Department of Geography/
Environmental and Resource Studies Program

GEOG /ERSC 3020H:

Remote Sensing of the Environment

2010-11 (FA)
Peterborough

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Course Description:

1. Introduction

The interconnection between local and global processes is undeniable. The multi-scale and temporal nature of current environmental problems coupled to the increasing availability of dedicated remote sensing platforms, from hand-held devices to orbiting satellites, makes the use of modern assessment and monitoring technologies imperative. These remote sensing technologies can attain instantaneous information on a host of variables relevant to important aspects of the environment over large expanses of landscape, whether locally, regionally, continentally or globally. Knowledge about the manner, process and timeliness in

which those data are attained, the technical details of data processing and their interpretation for specific purposes, are imperatives in modern environmental assessment and monitoring processes. This course introduces students to the science and technology and environmental applications of Remote Sensing.

2. Course Objectives.

This course has as its main objectives the following:

a). Introduce the theoretical elements underpinning Remote Sensing, its capabilities and functions, and to offer practical exposure to its environmental applications.
b). Initiate students in the development of skills in the acquisition, treatment and analysis of Remote Sensing data and their application to environmental assessment through the practical use of industry-standard software.
c). Provide opportunities for applying Remote Sensing concepts and procedures within an environmental assessment and problem-solving framework.

Course Pre-requisites: (consult the academic calendar)

Course Fees: A fee (between $5.00 and $10.00) may be applicable to recover costs of printing the lab manual.

Course Format: The course consists of one two-hour lectures weekly and one 3-hour computer lab fortnightly, delivered as follows:

Type	Day	Time	Location
Lectures (weekly)	Tuesdays	10:00- 11:50	DNA B104
Labs (fortnightly)	Wednesdays	9:00- 11:50	SC 207

Remote Sensing laboratory: This course is based on the application of Remote Sensing concepts and theory through practical exercises. Due to limited capacity in the **GEOMATICS LAB (SC 207)** there may be lab groups (see below) from which students can choose. Registration into a selected lab group will be arranged during the first lecture.

Lab Manual: A lab manual is essential for the practical part of this course. The manual can be acquired on the first lecture, or later from either the TA or the instructor.

Lab Sessions.

The lab sessions will be fortnightly. The lab manual must be read in advance of every lab session (a pre-lab quiz on MLS will be applied). Depending on enrollment and availability of equipment, there may be a need to create lab groups within the scheduled times:

Lab	Day	Time	Location	TA

Group				
A	Wednesday	9:00 – 11:50	SC 207	Chad Cordes
B	Wednesday (alternate week)	9:00 – 11:50	SC 207	Chad Cordes

***Important Notice Concerning the Length of Assignments*:** Due to an expected wide range of computer backgrounds, skills and abilities amongst students, the successful completion of some of the lab assignments **may require work in excess of the hours scheduled for the lab in the calendar and time-table.** The time necessary for completion of a given assignment will depend on individual ability and dedication**.**

Course Evaluation:

The course will be evaluated as per the following components:

Type of Assignment / test	Weighting	Due Date*
Lab assignment reports:	Total 55%	* ***Lab due dates:*** Unless otherwise indicated, the lab assignments are automatically due at the end of the day (4:30 PM) **prior the day of the next lab session, without exemptions**.
Lab 1	10%	
Lab 2	10%	
Lab 3	10%	
Lab 4	10%	
Lab 5	15%	
Mid-term quiz	15%	Tues, Nov 2^{d} (30 minutes, in lecture)
Final Examination	30%	See calendar

Pre-Lab Quiz: Since practical work is fundamental in Remote Sensing, preparation for laboratory exercises is deemed essential. Therefore, there will be a short pre-lab quiz on MLS that requires reading in preparation for every lab session. This quiz will be worth 10% of the lab mark for a given lab.

MyLearningSystem and Internet resources

This course uses MyLearningSystem for delivery of lecture materials, readings, notices and other course-related items. As possible, the features of MyLearningSystem will be utilized. Other internet resources may be used for particular topics. Dynamic links, for additional readings, will be provided via MyLearningSystem or in lecture, as required.

Required Texts: (There are no required texts for this course)

Recommended Texts: Organized in terms of relevance to the course:

1. Jensen, J. R. (2007) Remote Sensing of the Environment. 2nd Edition. Pearson-Prentice Hall, N.J.
2. Lillesand, T.M., R.W. Kiefer and J. W. Chipman (2008) Remote Sensing and Image Interpretation. 6th Edition. Wiley, N.Y.
3. Campbell, J. B. (2007) Introduction to Remote Sensing. 4th Edition, Guildford Press, N.Y.
4. Liang, S. (2004) Quantitative Remote Sensing of Land Surfaces . Wiley Series in Remote Sensing. John Wiley & Sons. N.Y.

Course Outline

Week	Date	Lecture	Lab
1	Sept 14	1. Part I: Introduction. Contemporary environmental problems and remote sensing. Current trends in monitoring the environment. 2. Part II: Remote Sensing Principles: Physical basis of remote sensing. Platforms and Sensors for Environmental Monitoring: Airborne Photography	No Labs this week Lab groups confirmed & Lab manual distributed.
2	Sept 21	3. Principles of Air-photogrammetry & Air-photo Interpretation (API): -Geometries, Scale, Area Measurement, Relief, Displacement, Parallax, Orthophotography. - Elements, Aids, Techniques, Methods and Procedures. - Environmental and Natural Resource Applications 4. Platforms and Sensors: Satellite Multi-Spectral Systems - Satellite Platforms, Main Satellite Missions - Spatial, Spectral, Temporal, and Radiometric Resolutions	
	Sept 22		Lab 1: Group A
3	Sept 28	5. Multispectral Scanning Systems: - Across-Track Scanners (AVHRR, Landsat MSS, Landsat TM and ETM+; Daedalus TMS). - Linear (along-track) Array Scanners (SPOT, IRS). - High Resolution Satellite Systems (Ikonos, Quickbird) 6. Remote Sensing in the Thermal Infrared Spectrum - Thermal Radiation Principles. -. Sensor System Characteristics - Detectors, IFOV, Sensitivity - Interpretation of Thermal Scanning Imagery - Thermal Mapping with Thermal Scanner Data	
	Sept 29		Lab 1: Group B

Week	Date	Lecture	Lab
4	Oct 5	7. PART III : Remote Sensing Image Analysis: The Visible, Infrared and Thermal Spectra -Data acquisition, Image Statistics. - Image Pre-processing: Radiometric and Geometric Corrections- -. Image Enhancement - Contrast Enhancement- Spatial Filtering to - Special Transformations- Band Ratios, Band Ratio Indices and Vegetation Indices - Principal Components Analysis and 8. Thematic Information Extraction and Image Classification – - Unsupervised Classification , - Supervised Classification Algorithms- - Knowledge-Based and Fuzzy Classification – - Land-Use Classification and Map Accuracy Assessment - Digital Change Detection and Change Detection Algorithms	
	Oct 6		Lab 2: Group A
5	Oct 12	9. Hyper-Spectral Remote Sensing - Principles of Hyper-spectral Imaging - Sensors (AIS, AVIRIS, CASI, Hymap, Hyperion, Orbview) - Applications 10. Active and Passive Microwave Remote Sensing (RADAR) - Principles: Passive and Active Microwave Sensing - Active Microwave Sensors (RADAR): - Real aperture radar (RAR) and synthetic aperture radar (SAR)	
	Oct 13		Lab 2 Group B
6	Oct 21	11. Active and Passive Microwave Remote Sensing (RADAR) (continued) - Atmosphere and Terrain Properties - Surface Roughness, Dielectric Constant - Radar Geometry, Interferometry, Polarimetry - Imaging Radar Sensors (SIR, ERS, J-ERS, Radarsat, Envisat, TerraSar) - Applications 12. Light Detection and Ranging (LIDAR) - LIDAR Systems (Principles, Sensors) - Atmospheric Sounders - Applications	
	Oct 22		Lab 3: Groups A & B
Oct 25-30 ********** READING WEEK **********			

Week	Date	Lecture	Lab
7	Nov 2	13. Light Detection and Ranging (LIDAR) (continued) - Applications 14. PART III. Assessment and Monitoring of the Environment with Remote Sensing: - The Terrestrial Environment -. Land Cover and Biodiversity -The Global Land Cover Facility (GLCF) and GOFCG	(Mid-Term Quiz -30 min-in Lecture time)
	Nov 3,		Lab 4: Group A
8	Nov 9	15. Assessment and Monitoring the Terrestrial Environment - Biomass and Net Primary Productivity (NPP) - Global and National Programmes: - The TERRA Satellite and the Moderate Resolution Spectro-Radiometer (MODIS) Program, data products and environmental applications. - GIMMS Program, data products and applications 16. Forest Ecosystem monitoring - Monitoring Ecosystem Health	
	Nov 10		Lab 4: Group B
9	Nov 16	17. Monitoring Land Degradation and Desertification - The LADA Program for Global Land Degradation and Desertification Assessment and Monitoring 18. Upscaling and Downscaling spatial and temporal estimates from remote sensing - Approaches, Procedures and Applications	
	Nov 17		Lab 5: Group A
10	Nov 23	19. Upscaling and Downscaling spatial and temporal estimates from remote sensing (Continued) 20. Assessment and Monitoring the Aquatic Environment - The AQUA satellite and monitoring oceans and aquatic environments - Wetland and aquatic assessment and modelling with remote sensing	
	Nov 24		Lab 5 Group B

Week	Date	Lecture	Lab
11	Nov 30	21. Assessment and Monitoring the Aquatic Environment (Continued) - Bathymetry, lake and ocean floor detection and measurements - Lake ecosystem health: change detection, lake vegetation and sediments, riparian vegetation and stream bank erosion. 22. Climate Change and Remote Sensing	Lab 5 due: Group A (before 4:30 PM)
12	Dec 7	COURSE REVIEW	
	Dec 8	******* Course Ends **********	Lab 5 due: Group B (before 4:30 PM)
Final Exam (during exam period Dec. 11-22; exact date & time TBA)			

University Policies

Academic Integrity:

Academic dishonesty, which includes plagiarism and cheating, is an extremely serious academic offence and carries penalties varying from a 0 grade on an assignment to expulsion from the University. Definitions, penalties, and procedures for dealing with plagiarism and cheating are set out in Trent University's *Academic Integrity Policy*. You have a responsibility to educate yourself – unfamiliarity with the policy is not an excuse. You are strongly encouraged to visit Trent's Academic Integrity website to learn more: www.trentu.ca/academicintegrity.

Access to Instruction:

It is Trent University's intent to create an inclusive learning environment. If a student has a disability and/or health consideration and feels that he/she may need accommodations to succeed in this course, the student should contact the Disability Services Office (BL Suite 109, 748-1281, disabilityservices@trentu.ca) as soon as possible. Complete text can be found under Access to Instruction in the Academic Calendar.

Please see the Trent University academic calendar for University Diary dates, Academic Information and Regulations, and University and departmental degree requirements.

Last date to withdraw from Fall term half courses without academic penalty in 2010-11 is November 12, 2010.

Department Policies:

Grammar and Style: It is expected that written assignments in Geography courses will conform to high standards of grammar and style. Although the penalty may vary from

course to course, and from one kind of written assignment to another, bad grammar and style will be penalized in all grading of written work submitted in Geography courses