SAULT COLLEGE OF APPLIED ARTS AND TECHNOLOGY

SAULT STE. MARIE, ONTARIO

COURSE OUTLINE

COURSE TITLE:	Theory of GIS, Remote Sensing and GPS		
CODE NO. :	GIS 404	**SEMESTER:**	F2001
PROGRAM:	Geographic Information Systems Applications Specialist		
AUTHOR:	Dennis Paradine		
DATE:	June, 2001	**PREVIOUS OUTLINE DATED:**	June, 2000

APPROVED:

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DEAN **DATE**

TOTAL CREDITS:	3		
PREREQUISITE(S):	None		
LENGTH OF COURSE:	8 hrs/wk x 5 wks	**TOTAL CREDIT HOURS:**	40

I. COURSE DESCRIPTION:

Geographic Information Systems (GIS), Global Positioning Systems (GPS) and remote sensing (RS) provide decision-making data in the natural resources, planning and urban services fields. Through lectures, student seminars and projects, methods used in the gathering, design, and production of digital maps will be presented. By using practical, real-world examples, students will gain a thorough understanding of GIS, GPS and remote sensing concepts.

II. LEARNING OUTCOMES AND ELEMENTS OF THE PERFORMANCE:

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

1. Describe current and historical Geographic Information Systems (GIS) and their components

   Potential Elements of the Performance:
   - Describe current GISs, their uses and components
   - Describe the history of cartography and GIS
   - Explain the GIS, GPS and remote sensing process
   - Understand the nature of real-world GIS problems

2. Describe the fundamentals of cartography

   Potential Elements of the Performance:
   - Describe the elements of good map design
   - Explain the use of colour and element positioning in cartography
   - Outline the stages of map production
   - Describe the use of different Earth models (datums), coordinate systems and map projections in GIS

3. Describe GIS data models

   Potential Elements of the Performance:
   - Describe how features are organized and displayed in a GIS
   - Describe the collection, input and output of GIS data
   - Explain raster, vector and object-oriented data models
   - Describe the role and types of relational databases used in GIS
   - Describe the role of programming in GIS

4. Explain GIS data quality issues

Potential Elements of the Performance:
- Explain the importance of precision and accuracy in a GIS
- Describe sources of positional and data accuracy error in a GIS
- Describe spatial and temporal variations in earth surface features and the nature of boundaries

5 Describe data analysis and modeling methods

Potential Elements of the Performance:
- Explain the integration of attribute data, map overlays, queries, buffers, intersections and unions
- Describe the role of classification and interpolation
- Understand 3-D, raster, network and regional analyses

6 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

7 Explain the foundations of radar remote sensing

Potential Elements of the Performance:
- Describe active and passive microwave sensors
- Describe radar signals and interactions with the earth's surface
- Explain radar analysis methods

8 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 imagers, aerial videography and photography systems

9. Describe image processing algorithms

   Potential Elements of the Performance:
   - Explain techniques for image enhancement and filtering
   - Describe supervised and unsupervised image classification
   - Describe accuracy assessment methods
   - Explain post-classification processing and GIS data export

10. Describe Global Positioning Systems (GPS)

    Potential Elements of the Performance:
    - Explain GPS history, theory and applications
    - Describe current GPS units
    - Describe the differential correction of GPS data

III. TOPICS:

1. History, Components and Capabilities of Geographic Information Systems (3 hours)
   - Course introduction
   - History of GIS development
   - Current GIS software
   - Components of GIS systems
   - Software capabilities and trends
   - The GIS, GPS and remote sensing process
   - Real world problems that can be solved using a GIS

2. Cartography (6 hours)
   - Map design, concepts and features
   - Cartographic use of colours
   - The map production process
   - Datums, coordinate systems and map projections

3. GIS Data Models (7 hours)
   - Collection and input of GIS data
   - Vector, raster and object-oriented GIS models
   - Topology
   - Relational databases
   - GIS programming

4. Data Quality and Errors (3 hours)
   - Precision and accuracy
   - Data quality issues / sources and types of GIS errors
   - Natural variations in Earth-surface features
   - The nature of boundaries, temporal changes in Earth-surface features

Mid-Term Test

5. Data Analysis and Modeling (4 hours)
   - Map overlays and queries
   - Interpolation and classification
   - Integration of attribute data
   - Raster GIS analysis
   - 3-D, network and regional analyses

6. Optical Remote Sensing (4 hours)
   - Energy sources and radiation principles
   - The electromagnetic spectrum
   - Atmospheric and Earth-surface energy interactions
   - The colour mixing process
   - Ideal and real remote sensing systems

Research Seminars

7. Radar Remote Sensing (3 hours)
   - Active and passive microwave sensors
   - Radar signal interaction with earth surface features
   - The nature of radar signals
   - Radar data analysis

8. Remote Sensing Applications (3 hours)
   - Optical and radar remote sensing applications
   - The Landsat, SPOT, IRS and Radarsat programs
   - Meteorological, continental and ocean imaging satellites
   - Hyperspectral scanners and airborne lasers
   - Scanned aerial photographs and aerial videography
   - Thermal remote sensing

9 Image Processing (3 hours)
- Contrast stretching and filtering of imagery
- Classification pre-processing
- Supervised and unsupervised classification
- Accuracy assessment
- Post-classification processing

10 Global Positioning Systems (GPS) (3 hours)
- GPS history, theory and applications
- Current GPS units
- GPS data collection and differential correction methods

Research Paper Due

Final Test

IV. REQUIRED RESOURCES/TEXTS/MATERIALS:

Aronoff, Stan. 1996. Geographic Information Systems: A Management Perspective. WDL Publications.

Lillesand and Kiefer. 1999. Remote Sensing and Image Interpretation. Wiley Press.

Zeiler, M. 2000. Modeling Our World. ESRI Press.

V. EVALUATION PROCESS/GRADING SYSTEM:

Grading System:

Mid-Term Test	25%
Seminars	15%
Research Paper	20%
Final Exam	40%
	100%

The following semester grades will be assigned to students in post-secondary courses:

Grade	Definition	Grade Point Equivalent
A+	90 – 100%	4.00
A	80 – 89%	3.75
B	70 – 79%	3.00
C	60 – 69%	2.00
R (Repeat)	59% or below	0.00
CR (Credit)	Credit for diploma requirements has been awarded.	
S	Satisfactory achievement in field placement or non-graded subject areas.	
X	A temporary grade. This is used in limited situations with extenuating circumstances giving a student additional time to complete the requirements for a course (see *Policies & Procedures Manual - Deferred Grades and Make-up*).	
NR	Grade not reported to Registrar's office.	

This is used to facilitate transcript preparation when, for extenuating circumstances, it has been impossible for the faculty member to report grades.

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 E1204 or call Extension 493, 717, or 491 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 post-secondary institutions.

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 advanced credit in the course should consult the instructor. Credit for prior learning will be given upon successful completion of the following:

VIII. DIRECT CREDIT TRANSFERS:

Students who wish to apply for direct credit transfer (advanced standing) should obtain a direct credit transfer form from the Dean’s secretary. Students will be required to provide a transcript and course outline related to the course in question.