Glassboro State College Senate Curriculum Committee

Approval Form

Proposal Title: INTRODUCTION TO GEOGRAPHIC INFORMATION SYSTEMS

Sponsor(s) RICHARD A. SCOTT Dept.: GEOG/ANTHRO ☎Ext. 6497

DEPT OF GEOG/ANTHRO 7311

Check one: ☒ Course ☐ Specialization ☐ Concentration ☐ Minor ☐ Achievement Certificate

☐ Certification Program ☐ Major Program ☐ Minor Change _____ (please name deletion or credit/title/catalog change)

☒ Undergraduate ☐ Graduate 3 Credit Hours

Step 1 (Department)

☑ Approved May 12, 1989 Date

☐ Not Approved

Dept CC Chairperson

☑ Reviewed _____ Date

Dept Chairperson

Step 2 (Receipt)

☐ SCC# 1989-90-01

Proposal Received June, 1989 Date

logged in for next year

Brenda A. Boley

SCC Chairperson

Step 3 (School CC)

Reviewed 10 13 89

☒ Approved

☐ Not Approved

Comments:

School Curr. Comm. Chairperson

Step 4 (Academic Dean)

☑ Recommend

☐ Not Recommend

☐ Conditionally Recommend (see comments)

Reviewed 10 18 Date

Comments:

Signature, Dean of School

Step 5 (SCC)

Open Hearing 11/13/89 Date ☒ Approved by Senate Curriculum Committee 11/13/89 Date

☐ Returned to sponsor(s) for the following reasons:

Linda Lees, Chair.

Step 6 (Senate)

Presented to Senate 11/17/89 Date ☑ Approved ☐ Not Approved

Notification to Executive Vice-President/Provost _____ Date

Signature, SCC Chairperson

Step 7 (Executive V.P./Provost)

Received 12/7/89
Date

Approved ☐ Yes ☐ No

If no, reasons are as follows:

Student credit hours 3

Faculty load hours 3

Equalized credit hours 3

Official copy and approval sheet filed 12/15/89
Date

Signature, Executive Vice-President/Provost

Registrar

Approved course description received _____
Date

Hegis Taxonomy and Course Number assigned _____

_____ _____ _____
Signature, Registrar Date

Notification forwarded:

- ☐ Senate Curriculum Committee Chairperson
- ☐ Department Chairperson(s)
- ☐ Academic Dean
- ☐ Registrar
- ☐ Sponsor(s)

Course Proposal:

Introduction to Geographic Information Systems

1. Details:

   a. Course Title: Introduction to Geographic Information Systems [GIS]

   b. Sponsors: Richard A. Scott Department of Geography and Anthropology, and the Geography and Anthropology Department

   c. Credit Hours: 3

   d. Course Level: Undergraduate (Junior and Senior level)

   e. Curricular Effect: The course will serve Geography majors as a Specialized Elective in the Geographic Techniques course bank. The course might also be of interest to and serve as an elective for Computer Science majors.

   f. Prerequisites: None.

   g. Time and scale of implementation:

      1. Time of implementation: Spring 1990

      2. Scale of implementation: The course will be offered once a year in rotation with an advanced GIS course.

   h. Adequacy or resources required to offer the course:

      1. Staff: The department currently has one full time faculty member who is capable of teaching this course. In addition several professionals working with Geographic Information Systems have expressed an interest in teaching a GIS course on an adjunct basis. We plan to offer the course using full time staff, unless demand for the course is such that it needs to be offered on a more frequent basis than proposed here [once a year].

      2. Computing Facilities: The introductory GIS course will require students to learn GIS concepts and analysis

techniques by way of hands on exercises with three software packages: 1) the Map Analysis Program (MAP) available through Ohio State University, 2) the IDRISI program available through Clark University, and 3) the ERDAS program from the ERDAS Corporation. MAP and IDRISI are inexpensive, but limited capability, programs developed by academic institutions and distributed specifically to support instruction in GIS. These programs will run on the IBM PS/2 computers in the Social and Behavioral Sciences Computing Laboratory (SBS Lab) in 122 Robinson Hall. The fourteen computers available in the SBS Lab provide ample computing facilities to support this class. Moreover, as the campus achieves more integrated networking capabilities, the prospect is that, in the near future, programs available on the SBS Lab file server will be accessible from many campus locations. The ERDAS program is a state-of-the-art commercial product that is available on one computer located in the Geography and Anthropology Department. This program can accommodate large data sets and has a range of functionality that enables it to work more effectively with real world research and policy analysis problems than the MAP or the IDRISI programs, which serve more as tools for teaching GIS concepts and analysis methods. The ERDAS program will be used by students to carry out a group term project.

3. Space Needs. The classroom and computer laboratory space currently available to the Geography and Anthropology Department are adequate for the support of this course.

4. Library Holdings. Library holdings are adequate to support offering undergraduate education in Geographic Information Systems. The Department of Geography and Anthropology has offered courses in computer cartography, quantitative analysis, and remote sensing since the later part of the 1970s. At that time we began to order library materials to support these course offerings. Inasmuch as GIS is an outgrowth of these areas, we already have significant holding to support the new GIS course. In anticipation of offering courses in GIS we have begun to increase orders for materials focused more specifically on the GIS area. For example, the department recently ordered the journal, Geographical Information Systems.

2. Rationale:

The value of the map as a fundamental tool for use in the analysis and presentation of spatial data is well known and appreciated by geographers, planners, resource managers, engineers, and others who work with geographically referenced information. The time, effort, and money required to construct

maps by hand is also well known by practitioners in these fields. The advent of widely available digital computing resulted in attempts to automate the painstaking processes required for producing maps. This technology, which initially saw the mimicking of manual methods as its goal, is now well developed. Given good software and high quality plotting devices, in many instances the only distinction between computer generated and hand generated maps is that one was made by a computer and the other was not. Figure 1 presents an example of a computer map generated by the Atlas Graphics mapping program. The map was designed in less than fifteen minutes and drafted by a low resolution dot matrix printer. Plotting on a vector plotter would result in a product of much higher quality.

Although the success of computer cartography in mimicking manual methods was slow in coming, even before this achievement geographers, landscape architects, planners, computer scientists, and other analysts saw that the computer promised much more than its drafting capability which computer cartography has taken advantage of so thoroughly. Once locational data were stored in the computer and tied there to attribute information [i.e., data describing characteristics of or magnitudes occurring at locations], a new set of possibilities arose. Namely, the computer could be used to query, compare, and analyze the information while maintaining the spatial context of the data. Thus, from the initial goal of automated display grew the additional objective of carrying out computer-assisted spatial analysis. Instead of merely asking the computer to reproduce a map, the analyst could use the computer as a tool to assist in answering questions about sets of spatial data. For instance, a person seeking to find acceptable sites for residential development using a GIS can produce a land use map, a zoning map, a slope map, a soils map, and a transport route map for display. However, one can also accomplish much more than this by asking the computer to use the information stored in it to produce a composite overlay that identifies those areas that are candidates for residential development. For example, the analyst might ask the computer to make a map depicting those locations that are vacant in land use, zoned residential, have a slope of greater than 1 and less than 10 percent, have well drained soil, and are within one quarter mile of a highway. The ability to accomplish this kind of analysis has made GIS technology very attractive to government agencies, private developers, trucking companies, cellular telephone companies, and others. [See the accompanying example of a simple GIS analysis carried out using the MAP program].

GIS technology is thus an outgrowth of automated mapping, remote sensing, and spatial analysis. In essence, it is a selective integration of these fields. For the Department of Geography and Anthropology to offer courses in this rapidly growing area is a logical outgrowth of our previous focus on computer

cartographics, remote sensing, and quantitative spatial analysis. This new course and the one to follow it [see forthcoming proposal for advanced GIS course] will bring the department to the forefront of undergraduate programs offering clusters of courses in digital cartography, remote sensing, quantitative analysis, and GIS. As such the course will serve to provide our students with a fuller understanding of the current state-of-the-art in the field of geography and will at the same time provide them with skills that are in demand in the marketplace.

Although GIS, quite naturally, grew from existing areas within geography and related fields, it is nonetheless distinct from related areas such as computer cartography and cartography. For instance, where our course in Computer Cartography focuses on the techniques, theory, and skills used to produce maps automatically for display or for use as analytical tools, the courses in GIS focuses on the capture, manipulation, and analysis of spatially referenced data. To GIS graphic display is important, but is by no means the primary reason for being. GIS is also related to cartography, often called the language of geography, and freely uses the theory of map projection, techniques of cartographic rectification, graphic communication, and display, but the emphasis on automated spatial analysis is missing from cartography.

3. Essence of the Course:

a. Objectives of the course. Upon completion of the course, Introduction to Geographic Information Systems, students will be able to:

1. define the concept of GIS in general terms and differentiate GIS from computer mapping, computer aided design, and other related technical areas.

2. outline the history of the development of GIS and relate the development of GIS to its roots in spatial analysis, automated cartography, remote sensing, and computer aided design.

3. define and explain elementary GIS analysis techniques including automated map overlay, areal measurements, proximity analysis, and others.

4. describe the hardware components of a GIS noting the function of each of the parts.

5. explain the similarities and differences between raster and vector mode GIS programs.

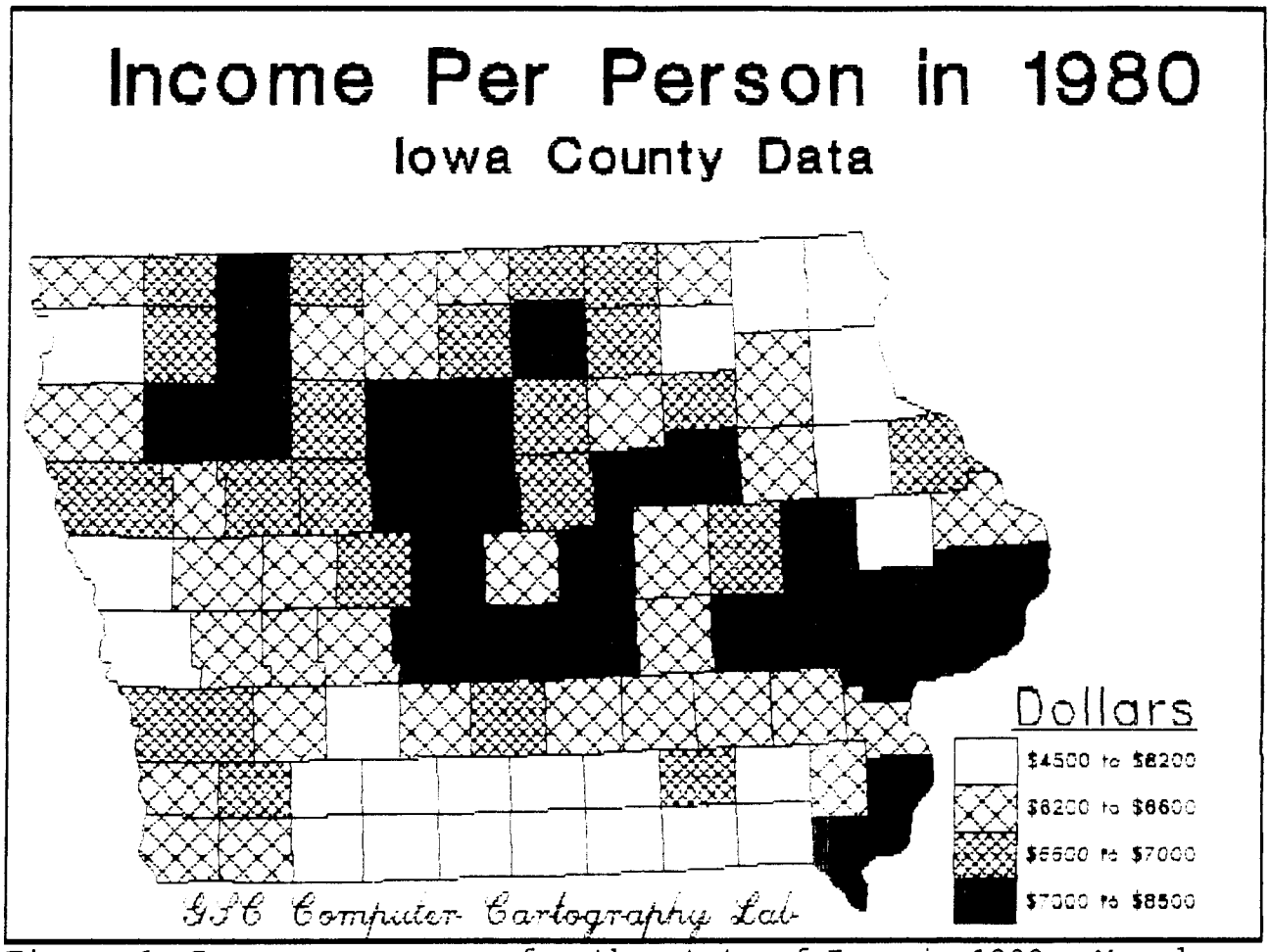

Figure 1. Income per person for the state of Iowa in 1980. Map drawn by Atlas Graphics.

6. define the types of spatial data (point, line, area, and volumetric) and explain how each of these is represented in raster and in vector mode systems.

7. describe the various public and private sources of raster and vector data for use in building GIS data bases.

8. demonstrate facility in the use of the Ohio State University Map Analysis Program, the Clark University IDRISI program, and the ERDAS program by completing laboratory assignments using the programs.

9. outline the steps in the process of implementing a GIS for use in the public and in the private sectors.

10. outline the life cycle of a typical GIS project.

b. Topical Outline:

I. Introduction to Geographic Information Systems

A. Definition of GIS

B. History of GIS with emphasis on relation to roots in automated cartography, remote sensing, and CAD

C. Likely future trends in GIS

II. Hardware and Software Elements of GIS

A. Devices used to capture map images and convert them to digital form

B. Families of processing units

C. Devices used to create maps from digital information

D. Software components associated with GIS hardware

E. First laboratory session and computer exercise: use GIS software and hardware to create a land use map and print it using the dot matrix printer

III. Spatial Data Types and Spatial Data Sources

A. Classification of spatial data types: the locational analysis data cube as a concept organizing device for working with point, line, and area data

B. Examples of spatial data types and their use in GIS analysis

C. Sources of data used in building GIS data bases

1. data that may be purchased in digital form from public and private sources

2. data obtained through digitization of paper maps and field work

D. Exercise on types and sources of spatial data used in GIS analysis

IV. GIS Analysis Techniques

A. Functions preparatory to analysis

1. display

2. classification of categories [aggregation]

3. recoding of values

B. Elementary analytical techniques

1. proximity analysis

2. overlay analysis

3. Boolean operations

C. Second laboratory session and computer exercise: use of GIS software to assist in making decisions concerning the location of a resource oriented manufacturing facility requiring highway access.

V. Tutorials in Software Systems [As is implied by the outline, students will gain basic familiarity with several software packages prior to this segment of the course. This portion, however, specifically emphasizes hands on experience with the OSU MAP, IDRISI, and ERDAS programs and enables students to attain the facility required for the final course project].

A. Advanced laboratory session in OSU MAP and computer exercise

B. Advanced laboratory session in IDRISI and computer exercise

C. Workshop in ERDAS and computer exercise

VI. Procedures and Pitfalls in Implementing a GIS

A. Conception

1. decision to build a GIS or not

2. deciding on the scope of the system, its capabilities, and who will participate in its construction, support, and use

3. identifying funding sources

B. Design of the system

1. general design of the system required to fulfill the capabilities decided upon in the previous step

2. specification of hardware and software required to make the system operational

C. Construction of the system

1. procurement of components

2. pilot test of system as implemented with selected hardware and software

D. Operational phase- making the system available to clients

c. Evaluation of students:

The students' progress in mastering the fundamentals of GIS will be ascertained in several ways: 1) midterm and final essay examinations, 2) problem exercises, and 3) computer laboratory assignments, including a final project that requires the student to use a GIS to solve a locational problem and write a short paper incorporating and explicating the results of the problem solution.

d. Course evaluation:

I will use a course evaluation strategy in this course similar to that I use in the other courses I teach. For overall evaluation of the teaching quality I will use the SIR form. For evaluation of the content, exercises, examinations, demonstrations, and laboratory sessions I will use a questionnaire designed specifically for the course.

IV. Results of consultation: Consultation under separate cover. The consultants are:

A. Jack Cimprich, Director of Academic Computing and Professor of Computer Science

B. Leigh Weiss, Professor of Industrial Education and Technology

V. Catalogue Description:

Geographical Information Systems [GIS] assist in the capture, storage, retrieval, transformation, analysis, and display of geographically referenced data. In essence, GIS enable automation of spatial and cartographic analyses previously done manually by geographers and others who work with spatial data. Introduction to Geographic Information Systems reviews the history of GIS, introduces students to the hardware and software components of GIS through lecture, demonstration, and hands on laboratory exercises, and teaches students to perform GIS analysis techniques through lecture and laboratory sessions. Student evaluation is based on performance on examinations and projects.

GLASSBORO STATE COLLEGE
Academic Computing Glassboro, New Jersey 08028 (609)863-6515

TO: Faculty Senate Curriculum Committee
FROM: Jack Cimprich, Coordinator of Academic Computing JRC.
RE: Geography Department's Course Proposals
DATE: October 11, 1989

I have reviewed the course proposals for "Introduction to Geographic Information Systems" and "Advanced Geographic Information Systems" submitted by Dr. Richard Scott of the Geography and Anthropology Department. As a professor in the Mathematics and Computer Science Department and as the Coordinator of Academic Computing for the entire campus, my observations are:

1. These are new courses which are aimed at incorporating the latest computer applications and techniques in the Geography curriculum. As such, they are vitally important in helping the College maintain currency in its offerings, attractiveness to prospective students, and marketability for its graduates.

2. Although computer usage is heavy in other departments, especially Computer Science, Business, and Technology, these proposed courses do not represent an overlap or redundancy with the content or interests of these other areas. In fact, these courses, along with the existing Computer Cartography course offered by the Geography Department, provide excellent free elective choices for majors in other computer-related disciplines.

3. Finally, regarding the impact of these proposed courses on computer resources, there is always the concern that additional demand may cause some problems. However, because the Geography Department has access to the excellent IBM lab on the first floor of Robinson, and, because there is inherent backup and room for overflow in several of the other student labs on campus, and, because of the implementation of a campus fiber optic backbone that will occur this year which will further allow sharing of computer resources, I see no problems in meeting the equipment needs.

In summary, these courses will be valuable to both the Geoagraphy/Anthropology Department as well as the rest of the college and can be accomodated by existing computing facilities.