**GIS and Remote Sensing GEOSCIENCE 3408 / SPRING 2019**

**GENERAL INFORMATION**

# INSTRUCTOR

Glenn Kroeger

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Office Hours: MF 10:00 AM - 12:00 PM, TR 12:00 - 2:00 PM

# CLASS MEETINGS

Time: TR 8:30 - 9:45 AM; MMH 225

M 1:30 – 4:00 PM; CSI 102

# COURSE TEXTS

Sobel, Dava, *Longitude*

Danson, Edwin, *Weighing the Earth: The Quest to Measure the Earth*

Additional readings and videos will be assigned from materials on reserve in the library

# COURSE OBJECTIVES

In this course, you will learn the ways in which digital data are stored and the formats and hardware used to store and transfer digital spatial data such as images and maps. You will study the basic concepts of cartography and the practical implications of the choices of datums and projections in mapping. You will be introduced to the principles behind the operation of the Global Positioning System and carry out field work with differential GPS. You will represent and manipulate vector and raster data in Geographic Information Systems to solve a variety of spatial problems. You will explore the way in which spatial data is acquired and visualized, and you will employ a variety of deterministic techniques to interpolate irregularly samples data into regularly spaced samples. You will examine the basic ideas of geostatistics including regionalized variables, and you will analyze semivariances of data sets and employ Kriging to create statistically optimal interpolations of those data. You will explore the principles behind the acquisition of electromagnetic remotely sensed data sets and process multispectral data for geologic and environmental applications. Finally, you will employ several methods to classify image data into thematic maps.

This course fulfills the Digital Literacy Core Capacity in the Pathways curriculum. In the process of meeting the course objectives, you will demonstrate the ability to manipulate digital information, by programming, scripting, or planning and executing structured sequences of software commands, to solve problems or engage in artistic expression.

# COURSE REQUIREMENTS

Examinations

Mid-term exams **Thursday, February 21** and **Thursday, April 4**

Final **Wednesday, May 8, 8:30 AM**

You must pass the final to pass the course. An unexcused absence from an exam will result in a grade of zero (0) on that exam. If you need to be excused from an exam, you should clear it with me **before** the exam date. If I excuse you from an exam, I will give you a make-up exam at the soonest, mutually convenient, time.

Exercises

There will be a series of exercises assigned in class and posted on TLEARN. Due dates will be announced with each exercise.

Lab Projects

There will be a series of lab projects, most of which involve the use of computers. Lab projects will be started (not surprisingly) in lab and due dates will be announced at that time. Projects will be graded primarily based on effort, creativity, completeness and timeliness although getting right answers will count some as well. Lab project due dates carry a one class-session grace period after which they will not be graded!

Online Tutorials

You will be assigned some online software tutorials in preparation for both class discussion and lab projects.

Class Attendance

You are responsible for all material presented in class. Significant material will be presented in class that is not in the reading. The exams will be based on material covered in class.You are allowed one unexcused absence from class. Additional unexcused absences will lower your final course grade by 1/3 letter.

# GRADING PERCENTAGES

35% In class exams

20% Final exam

30% Lab Projects

15% Exercises

# ACADEMIC INTEGRITY

All students are covered by the Honor Code that prohibits dishonesty in academic work. Under the Honor Code, a faculty member will (or a student may) report an alleged violation to the Academic Honor Council. It is the task of the Council to investigate, adjudicate, and assign a punishment within certain guidelines if a violation has been verified.

Students who are under the Honor Code are required to pledge all written work that is submitted for a grade: “On my honor, I have neither given nor received any unauthorized assistance on this work” and their signature. The pledge may be abbreviated “pledged” with a signature.

If you do not understand some aspect of the Honor Code, or how it applies to this course, ask me! Ignorance does not exempt you from its consequences.

**COURSE OUTLINE**

**Digital representation of spatial and non-spatial data**

Integers and floating-point numbers; Vectors and arrays

Raster graphics, lossy and lossless compression

Object-based graphics

Human visual physiology

Digital images, digital representations of color

Color models, spaces and gamuts

Black body radiation, Kelvin temperatures and whitepoints

Resolution, aliasing and moiré, sharpening

Standard graphic file formats (TIFF, GeoTIFF, JPEG, SVG, Postscript, PDF, etc.)

**Cartography**

Mapping datums; local vs. geocentric datums

Mapping projections: conformal and equal area projections,

Common US projections and Cartesian grids: Lambert Conformal, State Plane coordinates

UTM projections and grids

**GPS**

Basic theory of GPS, L1 & L2 signals, PRC concepts, CA and P-code

GPS components: Satellites, Ground Control, and Receivers

GPS errors and positional accuracy

Differential GPS, real-time DGPS, WAAS

GPS hardware

Future enhancements

**Geographic Information Systems**

Object vs. raster GIS systems

Major GIS software systems

GIS layers, geospatial data and attributes

Analysis operations on objects: selection, buffering, geoprocessing operations

Display of object data, symbology tools

Grid to grid operations; Raster map algebra

Object data sets, DLG, Tiger, FEMA

Raster data sets: DEM, DRG

Cost surfaces, path calculations

Drainage analysis

**Interpolation of Sampled Data**

Contouring by TIN (triangular inter-networks)

Contouring gridded data

Operations on gridded data

Gridding methods for irregularly spaced data sets

Geostatistics-semivariance

Kriging

Perspective surfaces, draping and light-source shading

DEMs

**EM Remote Sensing**

Panchromatic data

Multispectral Data, Landsat MSS and TM, SPOT

Hyperspectral Data, AVIRIS, ASTER

Band compositing

Band-to-band operations, spectral ratios

Transformations in color space, Principal Components Analysis, IHS transformations

Supervised and unsupervised classification

**Problem solving with GIS and remote sensing**

Modeling societal decision making with GIS