GEOM 3002	**Air Photo Interpretation and Remote Sensing**	**Fall 2016**

Instructor Doug King, Loeb B351
doug.king@carleton.ca

Office Hours Tuesday 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, OR 3rd 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. Basic mathematics and statistics background 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 in visual and computer-based identification, interpretation and mapping of Earth surface landforms and materials, urban environments, and land use/land cover mapping using aerial photographs and digital satellite imagery. This course provides a foundation for GEOM 4003W, Remote Sensing of the Environment, a digital image analysis course where quantitative modelling and thematic mapping 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; the elements of interpretation; interpretation of the landforms, surface materials, and land use/cultural patterns; landscape change analysis; camera/sensor formats, geometry, and flight planning for aircraft and 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) Introduction to digital image processing and classification: image processing to reduce noise and defects and to enhance imagery for visual interpretation and feature detection; automated thematic classification for mapping of land cover types.

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.

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. **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 the first part of term and in A237 Loeb for the second part. They consist of a combination of visual interpretation of hardcopy images, theoretical/descriptive questions, work with a spectro-radiometer, and computer analysis. They are one or two 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 Tuesday, but the TA receives it Friday evening, you will lose 10% for the rest of Tuesday, 10% for Wednesday, 10% for Thursday, and 10% for Friday, as it was handed in after 2:30 – the time of the lab) i.e. 40% 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. in Labs 2-4).

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.

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: write to me 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 see the Student Guide
- Religious obligation: write to me 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 see the Student Guide

Academic Accommodations for Students with Disabilities: The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or pmc@carleton.ca for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send me your Letter of Accommodation at the beginning of the term, and 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 me to ensure accommodation arrangements are made. Please consult the PMC website for the deadline to request accommodations for the formally-scheduled exam (if applicable).

GEOM 3002, Air Photo Interpretation and Remote Sensing
Tentative Schedule, 2016

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.**

i.e., Given labs are due on Tuesdays (Group 2) and Fridays (Group 1) at the beginning of your lab period, the rest of day up to midnight counts as 1 day late. Weekends up to Monday 8:00 AM count as 1 day late.

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, 3, 4 are in-class labs that should be completed during the lab period plus 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.

WEEK	LECTURE TOPICS	LABS	WHAT IS DUE BY BEGINNING OF LAB
1	**Sept 12: Lecture 1** Course introduction. • What is Remote Sensing? **Lab 1** Applications in remote sensing. Reading/writing assignment. **5%.** **Due in cuLearn before the Sept 19 lecture.**	**No lab period this week. Lab 1 discussed in Lecture 1.**	**Sept 13, 16** Nothing due; no need to go to lab.
2	**Sept 19: Lecture 2** Elements of visual image interpretation. **Lab 1 due before lecture.**	**Sept 20, 23 Loeb A211: Lab 2** Elements of visual image interpretation. **Due Sept 27, 30. 5%.** Stereoscope sign-out	**Sept 20, 23** Nothing due during your lab this week.
3	**Sept 26: Lecture 3** Interpretation of glacial landforms and surface materials in aerial photographs.	**Sept 27, 30 Loeb A211: Lab 3** Interpretation of glacial landforms and surface materials in aerial photographs. **Due Oct 4, 7. 5%.**	**Sept 27, 30** Lab 2 due.
4	**Oct 3: Lecture 4** Interpretation of other landforms and surface materials in aerial photos.	**Oct 4, 7 Loeb A211: Lab 4** Interpretation of other landforms and surface materials in aerial photos. **Due Oct. 11, 14. 5%**	**Oct. 4, 7** Lab 3 due.

5	**<u>Oct 10</u>** **Thanksgiving – no lecture**	**<u>Oct 11, 14</u>** No lab period this week.	**<u>Oct 11, 14</u>** Lab 4 due
6	**<u>Oct 17: Lecture 5</u>** A: Thematic mapping of Land cover/Land use. B. Image Geometry, Flight Planning, Photogrammetry, Ortho-Imaging.	**<u>Oct 18, 21 Loeb A237: Lab 5</u>** A: Image Geometry and Flight Planning. B: Thematic mapping of Land use/Land cover in Ottawa using visual interpretation of digital aerial imagery. **Due Nov. 1, 4. 10%.**	**<u>Oct 18, 21</u>** Nothing due
	<u>Oct 24</u> **Fall Break – no lecture**	**No lab period this week.** **Don't fall behind on Lab 5**	**<u>Oct 25, 28</u>** No lab
7	**<u>Oct 31: Lecture 6</u>** Introduction to electromagnetic radiation and spectral reflectance in remote sensing. **Guest Lecture:** Alex Foster – *Assessing long-term wetland change in eastern Ontario using archived air photos*	**<u>Nov 1, 4 Loeb A237: Lab 6</u>** Tutorial on PCI Geomatica Software. A. Introduction to electromagnetic radiation and spectral reflectance as applicable to remote sensing. (see Lecture 6). Measure ground target reflectance outside. B. Introduction to display, processing and analysis of digital images as 'data'; spectral analysis of land cover types (see Lecture 7), and Landsat TM imagery. **Due Nov. 15, 18. 15%.**	**<u>Nov 1, 4</u>** Lab 5 due
8	**<u>Nov 7: Finish Lecture 6,</u>** **<u>Start Lecture 7</u>** 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.	**<u>Nov 8, 11 Loeb A237: Lab 6</u>** (cont'd)	**<u>Nov 8, 11</u>** Nothing due
9	**<u>Nov 14: Finish Lecture 7,</u>** **<u>Start Lecture 8</u>** Remote Sensors	**<u>Nov 15, 18 Loeb A237: Lab 7</u>** A. Edge enhancement and noise reduction (see Lecture 7). B. Thematic mapping - Land cover / Land use mapping using Landsat data and unsupervised classification (see Lecture 9). **Due Dec 6, 9. 15%**	**<u>Nov 15, 18</u>** Lab 6 due

10	**<u>Nov 21: Finish Lecture 8,</u>** **<u>Start Lecture 9</u>** Thematic mapping - Land cover / Land use mapping using computer-based unsupervised classification algorithms.	**<u>Nov 22, 25 Lab 7 (cont'd)</u>**	**<u>Nov 22, 25</u>** Nothing due
11	**<u>Nov 28: Finish Lecture 9,</u>** **<u>Start Lecture 10</u>** Remote sensing applications.	**<u>Nov 29, Dec 2 Lab 7 (cont'd)</u>**	**<u>Nov. 29, Dec 2</u>** Nothing due.
12	**<u>Dec 5: Finish Lecture 10</u>** **Guest speaker**: Niloofar Alavi –*Multi spatial and temporal scale modelling of biodiversity in eastern Ontario farmland using MODIS and Landsat data* **Hand out** – Sample exam questions and course summary to review in lecture Dec. 9.	**<u>Dec 6, 9</u>** No new lab	**<u>Dec 6, 9</u>** Lab 7 due
	<u>Dec 9 (Friday)</u> Course summary, take-up sample exam questions, discuss exam and answer questions on course content.		