Eastern Illinois University  
New Course Proposal  
GEG 3820, Remote Sensing 1

Please check one:  ☒ New course  ☐ Revised course

PART I: CATALOG DESCRIPTION

1. Course prefix and number: **GEG 3820**
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 introduction to basic principles and applications of remote sensing. The theory and physical properties of image acquisition, processing and analysis will be demonstrated using examples from a variety of applications.**
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
      (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 - Upon successful completion of the course, students will be able to:
   - Illustrate the physical basis and procedures used for remote sensing of the environment.
   - Select, process and analyze data sets.
   - 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.

2. Assignments/activities the instructor will use to determine how well students attained the learning objectives:
   - Mid-term examination  25%
   - Laboratory assignments  33%
   - Individual project   12%
   - Final exam   30%

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

<table>
<thead>
<tr>
<th>Learning Objectives</th>
<th>25% Mid-term Exam</th>
<th>33% Laboratory Assignments</th>
<th>12% Individual Project</th>
<th>30% Final Exam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illustrate the physical basis and procedures used for remote sensing of the environment.</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Select, process and analyze data sets.</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Identify and distinguish the merits of publicly available sources of data.</td>
<td></td>
<td>X</td>
<td>X</td>
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<tr>
<td>Derive analytical results and integrate them with real-world scenarios in the natural and built environment.</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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</tbody>
</table>

4. Not technology delivered.

5. Not a graduate level course.

6. This course is writing-active. Students will be required to complete weekly laboratory assignments, fully explained in writing. An individual remote sensing
The project will take the form of a moderate length report (5-10 pages), focused on knowledge of physical properties and sensor attributes.

PART III: OUTLINE OF THE COURSE

<table>
<thead>
<tr>
<th>Week</th>
<th>Topics</th>
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<tbody>
<tr>
<td>1.</td>
<td>The Remote Sensing Process</td>
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<tr>
<td></td>
<td>Definitions</td>
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<td></td>
<td>Active vs. passive sensing</td>
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<td></td>
<td>Basic divisions (visible / near-visible, thermal, radar)</td>
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<td>Applications: local, regional, global</td>
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<tr>
<td></td>
<td>The remote sensing process (schematic)</td>
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<td>2.</td>
<td>Basics of the Electromagnetic Spectrum</td>
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<td>Measurement</td>
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<td>• wavelength and frequency</td>
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<td>• common units</td>
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<td>Energy sources</td>
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<td></td>
<td>Physical interactions</td>
</tr>
<tr>
<td></td>
<td>• reflection</td>
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<td></td>
<td>• transmission</td>
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<td></td>
<td>• absorption / reemission</td>
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<td></td>
<td>Lab – The electromagnetic spectrum</td>
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<td></td>
<td>Application focus: electromagnetic radiation</td>
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<td>3.</td>
<td>Atmospheric and Surface Interactions</td>
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<tr>
<td></td>
<td>Atmospheric interactions</td>
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<td></td>
<td>• scattering processes</td>
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<td></td>
<td>• atmospheric blinds / windows</td>
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<td>Surface (target) interactions</td>
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<td></td>
<td>• reflection (specular/ diffuse)</td>
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<tr>
<td></td>
<td>• absorption and reemission</td>
</tr>
<tr>
<td></td>
<td>Lab – Atmospheric and Surface Interactions</td>
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<td></td>
<td>Application focus: matter interactions</td>
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<tr>
<td>4.</td>
<td>Photography</td>
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<td>The chemical process</td>
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<td>Reproducing the visible (early pan photography)</td>
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<td>Beyond the visible (infrared photography)</td>
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<td>Aerial photography</td>
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<td></td>
<td>• types of images (vertical, high oblique, low oblique)</td>
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<td>• specialized equipment</td>
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<td>• radial displacement and parallax</td>
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<td>Lab – Flight lines and film</td>
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<td>Application focus: scale and visual summary</td>
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<tr>
<td>5.</td>
<td>Photogrammetry and Visualization</td>
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<td>Height measurements</td>
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<td></td>
<td>• shadow height</td>
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<tr>
<td></td>
<td>• radial displacement</td>
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</tbody>
</table>
• 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

   Uses and limitations of thermal bandwidths
   Scale factors
   Unique properties
   • thermal inertia
   • the diurnal cycle
   **Lab** – Thermal analysis
   *Application focus: vegetative classification*

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: water in thermal imagery*

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: geology and geomorphology*

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

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**PART IV: PURPOSE AND NEED**

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

   This course is a much needed addition to the Geographic Techniques/Spatial Analysis Concentration in the Geography BS Major curriculum. Trends in land cover analysis indicate that high resolution remotely-sensed data sets, once processed, can provide accurate information about large areas, over time, in a cost effective manner. Remotely sensed data is useful to physical and human geographers as well as physical, biological and social scientists. As government agencies and consulting firms rely more and more
on this technology, we must meet the needs of these agencies by training our students to use the valuable tools that remote sensing can provide to monitor the natural systems of the planet and human use of its space and resources. The course directly addresses goals 1 through 5 in the Geography Program Student Learning Assessment Plan.

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 Geography students and students from various other majors in the university.

4. Impact on Program(s):
   
   a. This course will be an approved elective in the Geography Major, Minor and the Interdisciplinary Minor in Geographic Information Sciences.
   
   b. Geography has no graduate program.

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:
   

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 CAA: 24 January 2008