SAULT COLLEGE OF APPLIED ARTS & TECHNOLOGY
SAULT STE MARIE, ON

COURSE OUTLINE

Course Title: THEORY OF GIS, REMOTE SENSING & GPS

Code No.: GIS 404 **Semester:** 1

Program: GIS SPECIALIST

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Date: OCT/98 **Previous Outline Date:** NEW

Approved: K. DeRosario — Oct. 8/98

Dean **Date**

Total Credits: 3 **Prerequisite(s):** NONE

Length of Course: 3 hrs/wk x 15 wks **Total Credit Hours:** 45

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GIS 404 — CODE NO.

I. COURSE DESCRIPTION:

With the state of the art software, it is very easy for users to routinely run analytical procedures without a proper understanding of the theoretical concepts. Students will dedicate 50% of their time to theory, and then focus on critiquing GIS and remote sensing projects previously completed by Natural Resources Canada and the Ontario Ministry of Natural Resources. At the end of this course, students will be able to review and critique proposals and projects based upon sound theoretical concepts.

II. LEARNING OUTCOMES:

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

1. Outline the history of GIS development and describe GIS systems and their components. (5%)

Potential elements of the performance:
- Outline the stages in the history of GIS
- Describe a variety of GIS systems
- Explain the components of GIS systems and their uses
- Describe current software capabilities and future directions

2. Describe the data structure for geographical information systems. (12%)

Potential elements of the performance:
- Describe how basic land features taken from maps are organized and displayed in GIS
- Describe the concept and give examples of spectral data organization in the computer (topology)
- Describe methods of storing geographical data
- Read references and **discuss** the above topics

3. Describe digital data models. (8%)

Potential elements of the performance:
- Explain advantages and disadvantages of raster and vector data models

4. Explain methods of inputting and managing data for GIS applications. (8%)

Potential elements of the performance:
- Describe methods of entering data into GIS
- Describe the process of verification and storage of data
- Describe the variety of data output products

5. Describe the sources of possible errors and variation in data quality in GIS. (8%)

Potential elements of the performance:
- Describe important sources of error
- Describe some possible reasons for variation in data quality
- Describe statistical nature of the boundaries
- Explain data quality issues
- Research above topics and **discuss**

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II. LEARNING OUTCOMES *continued . . .*

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

6. Describe methods of data analysis and modelling. (18%)

Potential elements of the performance:

- Explain the concept of map overlay
- Explain the role of natural language commands in cartographic modelling
- Describe the role of multivariate analysis and classification in GIS
- Describe interpolation methods
- Explain the role of automated tools in GIS
- Read references and **discuss** the above topics

7. Explain the concepts and foundations of remote sensing. (7%)

Potential elements of the performance:

- Describe energy sources and radiation principles in the physical atmosphere
- Describe energy interaction with earth surface features
- Describe the ideal remote sensing system
- Describe characteristics of real remote sensing systems

8. Describe the concept and methodology of multispectral scanning. (6%)

Potential elements of the performance:

- Explain principles and operation of multispectral scanners
- Describe multispectral scanner design considerations
- Describe the principles of imaging spectrometry

9. Describe the history and variety of earth resource satellites. (6%)

Potential elements of the performance:

- Describe the development of space imaging programs
- Describe the Landsat program
- Describe Landsat image interpretation
- Describe the SPOT satellite program
- Describe the purpose of and available data from meteorological and ocean monitoring satellites

10. Describe image processing algorithms. (20%)

Potential elements of the performance:

- Describe the concept of image rectification and restoration
- Explain techniques of image enhancement and contrast manipulation
- Describe the manipulation of multi-image data
- Describe image classification concepts
- Explain supervised and unsupervised classification
- Explain post classification smoothing
- Describe accuracy assessment methods in image classification

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II. LEARNING OUTCOMES *continued* . . .

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

11. Describe global positioning systems (GPS). (5%)

Potential elements of the performance:

- Explain concepts behind GPS
- Describe current stage of dialogue
- Explain uses of GPS
- Explain GPS as a georeferencing tool for GIS

Note: The above percentages relate to the proportion of the theory tests covering each unit.

12. Research and prepare a research report on a pre-selected topic in Geomatics. (20% of course grade)

Potential elements of the performance:

- Select topic from list provided
- Thoroughly research topic using all appropriate sources of information
- Write technical report using appropriate science format
- Submit report by deadline given

III. TOPICS:

1. Introduction — 1 week
   - History of GIS development
   - Description of GIS systems
   - Components of GIS systems
   - Software capabilities and trends

2. Geographic Data Concepts — 2 weeks
   - Basic map concepts
   - Map features
   - Spatial relationships
   - Storing geographic data
   - Topology

3. Digital Data Models — 1 week
   - Vector and raster models

4. Data Input, Verification, Storage and Output — 1 week
   - Data input
   - Data verification, correction and storage
   - Data output

5. Data Quality and Errors — 1 week
   - Sources of errors
   - Errors resulting from natural variations
   - The nature of boundaries
   - Data quality issues

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III. TOPICS *continued* . . .

6. Methods of Data Analysis and Modelling 2 weeks
   - General approach to map overlay
   - Cartographic modelling using natural language commands
   - Multivariate analysis and classification
   - Interpolation methods
   - Expert systems (ES) and decision support systems (DSS) for GIS

FIRST TERM TEST

7. Concepts and Foundations of Remote Sensing 1 week
   - Energy sources and radiation principles
   - Energy interactions in the atmosphere
   - An ideal remote sensing system
   - Characteristics of real remote sensing systems

8. Multispectral Scanning 1 week
   - Multispectral scanners
   - Multispectral scanner operation and design considerations
   - Imaging spectrometry

9. Earth Resource Satellites 1 week
   - Early history of space imaging
   - Landsat satellite program review
   - Landsat TM image interpretation
   - SPOT satelleite program
   - Meteorological satellites
   - Ocean monitoring satellites

10. Digital Image Processing 1 week
    - Image rectification and restoration
    - Image enhancement
    - Contrast manipulation
    - Multi-image manipulation

11. Image Classification 1 week
    - Image classification concepts and training steps
    - Supervised classification
    - Unsupervised classification

12. Classification Accuracy Assessment 1 week
    - Post classification smoothing
    - Data merging

13. Global Positioning Systems (GPS) 1 week
    - Concepts behind GPS
    - Current stage of development
    - Practical uses
    - Georeferencing in GPS

FINAL TERM TEST

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IV. REQUIRED RESOURCES/TEXTS/MATERIALS:

Aronoff, Stan. 1993. Geographic Information Systems: A Management Perspective. Ottawa, WDI Publications. 294 pp.

ADDITIONAL RESOURCE MATERIAL

Burrough, P.A. 1986. Principles of Geographical Information Systems for Land Resources Assessment. Oxford, Clarendon Press. 194 pp.

Kennedy, Michael. 1996. The Global Positioning System and GIS. An Introduction. Chelsea, Ann Arbor Press. 268 pp.

Morain, Stanley A. and Amelia M. Budge. 1996. Manual of Remote Sensing. 3rd Ed., Earth Observing Platforms and Sensors. CD Version 1.0. Bethesda, Amer. Soc. for Photogrammetry and Remote Sensing . CD disk.

Verbyla, David L. Satellite Remote Sensing of Natural Resources. Boca Raton, CRC Lewis Publishers. 198 pp.

V. EVALUATION PROCESS/GRADING SYSTEM:

Two Term Tests	70%
Research report	20%
Discussion of Topics/Participation	10%

GRADING:
A+ = 85% and over consistently
A = 75-84%
B = 68-74%
C = 60-67%
R = less than 60%

VI. SPECIAL NOTES:

Special Needs

If you are a student with special needs (eg. Physical limitations, visual impairments, hearing impairments, learning disabilities), you are encouraged to discuss required accommodations with the instructor and/or contact the Special Needs Office, Room E1204, Ext. 493, 717 or 491 so that support services can be arranged for you.

Plagiarism

Students should refer to the definition of "academic dishonesty" in the "Statement of Students Rights and Responsibilities."

Students who engage in "academic dishonesty" will receive an automatic failure for that submission and/or such other penalty, up to and including expulsion from the course, as may be decided by the professor.

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VI. SPECIAL NOTES *continued . . .*

Plagiarism *continued . . .*

In order to protect students from inadvertent plagiarism, to protect the copyright of the material referenced and to credit the author of the material, it is the policy of the department to employ a documentation format for referencing source material.

Advanced Standing

Students who have completed an equivalent post-secondary course should bring relevant documents to the Coordinator, Natural Resources Programs.

Retention of Course Outlines

It is the responsibility of the student to retain all course outlines for possible future use in gaining advanced standing at other post-secondary institutions.

Substitute course information is available at the Registrar's Office.

VII. PRIOR LEARNING ASSESSMENT:

Please contact the Prior Learning Assessment Office (H0240) for further information.