

New Course Proposal

GEG 5870 Remote Sensing 2

Please check one: ☒ New course ☐ Revised course

PART I: CATALOG DESCRIPTION

1. Course prefix and number: **GEG 5870**
2. Title (may not exceed 30 characters, including spaces): **Remote Sensing 2**
3. Long title, if any: **Remote Sensing 2**
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: **2009**
7. Course description (not to exceed four lines): **An advanced curriculum in remote sensing theory and practice. Material will focus on the processes underlying cutting-edge image enhancement and classification techniques, with special consideration to selecting the appropriate options for a given application. Laboratory work will highlight applications of current techniques to geographical, geological and biological topics, with graduate students supplementing in-class exercises with parallel readings from the literature. Class project should illustrate original research in the student's area of interest.**
8. Registration restrictions:
 - a. Identify any equivalent courses (e.g., cross-listed course, non-honors version of an honors course). **None**
 - b. Prerequisite: **GEG 5820**
 - c. Who can waive the prerequisite(s)?
☐ No one ☐ Chair ☒ Instructor ☐ Advisor ☐ Program Coordinator ☐ Other
(Please specify)
 - 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:
- Explain the procedures behind many standard remote sensing techniques. (Depth of content knowledge)
 - Identify and deliver state-of-the-art data transformations. (Depth of content knowledge)
 - Assess appropriate procedures for various real-world scenarios. (Effective critical thinking and problem solving)
 - Formulate projects, integrate data, deliver and evaluate results in a practical application. (Effective oral and written communication)
2. Assignments/activities the instructor will use to determine how well students attained the learning objectives:
- | | |
|------------------------|-----|
| • Mid-term Examination | 20% |
| • Final Exam | 25% |
| • Lab Exercises | 20% |
| • Research Paper | 35% |
3. Explain how the instructor will determine students’ grades for the course:

Graduate students will analyze various aspects of standard remote sensing procedure through written lab work and exams. In addition, students will be required to compose an in-depth research paper synthesizing advanced techniques (ideally relating to the student’s thesis work). Journal research and independent consultation with the instructor outside of course time is expected. The graduate student leaving this class should be comfortable with most aspects of remote sensing related to their research and be ready to integrate this knowledge into their thesis. Organized sessions outside of regular class time will allow graduate students to compare and evaluate one another’s research. Grades will consist of 20% midterm exam, 25% final exam, 20% written lab exercises, and 35% research paper.

Learning Objectives	20% Mid-term Exam	25% Final Exam	20% Lab Exercises	35% Research Paper
Explain the procedures behind many standard remote sensing techniques.	X	X	X	X
Identify and deliver state-of-the-art data transformations.	X	X	X	X
Assess appropriate procedures for various real-world scenarios.	X	X	X	X
Formulate projects, integrate data, deliver and analyze results in a practical application.			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 analyze various aspects of standard remote sensing procedure through written lab work and exams. In addition, students will be required to compose an in-depth research paper synthesizing advanced techniques (ideally relating to the students thesis work).. Journal research and independent consultation with the instructor outside of course time is expected. The graduate student leaving this class should be comfortable with most aspects of remote sensing related to their research and be ready to integrate this knowledge into their thesis. Organized sessions outside of regular class time will allow graduate students to compare and evaluate one another's research. Grades will consist of 20% midterm exam, 25% final exam, 20% written lab exercises, and 35% research paper.

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. In addition, graduate students will be expected to undertake an in-depth applied project related to their research interests. This research, presented as a comprehensive term paper at the end of the semester, will demonstrate an understanding of current remote sensing practice in the student's field of interest. Successful students will show the ability to plan, execute, and analyze original research utilizing remote sensing technology.

PART III: OUTLINE OF THE COURSE

<u>Week</u>	<u>Topics</u>
1.	Fundamentals of Digital Processing Neighborhood vs. per-pixel processing Contrast manipulation—different statistical approaches Level slicing
2.	Image Restoration and Spatial Filtering Radiometric correction Noise removal Convolution (nearest neighbor to bi-cubic convolution) Edge enhancement Fourier analysis Lab – Image preprocessing: radiometric correction and noise removal <i>Application focus: correcting for atmospheric disturbance</i>
3.	Georegistration Systematic vs. random distortions Selecting ground control points Lowering the RMS error Lab – Registering an image to a base map <i>Application focus: registering an urban scene</i>
4.	Pan Sharpening Combining disparate scales/resolutions The quick and dirty method True “pan-sharpening” Lab – Pan-sharpening current imagery <i>Application focus: distinguishing geomorphology from multi-scale imagery</i>
5.	Supervised Classification Feature space Common classifiers <ul style="list-style-type: none">• minimum distance to means• parallelepiped• maximum likelihood Accuracy assessment Lab – Comparing classification techniques <i>Application focus: classifying a forest</i>
6.	Unsupervised Classification Understanding the human input Common classifiers <ul style="list-style-type: none">• K-Means classification• The ISODATA approach Spectral Unmixing Fuzzy classification Contextual processing Lab – Replicating Anderson’s USGS classification system <i>Application focus: a rural classification</i>

7. **Principal Components Analysis**
The PCA transformation
The variance/covariance matrix
Eigenvectors and eigenvalues
Interpreting components
Lab – Performing and interpreting a PCA transformation
Application focus: using PCA to discriminate desert cover
8. **Review and Midterm exam**
Basic filtering and image restoration
Pan sharpening
Selection of classification techniques
PCA
9. **Mixing in Topography**
Digital Elevation Models (DEMs)
 - what they are
 - where they come from
 - how they differ from other remotely-sensed datasets**Lab** – Project Week 1
Application focus: defining your interest
11. **Topography and visualization**
Draping
Anaglyphic stereo induction
The Color stereoscopic effect
Lab – Project Week 2
Application focus: planning and obtaining data
12. **Volume and Brightness Analyses**
Using DEMs to determine volume
Modeling mass
Brightness from nighttime imagery
Population estimation from the world at night
Lab – Project Week 3
Application focus: importing and registering your data
13. **Multitemporal Processing**
Multitemporal composites
Difference images
Use in classification
Lab – Project Week 4
Application focus: processing and accuracy assessment
14. **Focus on Projects**
Lab – Project Week 5
Application focus: analyzing and reporting your data
15. **Project Presentations and Final Exam Review**
Class presentations
Review for Final
 - topography, visualization
 - modeling, multitemporal analysis

PART IV: PURPOSE AND NEED

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

This course will provide graduate students with a useful follow-on course to Remote Sensing 1. By adding in-depth understanding to the working knowledge of common skills gained in the first course, Remote Sensing 2 will assist the student in applying advanced spatial analysis techniques to their independent research. The project-oriented nature of the course will highlight all steps in the remote sensing process, from defining image needs and availability to rendering analytical conclusions. The flexibility exists to tailor lecture topics to individual student interests and needs.

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

This course has one prerequisite, GEG 5820 or Remote Sensing 1. The introductory course provides familiarity with the principles underlying the application of remotely-sensed data. These fundamentals are essential prior to tackling more advanced procedures and studying complex variations found in classification and analysis tools. The emphasis on practical projects also necessitates a comfortable working knowledge of the subject.

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. Advanced knowledge of remote sensing techniques will assist graduate students engaged in research.
4. Impact on Program(s):

It will provide graduate students throughout the university to be versed in Remote Sensing theory and practical applications in 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 _____