CGS Agenda Item: 08-02
Proposal Effective Date: Fall 2008

New Course Proposal

GEG 5820 Remote Sensing 1

Please check one: ☒ New course ☐ Revised course

PART I: CATALOG DESCRIPTION

1. Course prefix and number: **GEG 5820**
2. Title (may not exceed 30 characters, including spaces): **Remote Sensing 1**
3. Long title, if any: **Remote Sensing 1**
4. Class hours per week, lab hours per week, and credit: **2-2-3**
5. Term(s) to be offered: ☒ Fall ☐ Spring ☐ Summer ☐ On demand
6. Initial term of offering: ☒ Fall ☐ Spring ☐ Summer ☐ Year: **2008**
7. Course description: **An in-depth study of the physical principles and common applications of remote sensing. All steps in the process, including image acquisition, correction, enhancement, classification, and analysis, will be examined. A focus will be placed on directing these skills to research applications in the student's home discipline. Additional readings and discussion from the literature will be expected of graduate students. Laboratory exercises will feature a variety of applied examples drawn from biology, geography, geology, atmospheric sciences, and human impacts/planning.**
8. Registration restrictions:

   a. Identify any equivalent courses (e.g., cross-listed course, non-honors version of an honors course). **None**

   b. Prerequisite: **None**

   c. Who can waive the prerequisite(s)?
   ☐ No one ☐ Chair ☐ Instructor ☐ Advisor ☐ Program Coordinator ☐ Other

   d. Co-requisites (course(s) which MUST be taken concurrently with this one): **None**

   e. Repeat status: ☒ Course may not be repeated.
   ☐ Course may be repeated to a maximum of hours or times.

   f. Degree, college, major(s), level, or class to which registration in the course is restricted, if any: **None**

   g. Degree, college, major(s), level, or class to be excluded from the course, if any: **None**
9. Special course attributes [cultural diversity, general education (indicate component), honors, remedial, writing centered or writing intensive]: **None**

10. Grading methods (check all that apply): ☒ Standard letter ☐ C/NC ☐ Audit ☐ ABC/NC ("Standard letter"—i.e., ABCDF--is assumed to be the default grading method unless the course description indicates otherwise.)

11. Instructional delivery method: **Lecture and lab**

PART TWO: ASSURANCE OF STUDENT LEARNING

1. Objectives - students will be able to:

   - Illustrate the physical basis and procedures used for remote sensing of the environment. (Depth of content knowledge)
   - Select, process and analyze data sets. (Depth of content knowledge)
   - Identify and distinguish the merits of publicly available sources of data.
   - Derive analytical results and integrate them with real-world scenarios in the natural and built environment. (Effective critical thinking and problem solving)

2. Assignments/activities the instructor will use to determine how well students attained the learning objectives:

   - Mid-term examination 20%
   - Final Exam 25%
   - Laboratory assignments 30%
   - Final Research Paper 25%

3. Explain how the instructor will determine students' grades for the course:

   Graduate students will illustrate advanced understanding of remote sensing principles through submission of all laboratory assignments, individual projects, as well as additional discussion and a final research project. In addition to normal course work, graduate students are expected to identify current journal research regarding remote sensing applications to their areas of interest. Students will compare and contrast these techniques in additional meetings with the instructor as well as an original research paper focusing on applications of remote sensing skills. Graduate students will outline their research projects with one another in additional, organized sessions moderated by the instructor. The midterm will encompass 20% of their grade, the final exam 25%, lab assignments 30%, and the final research paper 25%.

Learning Objectives	20% Midterm Exam	25% Final Exam	30% Lab Assignments	25% Final Research Project
Illustrate the physical basis and procedures used for remote sensing of the environment.	X	X	X	X
Select, process and analyze data sets.	X	X	X	X
Identify and distinguish the merits of publicly available sources of data.			X	X
Derive analytical results and integrate them with real-world scenarios in the natural and built environment.	X	X	X	X

4. Not technology delivered.
5. For courses numbered 4750-4799, specify additional or more stringent requirements for students enrolling for graduate credit.

   Graduate students will illustrate advanced understanding of remote sensing principles through submission of all laboratory assignments, individual projects, as well as additional discussion and a final research project. In addition to normal course work, graduate students are expected to identify current journal research regarding remote sensing applications to their areas of interest. Students will compare and contrast these techniques in additional meetings with the instructor as well as an original research paper focusing on applications of remote sensing skills. Graduate students will outline their research projects with one another in additional, organized sessions moderated by the instructor. The midterm will encompass 20% of their grade, the final exam 25%, lab assignments 30%, and the final research paper 25%.

6. If applicable, indicate whether this course is writing-active, writing intensive, or writing-centered, and describe how the course satisfies the criteria for the type of writing course identified.

   This course is writing-active. Students will be required to complete weekly laboratory assignments, fully explained in writing. Graduate students will be expected to produce an additional 15-20 page paper, properly cited, demonstrating familiarity with the literature. This final research project should focus on an original application of remote sensing skills to a topic of their choice.

PART III: OUTLINE OF THE COURSE

Week **Topics**

1. **The Remote Sensing Process**
Definitions
Active vs. passive sensing
Basic divisions (visible / near-visible, thermal, radar)

Applications: local, regional, global
The remote sensing process (schematic)

2. Basics of the Electromagnetic Spectrum

Measurement
- wavelength and frequency
- common units

Energy sources
Physical interactions
- reflection
- transmission
- absorption / reemission

Lab – The electromagnetic spectrum
Application focus: electromagnetic radiation

3. Atmospheric and Surface Interactions

Atmospheric interactions
- scattering processes
- atmospheric blinds / windows

Surface (target) interactions
- reflection (specular/ diffuse)
- absorption and reemission

Lab – Atmospheric and Surface Interactions
Application focus: matter interactions

4. Photography

The chemical process
Reproducing the visible (early pan photography)
Beyond the visible (infrared photography)
Aerial photography
- types of images (vertical, high oblique, low oblique)
- specialized equipment
- radial displacement and parallax

Lab – Flight lines and film
Application focus: scale and visual summary

5. Photogrammetry and Visualization

Height measurements
- shadow height
- radial displacement
- absolute stereoscopic parallax

Stereo visualization methods
Lab – Hard copy photogrammetry and the 3-D model
Application focus: geomorphology and hazards

6. Photointerpretation

Colwell's photo interpretation model
Interpretation elements
- shape, size, tone
- pattern , texture

Using all available information

- ancillary data
- common sense

Lab – Visual interpretation and analysis

Application focus: industry and infrastructure

7. Multispectral Remote Sensing

From photography to Electro-optical sensors

Individual radiation records

Colors and color mixing

The origins of earth-observing satellites

Lab – Small scale remote sensing

Application focus: forestry from repeat observations

8. Review and Midterm exam

The remote sensing process

EMR and interactions

Photogrammetry and photointerpretation

Multispectral remote sensing

9. Resolution and Processing Advances

Landsat MSS and TM

SPOT and the rise of international remote sensing

The global image base

Dealing with digital reflectance values

Lab – Image sources and basic processing

Application focus: geologic and biologic applications of band ratios and indices

10. High Spectral Sensitivity

From "signatures" to "fingerprints"

Hyperspectral imagery

Hyperspectral data visualization approaches

Redundancy issues

Lab – Unsupervised classification

Application focus: urban classification

11. High Spatial Sensitivity

Contemporary sensors

Resolution trade-offs

Diminishing returns

Lab – Supervised classification

Application focus: vegetative classification

12. Exotic Approaches, Part I: Thermal Remote Sensing

Uses and limitations of thermal bandwidths

Scale factors

Unique properties

- thermal inertia
- the diurnal cycle

Lab – Thermal analysis

Application focus: water in thermal imagery

13. **Exotic Approaches, Part II: Radar and Lidar**

Radar

- unique properties
- interpretation challenges

Lidar

- dataset attributes
- DEMs from laser altimetry

Lab – Radar and Lidar applications

Application focus: geology and geomorphology

14. **The Future of Remote Sensing**

Future sensors

Industry trends

Ongoing value of analytical skills

Final Semester Project – Design proposal for your own sensor

Application focus: Student choice

15. **Remote Sensing Beyond the Earth and Final Exam Review**

Interplanetary applications

Review for final

- early to contemporary sensors
- image analysis techniques
- thermal, radar and lidar data
- industry trends

Final Semester Project - Continued

PART IV: PURPOSE AND NEED

1. Explain the department's rationale for developing and proposing the course.

   This course will provide graduate students with the skills needed to apply common remote sensing techniques in their individual research work. Tools provided by remote sensing have advantages, not just in terms of cost and accessibility, but also in access to a multitude of scales and time periods. Integrating remotely-sensed spatial data benefits research in both the natural and social sciences. Training in image processing and analysis gives EIU graduate students experience at the forefront of environmental and resource management.

2. Justify the level of the course and any course prerequisites, co-requisites, or registration restrictions.

   The course has no prerequisites.

3. If the course is similar to an existing course or courses, justify its development and offering.

   a. The course is not similar to any existing courses.
   b. No courses are to be deleted. Providing remote sensing experience is important for facilitating graduate-level thesis research.

4. Impact on Program(s):

It will provide graduate students throughout the university with the opportunity to be versed in Remote Sensing theory and practical applications to their home departments.

PART V: IMPLEMENTATION

1. Faculty member(s) to whom the course may be assigned:
   David Viertel or qualified faculty members in the Geography Program.
2. Additional costs to students:
   Course Fee: $30 (Pending approval by the President's Council)
3. Text:
   Remote Sensing and Image Interpretation, 5th Ed., 2004, Thomas M. Lillesand, Ralph W. Kiefer, and Jonathan W. Chipman, John Wiley & Sons, Hoboken, NJ, 763 pages.

PART VI: COMMUNITY COLLEGE TRANSFER

A community college course will not be judged equivalent to this course.

PART VII: APPROVALS

Date approved by the Department of Geology/Geography 29 October 2007

Date approved by the College of Sciences Curriculum Committee 30 November 2007

Date approved by CGS ______________