SAULT COLLEGE OF APPLIED ARTS AND TECHNOLOGY

SAULT STE. MARIE, ONTARIO

COURSE OUTLINE

COURSE TITLE:	Introduction to Remote Sensing		
CODE NO. :	GIS422	**SEMESTER:**	F2008
PROGRAM:	Geographic Information Systems Applications Specialist		
AUTHOR:	Heath Bishop		
DATE:	June, 2008	**PREVIOUS OUTLINE DATED:**	June, 2007
APPROVED:	"B. Punch"		
	_____ **CHAIR**		_____ **DATE**
TOTAL CREDITS:	4		
PREREQUISITE(S):	None		
HOURS/WEEK:	5		

I. COURSE DESCRIPTION:

Remote sensing can be defined as the interpretation of images taken at a distance from the object viewed. In this course, the student will gain a theoretical background in remote sensing and a practical ability in the ENVI and PCI Geomatica software environment. Topics to be covered include: remote sensing physics, data sources, visual imagery, image enhancement and filtering, georeferencing, multispectral classification, data import and export and GIS integration. In the second portion of the course students will learn atmospheric and radiometric correction, hyperspectral, high resolution, multi-scale and radar image analysis, georeferencing and mosaicing aerial photographs, orthorectification and LIDAR imagery.

II. LEARNING OUTCOMES AND ELEMENTS OF THE PERFORMANCE:

Upon successful completion of this course, the student will demonstrate the ability to:

1. Explain the foundations of optical remote sensing

   Potential Elements of the Performance:
   - Describe remote sensing energy sources and radiation principles
   - Describe the colour mixing process
   - Describe the electromagnetic spectrum
   - Describe energy interactions with earth surface features
   - Describe characteristics of ideal and real remote sensing systems
   - Explain the appearance of features on remote sensing images
   - Locate Earth-surface features on different band combinations

2. Perform interactive analyses within ENVI

   Potential Elements of the Performance:
   - Work within the ENVI environment (windows, displays, menus)
   - Load and save imagery
   - View different band combinations
   - Locate and understand georeferencing information
   - Zoom in and out of imagery and link image windows

3. Describe remote sensing applications

   Potential Elements of the Performance:
   - Describe optical, radar and thermal remote sensing

applications
- Describe the Landsat, SPOT, Radarsat and IRS programs
- Describe meteorological, continental and ocean monitoring satellites
- Describe hyperspectral imagery and photography systems

4. Filter and enhance remote sensing imagery

   Potential Elements of the Performance:
   - Apply filters to remote sensing imagery
   - Enhance remote sensing imagery

5. Review the statistical nature of remotely sensed imagery

   Potential Elements of the Performance:
   - Perform and analyze data views, image histograms, scatterplots and low-level classifications
   - Apply band mathematics and image transformations (band ratios, vegetation indices and principle component analyses) to imagery

6. Perform image classifications

   Potential Elements of the Performance:
   - Collect regions of interest as classification training data
   - Complete a supervised classification
   - Complete an unsupervised classification
   - Transfer classifications to a GIS environment

7. Assess the accuracy of image classifications

   Potential Elements of the Performance:
   - Collect ground reference data for accuracy assessment
   - Perform Accuracy Assessments

8. Review Photogrammetric Processes

   Potential Elements of the Performance:
   - Describe photgrammetirc procedures
   - Identify available software and hardware
   - Perform DEM extraction on Stereo Images

9. Work within the PCI Geomatica Environment

Potential Elements of the Performance:

- Perform image analyses operations in PCI Geomatica Focus
- Atmospherically and radiometrically correct imagery
- Exchange image and vector data between remote sensing and GIS software packages
- Create a cartographically correct image-based map composition
- Use the EASI, and Algorithm Librarian interfaces

10. Perform Hyperspectral Image Analysis

Potential Elements of the Performance:

- Describe hyperspectral image analysis theory
- Work with hyperspectral imagery
- Perform a hyperspectral image classification

11. Perform Modeler Functions

Potential Elements of the Performance:

- Use batch mode modeler functions to automate processes
- Isolate and accumulate various Landsat MSS bands using Modeler

III. TOPICS:

1. Optical Remote Sensing

- Energy sources and radiation principles
- The electromagnetic spectrum
- Atmospheric and Earth-surface energy interactions
- The colour mixing process
- Ideal and real remote sensing systems
- Visual interpretation of remote sensing imagery
- Interpreting different band combinations

2. Introduction to ENVI

- ENVI file formats
- The ENVI environment (windows, displays, menus)
- Loading, saving and creating sub-sets of imagery
- Zooming in and out of imagery
- Linking image windows
- Image georeferencing data

3. Remote Sensing Applications

- Optical and radar remote sensing applications
- The Landsat, SPOT, IRS and Radarsat programs
- Meteorological, continental and ocean imaging satellites
- Hyperspectral scanners and airborne lasers
- Aerial photography
- Thermal remote sensing

4. Filtering and Enhancing Remotely-Sensed Images

   - Filtering imagery
   - Enhancing imagery

5. Performing Statistical Analysis on Remote Sensing Imagery

   - Image histograms
   - Scatterplots
   - Low-level classifications
   - Band mathematics
   - Image transformations

6. Performing Image Classifications

   - Regions of interest
   - Supervised classification
   - Unsupervised classification
   - Post-classification processing
   - GIS transfer

7. Accuracy Assessment

   - Collecting accuracy assessment ground reference data

8. Photogrammetric Processes

   - Triangulation
   - Parallax
   - Orthophotoscopes
   - Stereopairs
   - DEM extraction

9. PCI Geomatica

   - PCI Focus
   - PCI Orthoengine
   - PCI Modeler

- PCI EASI
- Cartography in PCI
- File conversion in PCI

10. Hyperspectral Imagery

- Hyperspectral data theory
- Viewing Hyperspectral data
- Viewing Hyperspectral Thumbnails
- Spectral Signatures
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11. PCI Modeler

- Automation
- Merging and Splitting in Modeler
- Creating contours from multiple DEMs
- Pan-Sharpening in Modeler

IV. REQUIRED RESOURCES/TEXTS/MATERIALS:

Jensen, J.R., 2007. Remote Sensing of the Environment (second edition). Pearson/Prentice Hall.

V. EVALUATION PROCESS/GRADING SYSTEM:

Grading System:

Laboratories (6)	60%
Mid-Term	20%
Final Exam	20%
	100%

Note: Students must achieve a mark of at least 50% on the Test/Exam components to pass the course.
The following semester grades will be assigned to students:

Grade	**Definition**	*Grade Point Equivalent*
A+	90 – 100%	4.00
A	80 – 89%	
B	70 - 79%	3.00
C	60 - 69%	2.00
D	50 – 59%	1.00
F (Fail)	49% and below	0.00

CR (Credit)	Credit for diploma requirements has been awarded.
S	Satisfactory achievement in field /clinical placement or non-graded subject area.
U	Unsatisfactory achievement in field/clinical placement or non-graded subject area.
X	A temporary grade limited to situations with extenuating circumstances giving a student additional time to complete the requirements for a course.
NR	Grade not reported to Registrar's office.
W	Student has withdrawn from the course without academic penalty.

VI. SPECIAL NOTES:

Special Needs:
If you are a student with special needs (e.g. physical limitations, visual impairments, hearing impairments, or learning disabilities), you are encouraged to discuss required accommodations with your instructor and/or the Special Needs office. Visit Room E1101 or call Extension 2703 so that support services can be arranged for you.

Retention of course outlines:
It is the responsibility of the student to retain all course outlines for possible future use in acquiring advanced standing at other postsecondary institutions.

Communication:
The College considers ***WebCT/LMS*** as the primary channel of communication for each course. Regularly checking this software platform is critical as it will keep you directly connected with faculty and current course information. Success in this course may be directly related to your willingness to take advantage of the ***Learning Management System*** communication tool.

Course outline amendments:
The Professor reserves the right to change the information contained in this course outline depending on the needs of the learner and the availability of resources.

Substitute course information is available in the Registrar's office.

VII. PRIOR LEARNING ASSESSMENT:

Students who wish to apply for advance credit transfer (advanced standing) should obtain an Application for Advance Credit from the program coordinator (or the course coordinator regarding a general education transfer request) or academic assistant. Students will be required to provide an unofficial transcript and course outline related to the course in question.

Credit for prior learning will also be given upon successful completion of a challenge exam or portfolio.