TEXAS EDUCATION AGENCY

Course: *Raster-Based GIS*
PEIMS Code: *N1302806** *Abbreviation:* *RBGIS*
Number of credits that may be earned: *1.0*

Brief description of the course (150 words or less):

This course introduces the principles of GIS data sets including raster-based information such as images or photographs. Students will study local problems and acquire information including images or aerial photographs, process the data and merge it with vector data. Students will plan, conduct, and present solutions for the locally-based problems while working with the private sector businesses and local government.

Essential Knowledge and Skills of the course:

1. The student will have an understanding of ERMapper, the use and application of Raster-based software.

2. The student will be able to define the following processes as it pertains to Remote sensing data:
   a. Photographic interpretation
   b. Maximal definition
   c. Minimal definition

3. The student will be able to describe the equipment and how it is used in remote sensing.

4. The student will be able to list the advantages, disadvantages and limitations of remote sensing.

5. The student will be able to understand the remote sensing process.

6. The student will be able to identify cities, bridges, shorelines, roads and other important features on the image they have downloaded.

7. The student will understand how electromagnetic Radiation is created, how it propagates through space and how it interacts with other matter.

8. The student will understand the wave model of electromagnetic energy.

9. The student will understand the particle model.

10. The student will be able to explain
    a. Refraction
    b. scattering
    c. Absorption
    d. Reflectance

11. The student will be able to use Digital Orthoimagery Quarter Quadrangles (DOQQ) to perform tone balancing.

12. The student will be able to explain the fundamental principles of a camera as it pertains to GIS use.

13. The student will be able to explain the development of the photographic industry as it relates to the GIS.

14. The student will be aware of the history of photography from aerial platforms.

15. The student will be aware of history photo-reconnaissance during World War 1 and World War 2.

16. The student will be able to mosaic together DOQQ images both the black and white and the Color Infrared (CIR).

17. The student will be able to understand the following types of aerial photography:
    a. Vertical aerial photography
    b. Oblique aerial photography

18. The student will understand the parts on an aerial camera.

19. The student will be able to explain the difference between a personal camera and an aerial camera.

20. The student will understand how a multiple lens camera works (multiple-band).

21. The student will be able to explain how aerial photography filtrations effects aerial photography.

22. The student will explain the different types of films used in aerial photography and how it affects the aerial photograph.

23. The student will be able to give the reasons why photo or image interpretation is important in:
    a. A regional perspective photograph
    b. A three dimensional depth perception photograph.

24. The student will acquire the ability to obtain a historical image record to a document change.

25. The student will be able to perform a regional analysis. The analysis will consist of the following required elements:
    a. x,y location, including longitude and latitude, meters easting and northing in a Universal Transverse Mercator (UTM) map grid.
    b. Size: length, width perimeter and area
    c. Shape: an object's geometric characteristics.
    d. Shadow: gray tones, light medium and dark.
    e. Texture: characteristic placement and arrangement of repetitions of tone or color.
    f. Pattern: spatial arrangements of objects on the ground, systematic, unsystematic or random.
    g. Height/depth/volume/slope/aspect: z-elevation (height), depth (bathymetry), volume, slope and aspect.
    h. Site/situation/association: elevation, slope, aspect and exposure.

26. The student will be able to develop approaches to interpreting remotely sensed data including:
    a. Utilizing collateral information
    b. Converging evidence
    c. Applying the multi-concept in image analysis.

27. The student will be able to compress and compare the CIR and DOQQ images.

28. The student will be able to obtain the following measurements from a single vertical aerial photograph:
    a. Scale of the photography
    b. Object height
    c. Object length
    d. Area of object or polygon
    e. Perimeter of an object
    f. The grayscale tone or color of an object.

29. The student will be able to make the following quantitative measurements using multiple (0ver lapping) stereoscopic aerial photographs:
    a. Precise planimetric (x,y) object location of buildings, streets, hydrology, and shorelines in a standard map projection.
    b. Precise object height
    c. Planimetric accurate (x, y) orthography
    d. Digital elevation models (DEM)
    e. Bathymetric models
    f. Slope and aspect information derived from the digital elevation or bathymetric models.

30. The student will be able to download spatial data from Texas Natural Resources Information Systems (TNRIS) and re-project it to match the DOQQs. The student will be able to explain the

following types of data collection systems:

a. Multispectral imaging using discrete detectors and scanning mirrors.
b. Multispectral imaging using linear arrays.
c. Imaging spectrometry using linear and area arrays.

31. From a given set of photograph the student will be able to recognize which type of data collection system they derived from.

32. The student will know the history of Thermal Infrared Remote Sensing.

33. The student will be able to explain the following properties of Thermal infrared radiation:
    a. Kinetic heat
    b. Temperature
    c. Radiant energy
    d. Radiant flux.

34. The student will have an understanding of the following thermal radiation laws:
    a. Stefan-Boltzmann Law
    b. Wien's Displacement Law
    c. Emissivity
    d. Kirchoff's Radiation Law
    e. Thermal Properties of Terrain

35. The students will have an understanding of how Thermal infrared data is collected using the following systems:
    a. Daedalus DS-1260 system
    b. Airborne Mulitscanner (AMS)
    c. Timberlands Information Management System (TIMMS)
    d. ATLAS

36. The student will be able to explain the difference between push broom linear scanning and Area array scanning.

37. The student will be given an infrared image and will be able to give a detailed data analysis of the image.

38. The student will be able complete the re-projection of a raster image to match the DOQQ and the spatial data.

39. The student will have an understanding of Active Microwave (RADAR) Remote Sensing.

40. The student will be able to list the Active Microwave system components:
    a. shadows
    b. relief displacement

c. speckle
d. image foreshortening
e. resolution
f. depression angle
g. azimuth direction
h. range direction
i. incident angle
j. polarization
k. wavelength
l. frequency
m. pulse length

41. Through image analysis the student will be to explain the following characteristics of an image:
    a. Surface roughness
    b. Moisture content
    c. Vegetation
    d. Backscatter and Biomass
    e. Urban structures

42. The student will complete classifications from the ERMapper text.

43. The student will be able to calculate regional spatial information using point observation for a number.

44. The regional spatial calculations will include:
    a. water surface area (streams, rivers, ponds, lakes, reservoirs and seas)
    b. Water constituents (organic and inorganic).
    c. Water depth (bathymetry)
    d. Water surface temperature
    e. Snow-surface temperature
    f. Snow-water equivalent
    g. Ice surface area
    h. Cloud cover
    i. Precipitation
    j. Water vapor.

45. The student will perform a classification to build a shoreline of a lake.

46. The student will be able to complete a raster image analysis.

Description of the specific student needs this course is designed to meet:

While the demand for GIS may be impacted by economy, the demand for highly-trained individuals still remains high. GIS plays a vital role in national security and the economy. Regional workforce demand for Geographical Information Scientist with a variety of specializations remains high.

Major resources and materials to be used in the course:

The most valuable resource will be the consistent interaction with a richly experienced teacher in the classroom. The materials that are required for this class will include a computer for each student, the software program ArcGis Desktop, MS Office Suite -- Word, PowerPoint, Excel, laser printer and the textbook *Making Spatial Decisions Using GIS* and portable Garmin Vista Etrex GPS devices

Required activities and sample optional activities to be used:

The students will learn how to solve locally-based problems. Students will use locally-based problems to acquire data, process the data and merge it with vector data. Students will plan, conduct, and present solutions.

Methods for evaluating student outcomes:

The students will be evaluated through the use of written tests, observation, worksheets, quizzes, skill based tests and projects.

Required qualifications of teachers:

Bachelor's degree in Geographical Information Systems field is strongly preferred. Agree to meet Texas teacher certification requirements for Trade and Industry certification or certification in Technology Education/Industrial Technology/Industrial Arts or a Secondary Social Studies Composite certification.

Additional information (optional):