GEOM 3002 **Air Photo Interpretation and Remote Sensing** **Fall 2018**

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Office Hours Wednesday 10:00-12:00 or during the labs. Please drop by or e-mail me to set an appointment.

T.A. TBA

Schedule Two-hour lecture and two-hour laboratory
Details to be presented in the first lecture.

Prerequisite
GEOM 1004 AND 2nd year standing, OR permission of department. Students without these should see me after the 1st class to discuss.

Some understanding on the part of the student of spatial patterns on the Earth's surface and of maps and scales is assumed. Experience with GIS software (as in GEOM 1004 or GEOM 2007) and basic mathematics and statistics (e.g. GEOG/ENST 2006) is beneficial. Some use of calculators is required in labs and exams.

Objectives / Summary
Lectures provide the conceptual and technical background related to image formation and spectral reflectance theory, visual interpretation of images, image enhancement, types of remote sensors currently in use, thematic mapping using remotely sensed imagery, and other applications of remote sensing. Labs offer an opportunity for students to apply these concepts and techniques with field spectral reflectance data, aerial photographs and satellite imagery in visual and computer-based interpretation and mapping of land use/land cover, landforms and surface materials in rural and urban environments. This course provides a foundation for GEOM 4003W, Remote Sensing of the Environment, a digital image analysis course where quantitative modelling, mapping and temporal analysis techniques are presented for the major applications of remote sensing.

Course Contents
a) Aerial photography: stereo visual interpretation of archival hardcopy photos and of on-screen digital photos; interpretation and analysis of the landforms and surface materials, land use/cultural patterns and landscape change analysis; camera/sensor formats, geometry and their use in flight planning for aircraft or UAV-based imaging.

b) The electromagnetic spectrum and sensors: the physical basis for remote sensing; the nature of Earth surface reflectance/emittance; spectral reflectance curves; overview of remote sensors and platforms.

c) Digital multispectral imagery: colour and false colour image display; linking image brightness to spectral reflectance of land cover types at various wavelengths; analysis of multispectral image data and statistics; image processing to reduce noise and defects, and to enhance imagery for visual interpretation and feature detection.

d) Semi-automated and automated thematic classification for mapping of land cover/land use.

Recommended Texts on Reserve in Library in ARES
I have found the best overall text on remote sensing and image interpretation for this course to be:
Lillesand, T., R. Kiefer, and J. Chipman. 2015. Remote sensing and image interpretation. 7th edition. John Wiley and Sons. Toronto. **Ordered for Bookstore and available online.** Note: this text is available in e-book version for 1/3 the price at the Wiley Website:
http://ca.wiley.com/WileyCDA/WileyTitle/productCd-EHEP003336.html

Other good texts that present additional course detail for certain topics or a different perspective are:

Jensen, J. R. 2015. Introductory digital image processing: A remote sensing perspective, 4th edition. Prentice-Hall. A bit more quantitative, showing more on how algorithms work than Lillesand et al.

Campbell, J.B. and R. H. Wynne. 2011. Introduction to Remote Sensing, 5th ed. Guilford Press.

Jensen, J.R. 2007. Remote Sensing of the Environment: An Earth Resource Perspective. 2nd edition. Prentice-Hall. An applications-based text. E.g. Water, Vegetation etc.

For air photos and interpretation:
Read, R. and R. Graham. 2002. Manual of aerial survey: primary data acquisition. CRC Press/Whittles Publishing, Boca Raton, FL.

Bird, S.J.G. and I.M. Hale. 1993. Air Photo Interpretation of the Physical Environment. Bird and Hale Consultants, Toronto. Old, but has examples from Ontario. **I have a copy of this and we will use photo examples from it.**

Websites with Remote Sensing Tutorials: e.g.,
http://www.nrcan.gc.ca/earth-sciences/geography-boundary/remote-sensing/fundamentals/1430
A PDF of the whole tutorial can also be downloaded at this site.

Evaluation

Lab reports	60%
Final examination	40%

Standing in a course is determined by the course instructor subject to the approval of the Faculty Dean. This means that grades submitted by the instructor may be subject to revision. No grades are final until they have been approved by the Dean.

Lab work
Labs are in A211 Loeb for Weeks 1-3, and in A237 Loeb for the rest of the term. They consist of a combination of visual interpretation of hardcopy images, theoretical/descriptive questions, work with a spectro-radiometer, and computer-based image analysis and mapping. They are 1-3 weeks in duration and will be handed back within 2 weeks. Each week of lab work is generally worth 5%. The lecture and lab schedule will be presented in the 1st lecture.

Deadlines: All labs are due within 1 hour of the beginning of your lab period on the due date.

After that, 10% of the lab worth will be deducted per day, starting on the day it is due. i.e., If your lab is due at 2:30 PM on Wednesday, but the TA receives it Friday evening, you will lose 10% for the rest of Wednesday, 10% for Thursday, and 10% for Friday, as it was handed in after 2:30 – the time of the lab) i.e. 30% total. If you finish a lab on the weekend, hand it in through cuLearn right away as each day on the weekend counts as 10% (you may need to scan the lab if you use the paper format (e.g. for in Labs 2 and 3).

You may collaborate with others in working through the assignments, but you must prepare and submit your own separate lab report, written in your own words, which clearly demonstrates your understanding, interpretation and analysis. The goal is to learn the material on your own, so try to avoid depending on others for answers to questions in the assignments and try not to give blatant answers to others (see plagiarism note below).

Exam
Combination of multiple choice, short answer, and long answer (synthesis) questions. No aids except calculator. The exam will be discussed, including sample exam questions and a summary of the course, at the end of the course.

Plagiarism
Remember that plagiarism is an offence at Carleton University. Plagiarism is a violation of the academic code of conduct: http://www2.carleton.ca/studentaffairs/academic-integrity
The University Senate defines plagiarism as "*presenting, whether intentionally or not, the ideas, expression of ideas or work of others as one's own.*" This can include:

- reproducing or paraphrasing portions of someone else's published or unpublished material, regardless of the source, and presenting these as one's own without proper citation or reference to the original source;
- submitting a take-home examination, essay, laboratory report or other assignment written, in whole or in part, by someone else;
- using ideas or direct, verbatim quotations, or paraphrased material, concepts, or ideas without appropriate acknowledgment in any academic assignment;
- using another's data or research findings;
- failing to acknowledge sources through the use of proper citations when using another's works and/or failing to use quotation marks;
- handing in "substantially the same piece of work for academic credit more than once without prior written permission of the course instructor in which the submission occurs."

Plagiarism is a serious offence that cannot be resolved directly by the course's instructor. The Associate Dean of the Faculty conducts a rigorous investigation, including an interview with the student, when an instructor suspects a piece of work has been plagiarized. Penalties are not trivial. They can include a final grade of "F" for the course.

Academic Accommodation
You may need special arrangements to meet your academic obligations during the term. For an accommodation request, the processes are as follows:

Pregnancy obligation
Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist.

For more details, visit the Equity Services website: **carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf**

Religious obligation
Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, visit the Equity Services website: **carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf**

Academic Accommodations for Students with Disabilities
If you have a documented disability requiring academic accommodations in this course, please contact the Paul Menton Centre for Students with Disabilities (PMC) at 613-520-6608 or pmc@carleton.ca for a formal evaluation or contact your PMC coordinator to send your instructor your Letter of Accommodation at the beginning of the term. You must also contact the PMC no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). After requesting accommodation from PMC, meet with your instructor as soon as possible to ensure accommodation arrangements are made. **carleton.ca/pmc**

Survivors of Sexual Violence
As a community, Carleton University is committed to maintaining a positive learning, working and living environment where sexual violence will not be tolerated, and its survivors are supported through academic accommodations as per Carleton's Sexual Violence Policy. For more information about the services available at the university and to obtain information about sexual violence and/or support, visit: **carleton.ca/sexual-violence-support**

Accommodation for Student Activities
Carleton University recognizes the substantial benefits, both to the individual student and for the university, that result from a student participating in activities beyond the classroom experience. Reasonable accommodation must be provided to students who compete or perform at the national or international level. Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. **https://carleton.ca/senate/wp-content/uploads/Accommodation-for-Student-Activities-1.pdf**

For more information on academic accommodation, please contact the departmental administrator or visit: **students.carleton.ca/course-outline**

GEOM 3002, Air Photo Interpretation and Remote Sensing
Tentative Schedule, 2018

All labs are due at the beginning of your lab period on the date given unless otherwise noted. **10% of the lab's worth is deducted for each day late; the 1st day late starts 1 hour after the time due because I don't want you scrambling to finish a lab when we are starting a new lab.**

Try to never hand in something late. It is the most common reason for grades that don't reflect a student's capabilities.

Notes:

- Labs 2 and 3 should be completed during the lab period plus perhaps 1-2 hours in the library.
- Lecture dates are tentative. If we don't finish a lecture in a given week we will complete it the following week. All labs will be give after the lecture material is presented.

LECTURES	LABS
	Sept. 5, 6: No lab
Sept 11: Lecture 1 Course introduction. • What is Remote Sensing?	**Lab 1 presented and discussed in Lecture 1. Do not go to your lab period Sept 12 or 13.** Applications in remote sensing. Reading/writing assignment. **Due in cuLearn before the Sept 18 lecture. 5%.**
Sept 18: Lecture 2 Elements of visual image interpretation. **Lab 1 due before lecture.**	**Sept 19, 20 Loeb A211: Lab 2** Elements of visual image interpretation. **Due Sept 26, 27. 5%.** Stereoscope sign-out
Sept 25: Lecture 3 Interpretation of landforms and surface materials in aerial photographs.	**Sept 26, 27 Loeb A211: Lab 3** Interpretation of landforms and surface materials in aerial photographs. **Due Oct 3, 4. 5%.**
Oct 2: Lecture 4 A. Image Geometry, Flight Planning, Photogrammetry. B. Thematic mapping of Land cover/Land use.	**Oct 3, 4: Lab 4** A. Interpretation and mapping of land use/land cover in Ottawa in digital aerial imagery. B. Image geometry and flight planning. **Due Oct. 17, 18. 10%**
Oct 9: Lecture 5 Introduction to electromagnetic radiation and spectral reflectance in remote sensing.	**Oct 10, 11: Lab 4 (cont'd)**
Oct 16: Lecture 6 Introduction to digital imagery, colour infrared composite and pseudo colour display, spectral analysis of land cover types, histogram analysis, contrast enhancement, edge enhancement and noise reduction.	**Oct 17, 18 Loeb A237: Lab 5** A. Introduction to electromagnetic radiation and spectral reflectance as applicable to remote sensing. Use spectro-radiometer outside to obtain and analyze spectral reflectance curves for various land cover types. (See Lecture 5) B. Start work with PCI Geomatica software.

Start Lecture 7: Remote sensors.	Introduction to display, processing and analysis of digital images as 'data'; spectral analysis of land cover types and Landsat OLI imagery. See Lecture 6) **Due Oct 31, Nov 1. 10%.**
<u>Oct 23</u> **Fall Break – no lecture**	**No lab period this week. Work on Lab 5**
<u>Oct 30: Lecture 7 (Cont'd)</u> Remote Sensors	**<u>Oct 31, Nov 1 Loeb A237: Lab 6</u>** Image processing: sharpening; edge detection; noise reduction (See Lecture 6) **Due Nov 7, 8. 5%**
<u>Nov 6: Lecture 8</u> Unsupervised classification for thematic mapping of Land cover / Land use. Accuracy assessment of thematic maps.	**<u>Nov 7, 8 Loeb A237: Lab 7</u>** Unsupervised classification for land cover / land use mapping using Landsat data (see Lecture 8). **Due: Nov 14, 15: 5%**
<u>Nov 13: Lecture 9</u> Supervised classification for thematic mapping of Land cover / Land use. Accuracy assessment of thematic maps.	**<u>Nov 14, 15 Loeb A237: Lab 8</u>** Supervised classification for land cover / land use mapping using Landsat data; accuracy assessment of thematic maps. (see Lecture 9). **Due: Dec 5, 6. 15%**
<u>Nov 20: Lecture 9 (cont'd)</u> **Guest Speaker**: TBA	**<u>Nov 21, 22 Loeb A237: Lab 8 (cont'd)</u>**
<u>Nov 27: Lecture 10</u> Remote sensing applications. **Hand out** – Sample exam questions and course summary to review in lecture Dec. 9.	**<u>Nov 28, 29 Loeb A237: Lab 8 (cont'd)</u>**

Dec 4: Lecture 10 (cont'd) Course summary, take-up sample exam questions, discuss exam and answer questions on course content.	**Dec 5, 6** No lab