case studies

7. 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.
   (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)
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<thead>
<tr>
<th>Week</th>
<th>Date of Monday</th>
<th>Lecture topics</th>
<th>Labs assigned</th>
<th>Lab due (at the beginning of the lab)</th>
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<td>Sept. 2</td>
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<td>No lab</td>
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<td>Sept. 9</td>
<td>Introduction to the course/ 1. Introduction to remote sensing</td>
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<td>1. Introduction to remote sensing</td>
<td>Lab #1</td>
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<td>4</td>
<td>Sept. 23</td>
<td>2. Aerial photographs and photogrammetry</td>
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<td>5</td>
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<td>2. Aerial photographs and photogrammetry</td>
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<td>Oct. 7</td>
<td>3. Digital image processing– image enhancement</td>
<td>Lab #3</td>
<td>Lab#2 due</td>
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<td>4. Digital image processing – image classification</td>
<td>Lab #4</td>
<td>Lab #3 due</td>
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<td>Oct. 21</td>
<td>Midterm test - October 22</td>
<td>Lab #4</td>
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<td>9</td>
<td>Oct. 28</td>
<td>4. Digital image processing – image classification</td>
<td>Lab #5</td>
<td>Lab #4 due</td>
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<td>Nov. 4</td>
<td>Fall Reading week (No class)</td>
<td>No lab</td>
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<td>Nov. 11</td>
<td>5. Remote sensing image interpretation and applications</td>
<td>Lab #6</td>
<td>Lab #5 due</td>
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<td>Nov. 18</td>
<td>6. Remote sensing case studies</td>
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<td>13</td>
<td>Nov. 25</td>
<td>Student presentations</td>
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<tr>
<td>14</td>
<td>Dec. 2</td>
<td>Student presentations</td>
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Last day of classes: Dec. 5, 2019.