

# Geographic Information Systems 120

## Introduction to Remote Sensing

**Units:** 4, Course offered in Summer and Fall Terms

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Letter Grade or Credit/No Credit Option

### CATALOG COURSE DESCRIPTION:

GISG 120 introduces students to the basics of remote sensing applications, characteristics of remote sensors, electromagnetic radiation and its interactions with remote sensing media, visual interpretation of aerial imagery, digital image analysis and remote sensing applications in academic disciplines and professional industries.

Students of Geographic Information Systems (GIS) who wish to explore collection of environmental data and imagery from remote platforms and explore the basics of visual interpretation, digital analysis and application of remote sensing in industry and academia.

The course deals with remote sensing applications, the basics of image acquisition and data analysis used in field of geomatics, as well as conceptual issues involved with collecting data in the electromagnetic spectrum, storing, processing and analyzing remotely sensed datasets and images. The class focuses on learning fundamentals and designing a workflow in remote sensing to solve an environmentally based problem with real-world applications.

### REQUISITES:

#### Advisory:

GISG 111 with a grade of "C" or better, or equivalent

**FIELD TRIP REQUIREMENTS:** May be required

**TRANSFER APPLICABILITY:** Associate Degree Credit & transfer to CSU and/or private colleges and Universities

**LECTURE HOURS PER WEEK:** 2.5

**LAB HOURS PER WEEK:** 1.5

### STUDENT LEARNING OBJECTIVES:

Upon successful completion of the course the student will be able to:

1. Explain remote sensing basic principles, purposes, advantages, and limitations.
2. Define and describe basics of electromagnetic spectrum and interactions with various types of media.
3. Describe industry-specific image sources, collection methods, platforms, sensors and digital image processes.
4. Describe basic characteristics of remote sensing imagery.
5. Describe sensors and image acquisition methods.

6. Locate and acquire data sources for remote sensing applications.
7. Construct a workflow for image analysis, following appropriate design processes.

## **SECTION II**

### **1. COURSE OUTLINE AND SCOPE:**

#### **Outline Of Topics:**

The following topics are included in the framework of the course but are not intended as limits on content. The order of presentation and relative emphasis will vary with each instructor.

- I. Remote Sensing and GIS
  - A. Remote Sensing Defined
  - B. Applications of Remote Sensing
  - C. Basic Processes
  
- II. A brief history of remote sensing for earth observation
  - A. History of photography
  - B. Digital images
  - C. Evolution of platforms
  - D. Sensor Characteristics
  
- III. Remote Sensing Basics
  - A. Remote Sensing Data Collection
  - B. Remote Sensing Process
  - C. Earth Observations
  - D. Electromagnetic Radiation
  - E. Atmospheric Energy-Matter Interactions
  
- IV. Frame Captured Sensors and Line Scanners
  - A. Frame Capture
    1. Photographic Cameras
    2. Digital Cameras
    3. Videography
  - B. Scanners
    1. Across-track Scanners
    2. Along-track Scanners
    3. Hyperspectral Scanners
  
- V. Satellite-based Sensors in Visible and Infrared Wavelengths
  - A. Low-spatial Resolution Sensors
  - B. Medium-spatial Resolution Sensors
  - C. High-spatial Resolution Sensors
  
- VI. Active Sensors: Radar and Lidar
  - A. Active Microwave (RADAR) Remote Sensing

- B. Radar Interferometry
- C. Passive Microwave Radiometers
- D. Lidar
  1. Lidar Principles
  2. Lidar-derived Vegetation Information
  3. Lidar-derived Urban Information

#### VII. Sonar

- A. Side-scan sonar
- B. Multibeam sonar
- C. Global Seafloor Topography

#### VIII. Aerial Imagery – Visual Interpretation

- A. Nature of Aerial Images
- B. Ground Verification and Processing
  1. Control Points
  2. Ground Truthing

#### IX. GIS Integration

- A. Raster to Vector
- B. Image Formats (ENVI Image, GeoTIFF, ESRI Grid)

#### X. Remote Sensing Applications

- A. Agriculture
- B. Forestry
- C. Geology
- D. Oceanography
- E. Archaeology
- F. Military
- G. Urban Infrastructure

#### **Reading Assignments:**

Reading assignments are required and may include but, are not limited to, the following:

##### I. Textbooks

##### II. Newsletters

- A. ESRI ArcNews
- B. ESRI ArcUser

##### III. Periodicals

- A. PE&RS (Photogrammetric Engineering and Remote Sensing Journal)
- B. ArcNews
- C. GIS World

##### IV. Websites and Internet articles

- A. ENVI and ENVI EX, <http://www.ittvis.com>
- B. ESRI website: <http://www.esri.com>
- C. ESRI ArcLessons: <http://gis2.esri.com/industries/education/arclessons/arclessons.cfm>

B.

**Writing Assignments:**

Writing assignments are required and may include, but are not limited to, the following:

- I. Write short answer responses given questions related to remote sensing.
  - II. Document the workflow involved in acquiring and processing earth images for data analysis appropriate to intended users..
  - IV. Write and then present a final semester project, which includes a demonstration of problem solving and incorporates imagery acquisition, data processing and formal written presentation.
- C.

**Appropriate Outside Assignments:**

Outside assignments may include, but are not limited to, the following:

- I. Research current trends in remote sensing applications.
  - II. Research Remote Sensing employment opportunities and related job skills as defined by the Geographic Information Systems & Technology Body of Knowledge.
  - III. Attend user group meetings, conferences, and online training.
  - IV. Interview a geospatial professional.
  - V. Design an imagery analysis solution for a business or an organization.
- D.

**Appropriate Assignments that Demonstrate Critical Thinking:**

Critical thinking assignments are required and may include, but are not limited to, the following:

- I. Plan and model a workflow of image processing, including image acquisition, data download, digital data manipulation and imagery interpretation to achieve objectives using earth observation data.
  - II. Analyze imagery and propose appropriate workflows or processing for data analysis.
  - III. Research, analyze, and propose a workflow process to achieve a remote sensing image analysis goal.
  - IV. Evaluate the accuracy and effectiveness of completed remote sensing projects based on stated goals.
- E.

**2. METHODS OF EVALUATION:**

A student's grade will be based on multiple measures of performance unless the course requires no grade.

Multiple measures may include, but are not limited to, the following:

- I. Imagery analysis and image data processing assignments.
- II. Written responses on tests, quizzes, essay questions and assignments.
- III. Participation in class discussions, online chats, and group projects.
- IV. A culminating project presented in class.

**3. METHODS OF INSTRUCTION:**

Methods of instruction may include, but are not limited to, the following:

- \* Lecture Discussion
- \* Learning Modules
- \* Audio-Visual
- \* Collaborative Learning
- \* Lecture-Lab Combination
- \* Computer Assisted Instruction

**4. REQUIRED TEXTS AND SUPPLIES:**

Textbooks may include, but are not limited to:

**TEXTBOOKS:**

1. Remote Sensing for GIS Managers. By Stan Aronoff. ESRI Press, 2005.

**MANUALS:**

1. ENVI and ENVI-EX Tutorials (available online)

**PERIODICALS:**

**SOFTWARE**

1. ENVI Software, ITT VIS, Current edition.
2. ENVI-EX Software, ITT VIS, Current edition.
3. ArcGIS. ESRI, Current edition ed.

ESRI is the global leader in GIS software and their primary GIS software, ArcGIS, is used throughout this class.

**SUPPLIES:**

1. A portable storage device such as a flash drive.