University of Puerto Rico
Mayagüez Campus

1. General Information:

Course Number: GEOL 4048 and GEOL 6225

Course Title: Geological Applications of Remote Sensing

Credit - Hours: 3 crs.

2. Course Description:

This is an introduction to the theory and techniques of remote sensing with emphasis on the geosciences. It also includes the discussion of image processing and analysis. Laboratory focuses on learning the basics of remote sensing by processing and interpreting digital images.

3. Pre/Co-requisites:

GEOL 4006 and GEOL 4009 or permission of the Department Director.

4. Textbook, Supplies and Other Resources:

Introduction to Remote Sensing
Campbell, James B.
Edition 2nd 1996
Publisher: The Guilford Press

5. Purpose:

Elective undergraduate course in Geology.

6. Course Goals:

1. To understand the principles of remote sensing techniques and their apoplications to analysis of geological and environmental problems.
2. To develop an understanding of the physical principles of remote sensing, including energy sources, electromagnetic radiation, orbital dynamics, atmospheric interactions, and data acquisition
3. To examine various techniques, such as aerial photography, multispectral and hyperspectral remote sensing, SAR interferometry, and space-based geodesy
4. To introduce image processing and interpretation
5. To apply remote sensing methods to the evaluation of problems in the Earth Sciences, including tectonics, volcanology, geomorphology, watershed hydrolohy, and environmental degradation.

7. Requirements:

- Students are required to attend classes.
- No makeup examinations will be given except under extraordinary circumstances.
- The quizzes are unscheduled and may be given at any time.
- Some questions in the exams will be taken from material discussed only in class and not covered in the textbook or reading material.
- Students must turn off all electronic devices during the class.

8. Laboratory/Field Work (If applicable):

Labs are considered a major part of the class and all students are expected to participate. Radios, tape recorders and other audio or video equipment are not permitted in the lab or classroom at any time. Smoking is not permitted in any area other than tose areas designated for smoking.

9. Department/Campus Policies:

9a. **Class attendance:** Class attendance is compulsory. The University of Puerto Rico, Mayagüez Campus, reserves the right to deal at any time with individual cases of non-attendance. Professors are expected to record the absences of their students.

Frequent absences affect the final grade, and may even result in total loss of credits. Arranging to make up work missed because of legitimate class absence is the responsibility of the student. (Bulletin of Information Undergraduate Studies, pp 39 1995-96)

9b. **Absence from examinations:** Students are required to attend all examinations. If a student is absent from an examination for a justifiable reason acceptable to the professor, he or she will be given a special examination. Otherwise, he or she will receive a grade of zero of "F" in the examination missed. (Bulletin of Information Undergraduate Studies, pp 39, 1995-96)

9c. **Final examinations:** Final written examinations must be given in all courses unless, in the judgment of the Dean, the nature of the subject makes it impracticable. Final examinations scheduled by arrangements must be given during the examination period prescribed in the Academic Calendar, including Saturdays. (see Bulletin of Information Undergraduate Studies, pp 39, 1995-96).

9d. **Partial withdrawals:** A student may withdraw from individual courses at any time during the term, but before the deadline established in the University Academic Calendar. (see Bulletin of Information Undergraduate Studies, pp 37, 1995-96).

9e. **Complete withdrawals:** A student may completely withdraw from the University of Puerto Rico, Mayagüez Campus, at any time up to the last day of classes. (see Bulletin of Information Undergraduate Studies, pp 37, 1995-96).

9f. **Disabilities:** All the reasonable accommodations according to the Americans with Disability Act (ADA) Law will be coordinated with the Dean of Students and in accordance with the particular needs of the student.

9g. **Ethics:** Any academic fraud is subject to the disciplinary sanctions described in article 14 and 16 of the revised General Student Bylaws of the University of Puerto Rico contained in Certification 018-1997-98 of the Board of Trustees. The professor will follow the norms established in articles 1-5 of the Bylaws.

10. Campus Resources (If applicable):

General Library and University Computer Center is available to obtain professor's reference materials. The University's Counseling Office has a tutorial program for students who need extra help.

11. General Topics:

Part I: Principles of remote sensing

- Electromagnetic radiation
- Electromagnetic spectrum: UV, visible, IR, microwave
- Incident energy: radiated, absorbed, reflected, scattered, transmitted energy
- Orbital properties
- Spatial resolution: swath width; pixels; ground resolution cells; resolution targets; detection targets; contrast ratio
- Data transmission and recording; off-on switches
- Selective and non-selective atmospheric scattering
- Vision, lenses, filters
- Cameras, scanners, multispectral cross-track scanners; multispectral along-track scanners
- Aerial photography
- Stereoscopy
- Film: black and white; color; IR
- Color composites
- Field spectrometers
- Spectral reflectance curves of soils, minerals, vegetation

Part II: Images and instruments

- Manned space flight: Gemini; Skylab, etc.
- Landsat: Multispectral Scanner (MSS); Thematic Mapper (TM)
- SPOT: High resolution Visible (HRV)
- Other visible, IR and thermal IR instruments and programs (EOS-ASTER, Landsat 6, etc)
- Microwave instruments: principles of radar: surface roughness, dieletic constant, look direction, polarization, layover, atmospheric and surface penetration.
- Side-looking imaging radar (SLAR)

- Synthetic aperture radar (SAR)
- Shuttle imaging radar (SIR-A, AIR-B, SIR-C)
- Side-scan sonar
- GPS (Global Positoning System)

Part III: Applications of remote sensing

- Digital image processing: digital numbers, noise correction, contrast stretching, edge enhancement, spatial filtering, etc.
- GIS (Geographic information systems)
- Environmental uses of remote sensing: deforestation, vegetation health, contaminant transport, thermal monitoring
- Land use and land cover mapping
- Agriculture and soils: crop yields, soil surveys, wind and water erosion
- Engineering applications-landslides; flood control; earthquake damage
- Coastal processes
- Drainage patterns
- Resource exploration
- Urban applications

University of Puerto Rico
Mayagüez Campus

B. Instructor Information Sheet:

1. General Information:

Instructor:	Dr. Fernando Gilbes Santaella
Title:	Professor
Office:	F-417
Phone:	787-832-4040 Ext. 3000
Office Hours:	MWF 10:30-12:30
E-mail / URL:	gilbes@cacique.uprm.edu

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- Side-looking imaging radar (SLAR)
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- Agriculture and soils: crop yields, soil surveys, wind and water erosion
- Engineering applications-landslides; flood control; earthquake damage
- Coastal processes
- Drainage patterns
- Resource exploration
- Urban applications

12. Course Outline and Schedule:

Principles of Remote Sensing

- History and Scope
- Electromagnetic Radiation
- Radiometric Measurements

Image Acquisition

- Photographic Sensors
- Digital Data
- Image Interpretation
- Land Observation Satellites
- Active Microwave
- Thermal Radiation
- Image Resolution

Data Analysis

- Preprocessing
- Image Classification
- Field Data
- Accuracy Assessment
- Hyperspectral Remote Sensing

Applications

- Geographic Information Systems
- Plant Sciences
- Earth Sciences
- Hydrospheric Sciences
- Land Use and Land Cover
- Global Remote Sensing

13. Evaluating/ Grade Reporting:

- Two partial examinations: 50%
- Final examination: 25%
- Laboratory reports 25%

14. **Additional References**: