# **GEOG 265:** Introduction to Geographic Information Systems

## **Course Description**

Fundamentals of geographic information systems (GIS). How to visualize geographic information in ways that reveal relationships, patterns, and trends not visible in other software systems. Develop working knowledge of the full capabilities of GIS technology. (3 credit hours).

# **Course Objectives**

The UCC-21 cognitive skills that are listed above will be met via the following objectives.

- Identify, locate, and acquire spatial data pertinent to projects in their field of interest, as well as pinpoint significant gaps in or problems with existing information
- Evaluate the appropriateness of the existing data sources for use in a project
- Collect/create spatial data sets for the project
- Create spatial data from tabular information that includes a spatial reference
- Use ESRI ArcGIS software package effectively
- Perform basic spatial analyses (attribute and spatial queries, buffering, overlays) as well as linking these methods together in a more complex analytical model
- Create maps and associated graphics and text that clearly communicate spatial information and analyses

In order to meet the UCC-21 requirement that at least one course objective is consistent with a course's WISER designation, *Technological Literacy (T)*, students will:

• Identify and explain the social, cultural, ethical, ecological and environmental ramifications using GIS technology

# Course Rationale for Inclusion of GEOG 265 in UCC-21

GEOG 265 is an appropriate **Tier 2 Natural Science Domain** course for UCC-21. GIS has revolutionized the way that land is inventoried, managed, planned, and studied. GIS provides the theories and methods for organization and analysis of original measurements of location and secondary spatial data, as well as topography. GIS applications are diverse, such as determining the suitability of land for different uses, planning future land uses for different objectives, managing cadastral information for the purpose of property recognition, taxation and regulation, analyzing land use/cover properties for both resource inventories and scientific studies, and sitting commercial enterprises. The private-sector GIS industry has become a key component of the U.S. economy.

GEOG 265 will develop the following cognitive skills associated with the Knowledge to Judgment transformations.

- 1. Evaluate competing hypotheses, form judgments, and provide their rationale using multiple sources of geospatial information and knowledge
- 2. Evaluate strengths and weaknesses of arguments and actions in Geography
- 3. Describe effective decision-making strategies
- 4. Explain how actions affect the human-environment system

GEOG 265 emphasizes in both lecture and laboratory settings how spatial data leads to accurate description and prediction of the natural environment, human environment, and relationship between them. GEOG 265 enables students to accomplish the **Knowledge** to the **Judgment** transformation by utilizing a focus on active-learning centered pedagogies, which may include lectures, hands-on practice, internet exploration, and individual and/or group projects on real-world issues. These pedagogies help students learn to:

- Demonstrate their conceptualization and recognition of geographic information as a system and science (cognitive skill 1),
- Show how spatial information is structured (cognitive skill 1)
- Identify real-world issues that can be solved using GIS (cognitive skill 3 and 4),
- Practice to find spatial datasets needed to build a GIS (cognitive skill 2 and 3),
- Perform GIS operation and analysis (cognitive skill 1 and 3),
- Make decisions based on GIS analysis results (cognitive skill 3 and 4),
- Integrate knowledge from a variety of sources and disciplines to reach sound judgments (cognitive skill 1 and 4).

### **Course Content Outlines and Format**

This course uses a variety of class and small group discussion, lectures, computer lab, media representation, texts, and course projects to meet the UCC-21 Tier 2 **Natural Sciences** domain course requirements as articulated in the following course contents.

Getting to know GIS

- Defining GIS
- GIS history
- Components of a GIS

Data model and data sources

- Geographic features and surfaces
- Vector and raster data model
- GIS datasets
- GIS data sources

### Software

- Exploring ArcMap
- Exploring ArcCatalog
- Exploring ArcToolbox

Map projection and coordinate systems

- Map scales and projections
- Coordinate systems

Classifying spatial data

- Thematic maps
- Choropleth maps
- Descriptive statistics
- Classification methods

Mapping spatial data

- Labeling features
- Making maps from templates
- Making maps for presentation

Data query

- Selecting features by attributes
- Selecting features by location
- Joining and relating tables

Creating and editing data

- Creating features
- Editing features and attributes

Building geodatabases and geocoding

- Creating a personal geodatabases
- Geocoding addresses

Data analysis

- Dissolving features
- Clipping layers
- Buffering features
- Overlaying data

GIS in action: Project

- Identifying social or natural real-world issue
- Collecting data
- Analyzing data
- Present information

# **Assessment of Student Learning Outcomes**

All sections of GEOG 265 taught during the academic year will be assessed with the same methods. These include exams/quizzes, lab exercises, homework/assignments, and comprehensive projects. Exams and guizzes are primarily based on guestions requiring computations, matching, calculation, short answer, detailed answer, or data treatment. They will be all graded by faculty who teach both lecture and labs, graded materials will be returned to students with mistakes identified. Partial credit may be assigned on short/detailed answer questions based on whether the answers reflect that correct concepts and computational methods have been used and there is an indication of a reasonable scientific approach to the question or problem even if the answer is incorrect. Assessment of the laboratory exercises involves evaluating the data that students have collected, techniques and/or methods they applied, the results they obtained, and conclusion they drew, and discussion of the sources of errors and effects of these errors. These lab reports are graded and returned to the students with any misconceptions identified. Comprehensive projects will primarily be used to assess the achievement of learning outcomes which reflect the cognitive transformations described for a Natural Science UCC-21 course.

### UCC-21 Cognitive skills addressed in GEOG 265

| Cognitive Skills  | Example Assessment Methods (other methods also may apply)   |
|---|---|
| Knowledge to Judgment   |   |
| <ol> <li>Evaluate competing<br/>hypotheses, form<br/>judgments, and provide<br/>their rationale using<br/>multiple sources of<br/>geospatial information and<br/>knowledge</li> </ol> | <ul> <li>Lab exercises: require students to evaluate competing hypotheses and form judgment using the geospatial knowledge they learned in class.</li> <li>Examinations: assess students' ability to evaluate competing hypotheses and form judgment in Geography.</li> </ul>           |
| <ol> <li>Evaluate strengths and<br/>weaknesses of arguments<br/>and actions in Geography</li> </ol>   | <ul> <li>Examinations: assess students' ability to evaluate strengths and weaknesses of arguments and actions in Geography.</li> <li>Final project: require student to engage in the evaluation of strengths and weaknesses of arguments and actions in geospatial problems.</li> </ul> |
| 3. Describe effective decision-making strategies  | <ul> <li>Lab exercises: require students to apply GIS in real-world decision-making.</li> <li>Examinations: assess students' ability to apply GIS technology on real-world decision-making.</li> </ul>  |
| <ol> <li>Explain how actions affect<br/>the human-environment<br/>system</li> </ol>   | <ul> <li>Examinations: assess students' ability to explain<br/>how actions affect the human-environment<br/>system.</li> <li>Final project: require students to explain and<br/>reflect on how actions affect the human-<br/>environment system.</li> </ul>                             |

## WISER+ Designation

GEOG 265 will carry *Technological Literacy (T)* designation. The WISER+ proposal is appended to the Master Syllabus.

### **Course Assessment**

GEOG 265 will be assessed periodically to ensure that it successfully contributes to the goals and objectives of the UCC-21 curriculum. The primary method for assessing the success of this course in achieving the transformations listed above will be to use the responses to specific questions in the exams, laboratory reports, and projects that require the gathering and treating of geospatial data. The instructor will determine the percentage of students that correctly or nearly correctly answered questions specific for each cognitive skill. Each instructor will compile a summary of data to be submitted to the departmental curriculum committee along with a list of questions chosen and the cognitive skill measured. Our goal is that 75% of the students in the class will receive a score of all or nearly all correct on each cognitive skill linked with specific exam questions, and 80% for laboratory exercises. The departmental curriculum committee will compile there data for submitting to UCC-21 subcommittee.

### **Faculty Qualifications for Domain Courses**

GEOG 265 will be taught by faculty with graduate degrees in Geography or related disciplines and have specialized expertise in Geographic Information Sciences.

## **Supplemental Rationale or Other Statement**

Not applicable

### **WISER+** Designation T

GEOG 265 qualifies for a Technological Literacy (T) designation.

Technological literacy is a central theme for this course. At least 40 percent of the course grade depends on students' lab exercises or projects that use geospatial technology directly or developing an understanding of how technology is used to develop scientific models and theories. For example, all laboratory exercises need to be conducted in a computer lab with ArcGIS software package installed. Networks, the Internet, scanners or digitizers will be used to search, obtain, and store the data; their outputs will be either digital maps or printed maps using color printer/plotter.

## Assessment

The assessment of WISER+ *Technological Literacy (T)* designation will be handled in the same manner as the assessment for the entire course. That is, instructors will use exam guestions (essay and multiple choices) and lab exercises as ways to assess students' knowledge on principles of GIS history and development. In addition, students' ability with regard to cognitive transformations from Knowledge to Judgment will be mainly evaluated by individual and/or group projects. The topics of these projects have to be identified from real-world issues in social, cultural, ethical, ecological, and/or environmental ramifications and reflect how GIS technology changed people's ways in decision making. The completion of these projects needs most of the technologies they learned from this course, including to search and collect spatial data through the Internet and from the field, to display and analyze data using ArcGIS software, and to present the results in either digital PDF format or hardcopy maps (e.g., conference poster). Plus these projects have to be submitted in written format to instructor as well as presented orally to the class so that students can share their ideas, gain skills of communication, and learn from one another. Students' final performance on this course will be evaluated as unsatisfactory, satisfactory, or exemplary. These results will be communicated to the department's assessment coordinator and will be aggregated for all sections of GEOG 265 to assess the effectiveness of the course in accomplishing its transformational and WISER+ goals. The results will then be sent to the relevant college and university assessment committees.

## MASTER SYLLABUS

## GEOG 265 Introduction to Geographic Information Systems

#### 1. Credit hours: 3.0

#### 2. Course Description

Fundamentals of geographic information systems (GIS). How to visualize geographic information in ways that reveal relationships, patterns, and trends not visible in other software systems. Develop working knowledge of the full capabilities of GIS technology.

### 3. Course Materials and Resources

- Text books: Getting to Know ArcGIS Desktop (2<sup>nd</sup> edition for ArcGIS 9.3) ESRI Press or other texts selected by course instructors
- Blackboard: https://blackboard.bsu.edu/
- ESRI virtual campus: http://training.esri.com/
- GIS software/hardware: ArcGIS Desktop, BSU Graphics Computer Lab (CL469)

#### 4. Learning Outcomes and Objectives

After completing this course, students will be able to:

- Identify, locate, and acquire spatial data pertinent to projects in their field of interest, as well as pinpoint significant gaps in or problems with existing information
- Evaluate the appropriateness of the existing data sources for use in a project
- Collect/create spatial data sets for the project
- Create spatial data from tabular information that includes a spatial reference
- Master ESRI ArcGIS Desktop software package
- Perform basic spatial analyses (e.g. attribute and spatial queries, buffering, overlays)
- Create maps and associated graphics and text that clearly communicate spatial information and analyses

## 5. Measures of Learning Outcomes and Objectives

Students will be evaluated on their ability to capture, store, display, manipulate, and analyze geographic information as part of a series of lab assignments. In addition, their ability to think critically and spatially will be evaluated by class projects that

address complex real-world issues using GIS. Project reports will provide evidence of students' ability to identify the essence of a problem and offer solutions based on sound judgment derived from understanding the multiple facets and implications of the problem. Students' communication skills will be evaluated in their written and verbal presentations of the project and their findings.

## 6. Methods of Instruction

- a. Lecture/Discussion
- b. Lab exercises
- c. Internet exercises
- d. Projects
- e. Verbal presentation
- f. Guest lectures

## 7. Departmental Goals and Objectives

Based on the department assessment plan, GEOG 265 has the following goal and learning outcome.

Goal two: Comprehend the consequences of human/environment interactions by developing/applying a set of skills to geographic issues, both social/cultural and physical environmental.

- a. Identify and describe the distribution and spatial pattern of human and environmental phenomena
- b. Identify and explain the geographic processes which influence human and environmental systems
- c. Identify the implications of geographic scale and its influence on human and environmental processes
- d. Identify the use of remote sensing, GIS and GPS to understand spatial relationships

# 8. Assessment Activity

Assessment will involve evaluating the transformation from Knowledge to Judgment. In addition, the ability of students to achieve the courses objectives/goals will also be assessed. The evaluation will use exams, quizzes, essay questions, class discussion, lab assignments, projects, and/or presentations. The students' performances will be evaluated and identified as unsatisfactory, satisfactory, and exemplary.