Appendix B COURSES SYLLABI

CEGR 498-001 Fundamentals of Geographic Information Systems (GIS) **Credit:** 3

Catalog Description
A comprehensive introduction to the underlying concepts, principles, and applications of geographic information systems (GIS) are presented and illustrated. Data acquisition, processing, management, analysis, modeling, and product generation will be emphasized. GIS methodologies and applications in the sciences, engineering, and other disciplines will be also be presented. Training in GIS software, including ARC/INFO and ArcView will take place during the Labs.

Prerequisites
No prerequisites needed.

Objectives
- Introduce students to the underlying concepts, principles, and applications of GIS.
- Illustrate its utility as an optimal tool for solving problems in diverse disciplines such as the sciences, engineering, and related fields.
- Demonstrate the utility of GIS in real world problems.
- Produce highly trained personnel in cutting-edge technology.

Content
The following are major topics that will be covered in this course: Historical development, Data models, Hardware and software, Data collection/quality, Database implementation, Spatial analysis, Visualization, Organizational issues, Technical issues, Standards and access to data, Formal problems in GIS, and Future of GIS. Specialized seminars (invited speakers from government, industry and university research laboratories) will be provided when necessary. GIS software including ARC/INFO and ArcView will presented.

Teaching Methods and Activities
- Course Introduction & Overview
- Background & History
- Geographic Data and GIS (Essential Elements, Data Structures) and From Real World to GIS
- Basic Data Models (Vector, Raster)
- Advance Data Model, Georeferences, and Coordinate Systems
- Data Collection
- Data Quality
- Manipulation & Analysis
- Database Implementation
- Remote Sensing
- Remote Sensing & GIS
- Spatial Analysis
- Applications
- Future of GIS

Relationship to Program Objectives and Curriculum Sequence
This course is designed for multidisciplinary students; disciplines include the sciences, transportation, geosciences (geology, earth science, environmental science, and meteorology), engineering, business, and

management.

Grading System
Students will be graded on the following including an oral presentation of a written project.
- mid-term exams 20%
- final exam 25%
- 4 tests (@ 2.5%) 10%
- 5 quizzes (@ 2%) 10%
- 4 lab reports (@ 5%) 20%
- assignments 5%
- attendance and participation 5%
- projects 5%

Grading
- A 90-100%
- B 80-90%
- C 70-80%
- F < 70%

Attendance Policy
Attendance is mandatory, and more than four absences will lead to academic withdrawal.

Test and Exam Policy
Test and exam dates are fixed and there will be no makeup.

Text
Geographic Information Systems: An Introduction, Second Edition, by Tor Bernhardsen. Published by John Wiley & Sons, Inc.

Instructors: Wilson & Jackson-Pringle **01/12/04**

INSTRUCTORS: Frederick K. Wilson, Ph.D. & Judy A. Jackson-Pringle, M.S.
(433) 885-4200

COURSE No.: CEGR 498.001

TITLE: Fundamentals of Remote Sensing (RS)

CREDIT HOURS: 3

VENUE/TIME: S348/TR 3:00PM – 4:15PM

COURSE: (Prerequisites: None)
Introduction to sensor systems, methodologies, and basic concepts of remote sensing (RS). Aerial photographs and airborne/satellite images will be processed and analyzed. Emphasis will be placed on RS uses and applications in the sciences and engineering (biology, geology, forestry, ecology, agriculture, meteorology/weather, oceanography, hydrology, transportation, urban planing, resource management and engineering). NASA's Mission Planet Earth/Earth Observing Systems (EOS) Program and NOAA's Sciences will be examined and discussed. Training in RS software, including ENVI will form part of the RS Lab work. (*Offered only in Fall*).

COURSE OBJECTIVES
The primary objective of this course is to provide students with the fundamentals (principles and applications) of remote sensing, including airborne/space platforms, instruments, image processing/analysis techniques, and theories. Although the course is listed as lectures, other instructional instruments such as seminars and laboratory sessions will be included. Satellite images including Landsat Multispectral Scanner (MSS), Landsat Thematic Mapper (TM), SPOT (French satellite), and IKONOS will be processed and analyzed. Typical applications covered include the earth sciences, plant sciences, hydrospheric sciences, land-sue/cover, and engineering. Students will be introduced to core NASA's ESS Programs, such as Mission to Planet Earth (MPE)/Earth Observing Systems (EOS) Program and NOAA's sciences. The course will allow students to become familiar with some of the highly successful remote sensing software, hardware, peopleware, and methodologies. The skills acquired in this course will assist students in their academic endeavors, widen their job/career options, and help them cope better with the dynamics of today's technological paradigm.

COURSE SPECIFICS
Primary readings for the class will come from **Introduction to Remote Sensing by James B. Campbell, 3rd edition (2002); Guilford Press; ISBN: 1-57230-640-8** ($85.00 - hardcover); (**1-800-365-7006**). Other materials will be taken from The Remote Sensing Tutorial, by the Applied Information Sciences Branch (Code 935) at NASA's Goddard Space Flight Center (on the World Wide Web). The class will meet as stated (TR, 3:00 – 4:15 PM). Labs will include hands-on experience with major RS software packages including the Environment for Visualizing Images (ENVI).

REQUIREMENTS
No course prerequisites are needed for this course. There will be 2 exams, 4 tests, 5 quizzes per

semester, and 4 lab exercises during the semester. All lab reports and assignments must be received on time. Attendance and participation in class activities are very important and will account for part of the total grades.

GRADES

Grades will be based on the following:

* mid-term exams 20%
* final exam 25%
* 4 tests (@ 2.5%) 10%
* 5 quizzes (@ 2%) 10%
* 4 lab reports (@ 5%) 20%
* assignments 10%
* attendance and participation 5%

Grading:

* A 90-100%
* B 80-89%
* C 70-79%
* F < 70 %

COURSE OUTLINE

Dates:	Topics:
Week 1	Course Introduction & Overview
Week 2	History, Chap. 1
	EM Radiation, Chap. 2
Week 3	Sensors, Chap. 3
	Digital Data, Chap. 4
Week 4	Image Interpretation, Chap. 5
Week 5	Land Obs. Satellites, Chap. 6
	Active Microwave, Chap. 7
Week 6	Thermal Radiation, Chap. 8
Week 7	**Midterm Exam**
Week 8	Image Resolution, Chap. 9
Week 9	Image Processing, Chap. 10
Week 10	Image Classification, Chap. 11
Week 11	Field Data, Chap. 12 and Accuracy, Chap. 13
Week 12	GIS, Chap. 15.
Week 13	Applications, Chap. 16, 17.
Week 14	Applications, Chap. 17, 18.
Week 15	Applications, Chap. 19. And Future of RS.
Week 16	**Final Exam**

INSTRUCTOR Frederick K. Wilson, Ph.D.
Email: fwilson@eng.morgan.edu
Phone: (443) 885-4200 (Office)
Office: Room MB 207/Lab S348

COURSE No. CEGR 740.085

TITLE Special Topics in Geographic Information Systems (GIS)

CREDIT HOURS 3

PRERECQUISITS Introduction to GIS or Consent of Instructor

PLACE/TIME RM S202/Thursdays, 05:00-08:00 p.m.

COURSE
Advanced concepts, principles, modeling, and applications of geographic information systems (GIS) are presented and illustrated. Individual project design, data acquisition, management, analyses, and finished product generation is emphasized. Applications of GIS methodologies/models in real world problems from diversified disciplines will also be presented. Student will be required to complete (oral and written presentation) comprehensive GIS project as part of the final exam grade for the course. Offered in the Fall semesters.

INTRODUCTION

This section involves a broad range of data types and analyses necessary for specific site selection (site suitability analyses). As environmental concerns and awareness grow, so also will the need for optimal solutions to engineering and environmental problems. GIS technology offers one of the very best solutions to these problems. "Green" (environmentally friendly) structures (building, factories, and transportation) are becoming more and more prolific than ever before. This course will emphasize the great possibilities that exist for merging modern technologies and the environment without disrupting the ecological balance.

OBJECTIVES
- Introduce students to advanced concepts, principles, models, and applications of GIS.
- Emphasize "green" engineering concepts – viable, environmentally friendly, energy-efficient, and sustainable engineering projects and plans.
- Facilitate GIS methodology development for problem solving in engineering and related fields.
- Demonstrate the utility of GIS in real world problems.
- Produce highly trained personnel in cutting-edge technology.

TEXT BOOK
Exploring Spatial Analysis in Geographic Information Systems by Yue-Hong Chou. Published by Onward Press, 1997.

SUPPLEMENTAL TEXTS

- GIS and Environmental Modeling: Progress and Research Issues by Michael F. Goodchild, *et al*. GIS World, Inc., 1996.
- Geographic Information Systems: An Introduction by Jeffery Starr and John Estes. Published by Prentice Hall, 1990.

REFERENCE BOOKS

- ArcView GIS Means Business, by ESRI, 1997.
- Exploring Geographic Information Systems by Nicholas Chrisman. John Wiley & Sons, 1997.
- Fundamentals of Geographic Information Systems by Michael DeMers. John Wiley & Sons, 1996.
- Getting Started with Geographic Information Systems by Keith Clarke. Prentice Hall, 1997.
- The Global Positioning System and GIS: An Introduction by Michael Kennedy. Ann Arbor Press, 1995.
- Understanding GIS: The ARC/INFO Method. ESRI, 1996.
- Zeroing In: Geographic Information Systems at Work in the Community. ESRI, 1997.

PERIODICALS

- ARC News, ESRI, Redlands, California.
- GIS World, Inc., Fort Collins, Colorado.
- Geo Info Systems, Advanstar Communications, Eugene, Oregon.
- GIS Europe, Geoinformation International, Cambridge, United Kingdom.
- GIS World - Since 1988, 12 issues per year, GIS World, Inc., Fort Collins, Colorado.
- Point Line Poly - Since 1991, six issues per year. Proctor VT.

EVALUATION

The class will adhere to **all** the rules and regulations of the graduate school, especially with regards to discipline, attendance, and performance. Grades will be computed from **tests, exams, attendance**, **participation in class, lab projects**, **assignments, competence** with the GIS software, and **successful completion of selected projects**.

GRADES

(%)	Letter
90 - 100	A
1. 80 - 89	B
70 - 79	C
0 - 69	F

Distribution of grades (%):	
Two exams (Mid-term (15%) & Final (25%)	40
Four tests (@ 5 % each)	20
Lab reports	10
Assignments	10
Projects	15
Attendance and Participation	05

COURSE CONTENT

I. Introduction
   1. The Course (and Housekeeping)
   2. Overview of GIS
   3. Role and Importance of the Technology
   4. Trends and Prospect of the Technology
   5. Summary

II. Introduction to Spatial Analysis
   1. Spatial Data
   2. Using GIS for Spatial Analysis
   3. Significance of Spatial Analysis
   4. Spatial Analysis Applications

III. Spatial Data
   1. Representation
   2. Required Elements
   3. Data Structures
   4. Data Modeling
   5. Summary

III Quantification of Spatial Analysis
   1. Measurement of location
   2. Geographic Grid System
   3. Coordinate System
   4. UTM System
   5. Measurements of Spatial Features
   6. Attribute Data measurement

IV. Single layer Operations
   1. Feature manipulation
   2. Boundary Operations
   3. Proximity Analysis
   4. Feature Identification and Analysis
   5. Feature Classification

V. Multiple Layer Operations
   1. Overlay Analysis
   2. Proximity Analysis
   3. Spatial Correlation Analysis
   4. Summary

VI. Point Pattern Analysis
   1. Descriptive Statistics of Point Features
   2. Spatial arrangements
   3. Spatial Autocorrelation
   4. Sampling Point Feature

VII. Network Analysis
   1. Data Requirements
   2. Evaluation of Network Structures
   3. Network Diameter
   4. Network Connectivity
   5. Network Accessibility
   6. Network Structure

VIII. Spatial modeling
    1. Model Building
    2. Structure and Spatial Factors
    3. Multiple Regression
    4. Significance Tests
    5. Logistic Regression
    6. Data Manipulation and INFO Programming

IX. Surface Analysis
    1. Organization of Information
    2. Spatial interpolation
    3. Surface Analysis Applications
    4. Summary

X. Grid Analysis
    1. Spatial Property of Grid Data
    2. Data value Assessment
    3. Grid Operations
    4. Zonal Functions
    5. Grid-based Spatial Analysis

XI. Decision Making in Spatial Analysis
    1. Qualitative Approach
    2. Morphological Analysis
    3. Quantitative Approach
    4. Problem Setting
    5. Specification of Variables
    6. Construction of Models
    7. Interpretation of Results

XII. Environmental Databases and Mapping

XIII. Environmental Modeling Linked to GIS

XIV. Building Environmental Models With GIS

XV. Applications
    1. Master Planning
    2. Socioeconomic (Land information systems),
    3. Socioeconomic (Transportation/Utility routing, Car navigation systems),
    4. Socioeconomic (Demographics, Market analysis),
    5. Environmental (Multisource, multinational databases),
    6. Management (Public policy),
    7. Management (Urban planning),
    8. Management (Land management),
    9. Resource Management, and
    10. Erosion Potential.

PROJECTS

Projects for the course will be allocated based on students major, interest, and/or availability of data. When possible students will be allowed to choose their own project.

INSTRUCTOR Frederick K. Wilson, Ph.D.
Email: fwilson@morgan.edu
Phone: (443) 885-4200 (Office)
Office: Room MEB 207 / Lab: Room S 348

COURSE No. CEGR 741.185

TITLE Special Topics in Remote Sensing (RS)

CREDIT HOURS 3

PRERECQUISITS Introduction to remote sensing (RS), or Consent of Instructor

PLACE/TIME Eng. Bldg. RM S348/Thursdays, 5:00-7:30 p.m.

COURSE
Comprehensive review of the history, concepts, principles, analysis, and applications of remote sensing (RS) are presented and illustrated. Applications of RS in real the world are presented. Lectures are supplemented by laboratory assignments, and individual project assignment (based on student's discipline/interest) is emphasized. RS data from a suite of sensors/platforms, including, Advanced Very High Resolution Radiometer (AVHRR), Landsat Multispectral Scanner (MSS)/Thematic Mapper (T M), System Probatoire d'Observation de la Terre (SPOT), IKONOS, and Moderate Resolution Imaging Spectroradiometer (MODIS) will be used. Image processing software will include ENVI and ERDAS. Students will be required to complete a RS project (oral presentation and written report) as part of the final exam grade for the course.

INTRODUCTION
Remote sensing (RS), as defined by T.J.M. Kennie (Remote sensing in civil engineering, 1985), is a science of acquiring information about some property of an object through the use of a measuring device which is not in physical contact with the object under investigation. This makes RS one of the most powerful technologies for interdisciplinary scientific applications. Uses include science and engineering, resource management and policy making, climate/weather research, and monitoring/updating spatial databases. As the spatial resolution of RS images improves and their acquisition costs decrease, the utility of this technology will undoubtedly escalate. Engineering and the sciences are prime areas that should take advantage of this opportunity if the Nation is to maintain its leadership role in spatial technologies.

This course will expose students to cutting-edge technologies available to scientists today, and provide them with hands-on experience that will assist them in meeting future challenges in their respective fields. Data will come from a suite of sensors including multispectral scanner (MSS)/ thematic mapper (TM), SPOT (French) satellite, IKONOS (USA), and (MODIS) aircraft. Emphases will be placed on image processing, analysis, and applications in the earth system sciences.

Since much of the U.S. (and the world) populations are concentrated in/near metropolitan centers

and coastal areas, this course will concentrate on terrain analysis, land-use/land-cover change, ecosystem/environmental degradation, and climate change. Major metropolitan areas to be studied include Washington, D.C.; Atlanta, GA; New Orleans, LA; Harrisburg, PA; Los Angeles and San Diego, CA; and Tucson, AZ. This course will also examine course-consequence relationships of natural and anthropogenic effects at multiple spatial and temporal scales on the environment.

OBJECTIVES

- Provide in-depth knowledge of remote sensing (RS) concepts, principles, methodologies, and applications.
- Examine and demonstrate the utility of RS methodologies in real world problems (terrain, urban, transportation, pollution, and water resource analysis at desperate spatial and temporal scales).
- Facilitate the use of RS methodology in problem solving in earth system sciences and related fields.
- Produce highly trained personnel in cutting-edge technology.

EVALUATION

The class will adhere to **all** the rules and regulations of the graduate school, especially with regards to discipline, attendance, and performance. **All students** are required to **COMPLY fully with ALL COPYRIGHT LAWS and REGULATIONS**. Neither MSU, nor the Instructor(s) will be held responsible in any way, shape, or form for ANY infringement on the laws governing ALL COPYRIGHTED materials and related materials by any student; students will be fully responsible.

Grades will be computed from **tests, exams, attendance**, **participation in class, lab projects**, **assignments, competence** with the RS software, and **successful completion of selected projects**.

GRADES

(%)	Letter
90 - 100	A
80 - 89	B
70 - 79	C
0 - 69	F

Distribution of grades	(%)
Two exams (Mid-term (15%) and Final (25%)	40
Four tests (@ 5 % each)	20
Lab reports	10
Assignments	10
Project	15
Attendance and Participation	5

COURSE OUTLINE

A. Lectures	B. Labs	C. Applications
Concepts and Foundation of RS	Introduction to Software	Siting/Construction
Elements of Photographic Systems	Basic Concepts	Transportation/Utility
Basic Principles of Photogrammetry	Functions	Urban Planning
Visual Image Interpretation	Tools	Land-use/land-cover Change
Multi, Thermal, & Hyper Sensing	Images	Utilities
Earth Resource Satellites	Transforms	Geology/Hydrology
Digital Image Preprocessing	Filtering	Environmental Degradation
Microwave Sensing	Registration/Corrections	Environmental Pollution.
Remote Sensing Applications	Masking	
Future Advances in Remote Sensing	Classification	

TEXT BOOK

Remote Sensing & Image Interpretation, 4th Edition, by Lillesand, Thomas M. / Kiefer, Ral; John Wiley & Sons, Inc., New York, 2000; ISBN: 0-471-25515-7.

SUPPLEMENTAL TEXTS

1. Remote Sensing: Models & Methods for Image; Processing; Acad Pr, 1997; Author: Schowengerdt, Robert.
2. Classification of Remotely Sensed Images, Ian L. Thomas, et al; 1987.
3. Applied Remote Sensing; P.C. Lo; Longman, January 1996.
4. Remote Sensing for Landscape Ecology: New Metric Indicators for Monitoring, Modeling, & Assessment of Ecosystems; Library Binding, Lewis Pubs, 1997; ISBN: 1566702755; Author: Frohn, Robert C.
5. Urban Applications of Satellite Remote Sensing & GIS Analysis; World Bank; Author: Paulsson, Bengt.

CEGR 741.185
Dr. Fred Wilson

Date:	**Topics:**
Week 1	Course Introduction & Overview
Week 2	Concepts and Foundation of Remote Sensing
Week 3	Concepts and Foundation of Remote Sensing (*continued*)
Week 4	Elements of Photographic Systems
Week 5	Basic Principles of Photogrammetry
Week 6	Visual Image Interpretation
Week 7	**Midterm Exam**
Week 8	Multispectral, Thermal, and Hyperspectral Sensing
Week 9	Multispectral, Thermal, and Hyperspectral Sensing (*continued*)
Week 10	Earth Resource Satellites
Week 11	Digital Image Preprocessing
Week 12	Digital Image Preprocessing (*continued*)
Week 13	Microwave Sensing
Week 14	Remote Sensing Applications
Week 15	Future Advances in Remote Sensing
Week 16	**Final Exam**