FERRIS STATE UNIVERSITY

College of Engineering Technology

SURVEYING ENGINEERING PROGRAM

ACADEMIC PROGRAM REVIEW REPORT

FINAL REPORT

BS, SURVEYING ENGINEEERING
AAS, SURVEYING TECHNOLOGY

JULY 28, 2012

FERRIS STATE UNIVERSITY
COLLEGE OF ENGINEERING TECHNOLOGY
SURVEYING ENGINEERING PROGRAM

ACADEMIC PROGRAM REVIEW REPORT

BS, SURVEYING ENGINEERING
AAS, SURVEYING TECHNOLOGY

PROGRAM REVIEW PANEL

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TO: APRC

cc: J K Yates Dean, College of Engineering Technology
Debbie Dawson School of CEEMS Director

FROM: Khagendra Thapa, Program Coordinator, Surveying Engineering Program

SUBJECT: Program Coordinator's Assessment of the Health of the BS in Surveying Engineering, and AAS in Surveying Technology Programs.

DATE: August 15, 2012

Introduction

The Program went through EAC/ABET accreditation process last year. I understand that I could have cross referenced the requirements of APR Report to ABET self-study report. However, when I tried to do that it turned out to be about the same amount of work because of the nature and format of ABET self-study; therefore, I ended up doing the whole thing. For the reference purpose, I have included the ABET report. We have not heard from ABET yet but we expect to get full six years accreditation.

Acknowledgements

I would like to express my sincere thanks to Debbie Dawson School Director, Sandy Kerridge and Lisa Knudson (both are school secretaries) for all their help. Prof. Gabor Barsai for labor market analysis report and Prof. Carl Shangraw for his input. I would also like to thank Prof. Hanna and Prof. Grey for their willingness to serve on the committee.

Programs' Highlights

The following are, but a few, of the highlights that both programs enjoy:

- A well-rounded curriculum consisting of the basic sciences, mathematic, general education, and technical components
- A seemingly successful ABET accreditation site visit in the fall semester of 2011
- A faculty group that, by in large, work well together to pursue a common goal – Educating high quality graduates
- A superb base of professional support from surveying instrument manufacturers and loyal friends and alumni of the program
- An excellent employment outlook for graduates not only in Michigan but in all states

Future Outlook

- Increase enrollment in the program

- Possible Certificate Program in Hydrographic Surveying in Collaboration with North Western Michigan College

- Aggressively advertise the on-line Certificate Program in GIS

- Explore expanding the civil engineering component of the program so more graduates can pursue dual licensure as professional Surveyor and Professional Engineer.

SURVEYING ENGINEERING
ACADEMIC PROGRAM REVIEW
2012

INTRODUCTION

The following report is for the Bachelor of Science, Surveying Engineering (SURE) degree and for the Associate of Arts and Sciences, Surveying Technology (SURT) degree both falling under the auspices of the Surveying Engineering Program. After modifying the Associates degree in 2007 in such a way that all courses within that degree program would count toward the Bachelor of Science degree, both degree programs are combined into a single Academic Program Review.

During Academic Year 2011-2012 the program underwent accreditation renewal under the auspices of Engineering Accreditation Commission/Accreditation Board of Engineering and Technology (EAC/ABET). Results of that undertaking should be available at the end July of 2012. Being EAC/ABET accredited and meeting the requirements of the State of Michigan Licensing Board for Professional Surveyors means that graduates of the baccalaureate program meet the educational requirements to be eligible to become both licensed Professional Engineers and licensed Professional Surveyors in the State of Michigan and in most of the United States.

Students enrolling in the SURT program do so for one of two reasons. The first and most common reason is that they are not yet ready for MATH 220 Calculus I. Majority of these students will eventually transfer into the SURE program. The second reason is that they are looking for a standalone associates degree. Some students pursue the SURT degree to augment other professional qualifications, e.g. the high school history teacher who desires a working knowledge of surveying and mapping to support historical/archeological research or those who enroll as sponsored students such as from Saudi- Aramco.

As will be seen throughout this report the surveying programs have had some enrollment issue s for the last three years. However due to our successful campaign to visit high schools and visits and attendance to neighboring States' Annual Conferences has resulted into big pool of applicants to the program. Nevertheless, the large pool of applicants did not result into high enrollment. We expect to have between 22-24 new students this year.
These programs are highly respected throughout the state, the nation and even internationally. They are rigorous, up to date, challenging and provide excellent opportunities for graduates to pursue careers of their choice in a wide variety of topical areas falling under the general umbrella of surveying.

Table of Contents

Section 1: Program Goals

An overview of the program that addresses broadly the areas of the program included in the Administrative Program Review document.

A. PROGRAM GOALS

State the goals of the program

Mission: *"To educate a new generation of Surveying Engineers; to promote a sense of scholarship, leadership and service to the community, to disseminate new knowledge and to play a leadership role in fostering interdisciplinary education to help solve the complex problems facing modern society."*

The surveying engineering program is designed to meet the demands of our students, employers, and the society. The educational objectives associated with the program, a list of outcomes, and a description of assessment methods used to find out how well the outcomes are being satisfied are given below:

PROGRAM EDUCATIONAL OBJECTIVES

The surveying engineering program faculty, together with their program advisers, have revised their program's educational objectives as follows:

The B.S. program in Surveying Engineering educational objectives are as follows:

1. Program graduates will apply communication skills, lifelong learning attitude, and the knowledge of mathematics and basic science to attain advancement within the surveying profession.
2. Program graduates will exhibit creativity, leadership and team-building abilities, cultural appreciation and an understanding of global, societal, and environmental context consistent with the principles of sustainable development.
3. Program graduates will be engaged in the professional practice of surveying engineering with high ethical and professional responsibilities.
4. The program graduates will strive for professional licensure.

The desired outcomes of the Surveying Engineering Program are:

Program Outcomes for the B.S. degree in surveying engineering which are related to the Program Educational Objectives are listed below. Further, the relationships to the Program Educational Objectives and the EAC/ABET Criterion 3 (a-k) outcomes are also identified.

1. A broad education and knowledge of contemporary issues necessary to understand the impact of surveying engineering solutions in a global, societal, and environmental context. (EAC/ABET Criteria 3d, c, h, j) (Program Educational Objectives B and C)

2. An ability to solve surveying engineering problems in practice by applying fundamental knowledge of mathematics, statistics, science, and by using modern surveying engineering techniques, skills, and tools. (EAC/ABET Criteria 3a, k) (Program Educational Objectives A and D)

3. An ability to identify, formulate, and solve surveying engineering problems, particularly the planning, design, establishing horizontal and vertical control, land use design, boundary determination, mapping and field layout of infrastructure that meet standards of accuracy and precision, keeping in mind cost, time, safety and quality needs, and objectives. (EAC/ABET Criteria 3c, e) (Program Educational Objectives A, B and D)

4. An ability to design and conduct experiments and to analyze and interpret data in engineering surveying, topographic surveying, geodetic surveying, and boundary surveying. (EAC/ABET Criteria 3b, j, k) (Program Educational Objectives A and D)

5. An ability to communicate technical material written papers/reports and oral presentations. (EAC/ABET Criterion 3g) (Program Educational Objective C)

6. An ability to function within multidisciplinary teams. (EAC/ABET Criterion 3d) (Program Educational Objective C)

7. An understanding of professional, societal, and ethical practice and responsibilities.

   (EAC/ABET Criterion 3f) (Program Educational Objectives B and C)

8. A recognition of the importance of professional licensure and a recognition of the need for, and an ability to engage in, life-long learning. (EAC/ABET Criterion 3i) (Program Educational Objectives C and D)

EAC/ABET Criterion 3 (a-k) outcomes
Engineering programs must demonstrate that their students attain:

a. *an ability to apply knowledge of mathematics, science, and engineering*

b. *an ability to design and conduct experiments, as well as to analyze and interpret data*

c. *an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability*

d. *an ability to function on multi-disciplinary teams*

e. *an ability to identify, formulate, and solve engineering problems*

f. *an understanding of professional and ethical responsibility*

g. *an ability to communicate effectively*

h. *the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context*

i. *a recognition of the need for, and an ability to engage in life-long learning*

j. *a knowledge of contemporary issues*

k. *an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.*

Explain how and by whom the goals were established.

The faculty and the Program Advisory Committee whose members represent surveying and mapping professionals from the private sector as well as governmental agencies established the program goals.

Process for Revision of the Program Educational Objectives

The involvement of the various constituencies is not the same because of their knowledge, experience, proximity, and availability. The program seeks input from the advisory committee members at least twice a year. The input from faculty is continual. The faculty group meets at least once a week. The relevancy and importance of the program and how the program may be improved is discussed whenever there is a new development in the profession. Formal and informal input from students as they take various courses is taken into account. However, the input from the employers and alumni is sought through the surveys the program conducts. The faculty and students also meet the employers and alumni annually at the Michigan Society of Professional Surveyors conference held in different parts of Michigan. The faculty also attend the national level conferences as well several state level conferences where input from alumni and employers is sought informally.

Two years ago, as a result of the formal as well as the informal input from the constituencies, both program educational objectives and the program outcomes were completely revised. They were changed to take into account the feedback from the constituencies.

The program has adopted a process whereby we seek input via formal surveys and informal input; when there is sufficient input; then new objectives are developed. These are first discussed by the faculty group. Once the faculty group approves them, they are taken to the advisory committee meetings to examine and discuss each objective and how it is relevant to the program. The program objectives are changed upon approval of the advisory committee.

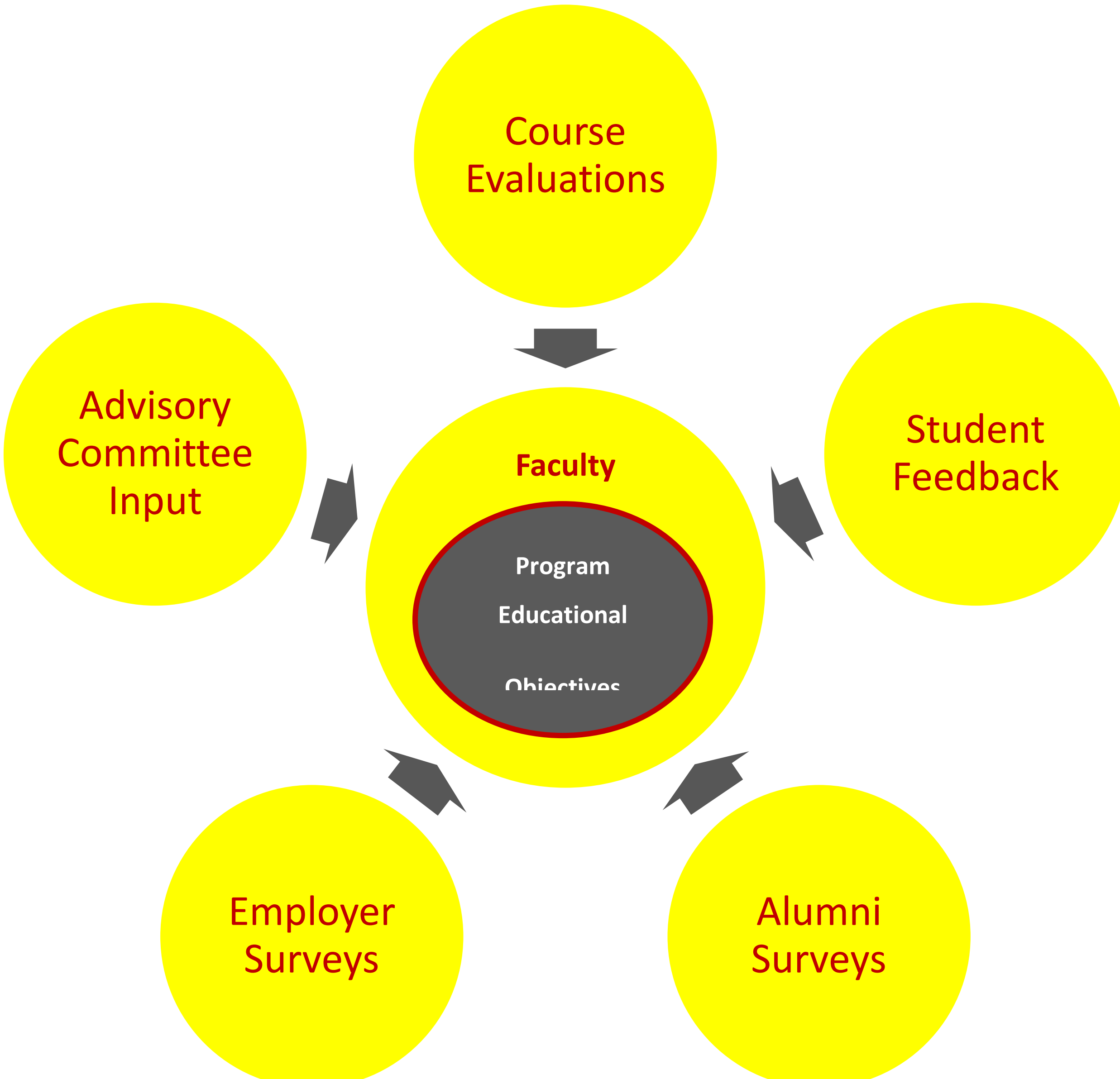
The step-by-step process for upgrading the Program Educational Objectives is as follows:

1. Seek input from the constituencies (refer to Table 2.1 for the kind of input and frequency of input); the level of involvement of each constituency and their responsibilities varies according to their role and importance. Obviously, faculty and the advisory committee will have a greater role than students.
2. The faculty in the program analyze and debate each suggestion and its relevance to the program educational objectives keeping in mind the requirements imposed by the state licensing board, general education requirements of the university, the ABET requirements, plus the developments in new technologies.
3. Once the faculty feel that the changes are required as a result of the input from the constituencies or changes from the licensing board or ABET, the required changes are made by the program faculty. These are then discussed and debated in the advisory committee meeting.
4. If the advisory committee approves the changes, the educational objectives are published in the Program website which is given below:

5. http://www.ferris.edu/ surveying/
6. It is a continual and cyclical process and does not really end as indicated in Figure 2.1

If the faculty decide to change the courses or curriculum as a result of the input from the constituencies, then the proposed changes as shown in figure 2.1 are made by the faculty group. These changes are then taken to the advisory committee meeting. The changes are adopted upon approval by the advisory committee.

Figure 2.1: Program Educational Objectives Change Cycle


Course
Evaluations
Advisory
Committee
Input
Faculty
Program
Educational
Objectives
Student
Feedback
Employer
Surveys
Alumni
Surveys

How do the goals apply to preparing students for careers in and meeting employer needs in the community/region/marketplace?

The goals were developed with considerable input from our constituents. The surveying profession needs individuals who are knowledgeable of developments accruing within the profession and who are able to help their employers grow and succeed. Graduates are in demand and the number of employment opportunities exceeds the number of graduates by a healthy margin. Companies which are on the cutting edge of the technology are often led by or have had mid-level survey managers who graduated from this program.

Have the goals changed since the last program review? If so, why and how? If not, why not?

The program goals have changed since the last program review. The Accreditation Board for Engineering and Technology (ABET) accredits the Surveying Engineering program as an engineering program. The process of accreditation is iterative, requiring that goals and outcomes be reviewed, evaluated, and if required, changed at regular intervals. Changes made reflect the new technologies that are redefining the needs of employers in the profession. The program objectives we have right now are the results of the requirements essentially dictated by the team chair of the ABET visitation team. They convey the same message as the ones we had. However, the wordings had to be changed to satisfy the team chair.

In order to assess the effectiveness, usefulness, and acceptability of the program educational objectives, the constituency surveys as portrayed in table 2.1 are conducted at various time periods and frequency depending on their level of contribution. Not all constituencies have the same level of interaction and stake in the program. The faculty and students have by far the highest interest and stake in the program followed by advisory committee members, alumni and employers. Therefore, the level and frequency of interaction and their contribution is not the same. The assessment tools and indicators used for students are: Class discussion and student surveys, Student end of semester surveys, and Student transcripts. These are conducted each semester except for student surveys which are conducted at least every three years. The faculty in the program by far have the highest level of interest and stake in the program. Moreover, they also have the responsibility to periodically update both program educational objectives and the student outcomes so that they satisfy the needs of the constituencies and updates in terms of the inclusion of the latest developments in the discipline of surveying engineering.

Constituency	Indicator	Frequency
Students	Class discussion and student surveys Student assessment of instruction Student surveys to evaluate program objectives Student transcripts	Periodically Each semester Each semester
Faculty	Weekly meetings Meeting with administration Faculty Survey	Each week Periodically Periodically
Advisory Committee	Formal input during Fall and Spring Semester meetings Informal input Advisory Committee surveys	Biannual Continual Periodically
Alumni	Informal input Alumni Survey	Continual Periodically
Employers	Employer Survey Informal input	Periodically Continual

Table 2.1 Frequency of Constituency Surveys

In order to ensure that the program instruction is going smoothly and also to monitor the program in terms of satisfying the needs of the constituencies, the program faculty group meets weekly. In addition, the faculty also meets periodically with the administration. In addition, the faculty input survey is conducted to ensure that all parts of program educational objectives as well as student outcomes and other issues related to the program are addressed.

The Surveying Engineering program at Ferris State University has a long history of having an advisory committee. It is a matter of pride for the program to note that several of our current and past advisory members have established scholarships for the students in the program. One member donated large sums of money to maintain the GIS and Photogrammetry lab and continues to donate funds every year in terms of challenge funds.

The advisory committee meets twice a year - once in the fall semester and again in the spring semester. In addition, we also conduct advisory surveys. Moreover, the students, faculty, and advisory committee members are in continual contacts with entities such as in Michigan Society of Professional Surveyors (MSPS) annual meetings and various other MSPS Chapter level meetings. These informal meetings and interactions provide a valuable input for the continual development of the program.

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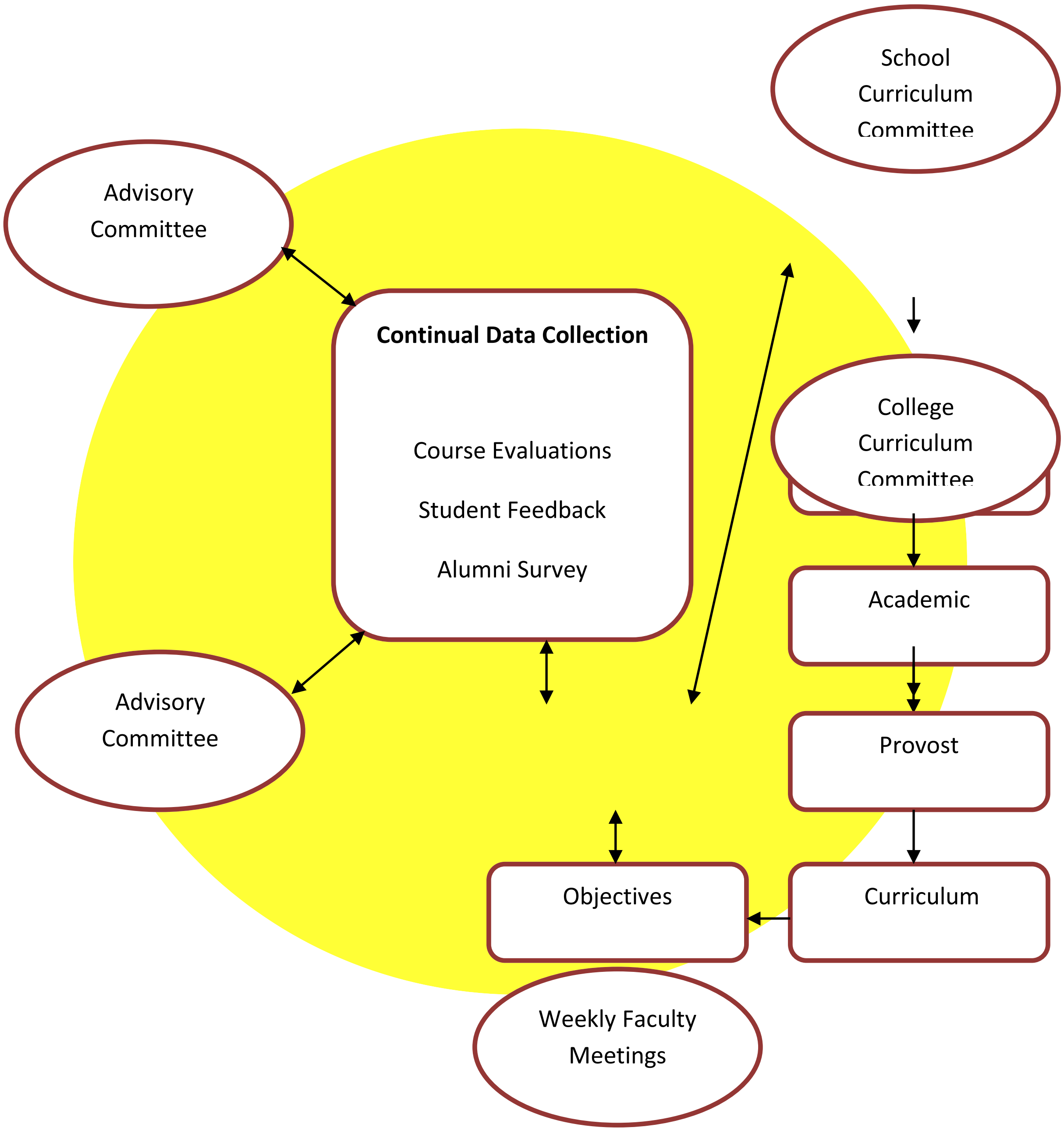

Figure2.2: Flow chart for assessment of Program Educational Objectives

The Surveying Program at Ferris was established in 1957 and has over 600 alumni. Our alumni are very active in both state and national level professional organizations. This provides our students, faculty, and advisory committee members an opportunity to interact informally on several occasions. In addition, the alumni surveys are conducted periodically.

The alumni of the program have found employment all over the world. They are working at different levels of government including the Federal government. In addition, they are also employed by private companies both large and small. The input from the employers is important to ensure that the program is keeping up with ever-changing technology and the changing nature of the responsibilities of the professionals involved with the spatial information systems. The employer surveys are conducted periodically and their input is incorporated in the objectives and the outcomes. These, in turn, guide us with upgrading the curriculum.

The flow chart shown in figure 4.1 shows how the program uses input from the constituencies to monitor and upgrade the program educational objectives. Please note that upgrading and changing of the program educational objectives does result in changing the program which requires addition/deletion of courses and changing the contents of the courses. Two years ago, the curriculum was changed as a result of the constituency surveys. The contents of some courses such as SURE115 were reduced to one credit. In some areas, such as in Legal Aspects of Surveying, a new course (SURE 366) was added as a result of the demands from students, alumni, and employers.

Describe the relationship of the program goals to the University's mission, and the departmental, college and divisional strategic plans.

The Mission of Ferris State University

"Ferris State University prepares students for successful careers, responsible citizenship, and lifelong learning. Through its many partnerships and its career-oriented, broad-based education, Ferris serves our rapidly changing global economy and society."

Keywords in this mission statement are successful careers, career-oriented, broad-based education, lifelong learning, and professional education in a rapidly changing global economy and society. The surveying programs, both the Bachelor of Science (BS) and the Associate in Applied Science (AAS), are programs certainly that satisfy all the keywords of the mission of the University.

The program objectives have been formulated and published and they indicate the critical role that the University mission statement has on the education of the surveying engineer here at Ferris.

To meet the University's mission and the departmental college and divisional strategic plans students must have a year of college mathematics and basic sciences. The 18 semester hours of mathematics (includes SURE 372 Adjustment Computations 1 and part of SURE 373 Adjustment Computations 2) and 18 hours of physics, chemistry and geology prepare the student to meet the challenges of the upper division level courses within the program. The mathematics and science courses provide the basic tools necessary for students to understand the surveying engineering courses. In addition, the science courses are critical in providing the experimental experience that the students need in the engineering design portion of the curriculum.

A minimum of one and one-half years of engineering topics is also required. The 70 semester hours of engineering courses are designed to prepare the graduate for the work place of tomorrow. Just as engineering has a number of divisions, survey engineering has a number of specialties. With the onset of new technologies, such as global positioning systems and laser scanning systems (both land-based and airborne), and geographic information systems it is essential that the graduates be prepared to enter a profession that will change considerably during their working years. The program consists of a mixture of practice and theory so that the graduates understand not only the advantages of this technology but also the limitations of these tools.

General education courses function to help students grow into productive citizens of the community where they will reside. The commitment to help and serve is nurtured through the general education requirements all students must complete prior to graduation. The general education requirements at Ferris require graduates to be able to communicate effectively and to understand issues of race, gender, and ethnicity. In addition, cultural enrichment, social awareness, and global consciousness courses help to make that graduate a better-rounded individual. This program has integrated general education principles into the curriculum. This is done with writing intensive coursework, requirements for research papers and reports, oral presentations, and a host of other activities that the faculty has incorporated within individual courses. In addition, some courses include invited speakers from industry to supplement the formal lectures the students receive.

To ensure that graduates are capable of functioning within the broad field of engineering, the specialization of surveying is augmented with other engineering courses. In particular, students must successfully complete coursework in materials testing, statics and strengths of materials, soils engineering, hydrology, and hydraulics engineering. These courses provide the minimum breadth necessary for graduates to function as members of an engineering team on design projects.

The ability to design and undertake experiments is critical for the surveying engineer since real- world problems are diverse and seldom follow the ideal setting found in textbooks. There are 21 technical courses in the program with laboratory components. These problem-solving experiences are designed to augment the material presented within the lectures. In addition, they give the students experience in formulating experiments, collecting data, and analyzing the results. It is also important for students to be exposed to “real-world” experiences as much as possible before they enter their professional lives. This approach to education has led to the success of the program as shown in the results of the NCEES Fundamentals of Surveying examination that most of the graduates take during their last semester. Ferris Surveying Engineering graduates consistently score higher than the national average.

The program is designed to show graduates that degree completion is just the first step in a life- long commitment to education. Professional status is maintained through a program of continuing education. Students are encouraged by faculty to commit to continuing education.

For example, the Michigan Society of Professional Surveyors (MSPS) allows students to attend seminars for a nominal charge. It also allows students to attend the annual conference at no charge. Students are encouraged to become involved in national professional organizations with a significant number of students attending the annual conference of the National Society of Professional Surveyors (NSPS)

The capstone course, SURE 485, Sustainable Land Development allows students to apply theory and practice into developing a major design project. The creation of a subdivision enables the student to look at the economic, technical, and aesthetic components of land use within the framework of sustainable development.

Students learn best when they are given the tools that they will be using on the job. For that reason, the program strives to maintain well-equipped and modern facilities. Computers are used throughout curriculum for a wide variety of applications from solving complex surveying and engineering problems to simple word processing and spreadsheet programming. Modern surveying instruments are generally integrated with computers to facilitate data processing Using Computer Aided Drafting (CAD) is routine.

B. PROGRAM VISIBILITY AND DISTINCTIVENESS

1. Describe any unique features or components of the program.

The BS Surveying Engineering Program is very unique at FSU in that it is the only Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (EAC/ABET) accredited engineering program in the College of Engineering Technology. At the time of writing this report, it is one of only six such accredited surveying engineering programs nationally. Furthermore, it is one of the best equipped undergraduate programs in the United States. The ABET visiting team was very impressed with our state-of-the-art equipment.

2. Describe and assess the program's ability to attract quality students.

1. The uniqueness and quality of the Surveying Engineering program is demonstrated by its status as only one of two in Michigan and one of seven nationally that are recognized by EAC-ABET accreditation. Our students team has own 1st place in several NSPS national student competition also emphasizes the quality of education provided by the program. The Program has over 20 scholarships totaling over $26,000.

2. Hundred percent placement rates for our graduates every year. Great opportunity and flexibility of employment from small companies to Federal Government. Our graduates have achieved high level position in Bureau of Land Management (BLM) and also National Geospatial Intelligence Agency (NGA).

3. Opportunity to be licensed as a professional surveyor and professional engineer. While majority of our graduates are licensed as professional surveyors some of them have taken

the opportunity to be licensed as professional engineer as well. One of our graduates owns his company in Traverse Michigan and he completes for projects in many states. Therefore, he is licensed as professional surveyor in seven states and professional engineer in 27 states.

4. Surveying Engineering Degree provides a very broad and comprehensive education involving not just surveying but also includes Geodesy (GPS), Photogrammetry, Geographic Information Systems (GIS), Legal Aspects of Surveying, etc. The broad exposure to different aspects of Surveying and Mapping enables our graduates to get jobs in a broad spectrum of professions.

5. Be part of a great profession where you play an indispensable role in the society. Surveyors' role in the information age is indispensable. The profession plays important role in the modern information age. Nearly 80% of the information used by the modern society requires the spatial component of the information age.

3. Identify the institutions that are the main competitors for prospective students in this program.

In Michigan, there is only one other four-year surveying program. This program is located at Michigan Technological University (MTU). There is a two-year program at Macomb Community College (MCC) in Detroit.

a) How are these programs similar and different from the FSU program?

First the two four-year programs at Ferris and at MTU respectively are similar because they both meet the requirements of the State of Michigan for licensure as a professional surveyor. They are different in that our program has a larger enrollment, greater number of faculty and staff, and is better equipped.

Second, the two-year program at MCC focuses on training technicians to serve the needs of the local community and also on providing an avenue for those in the workforce to work toward obtaining a two-year degree. Some of its graduates elect to transfer either to Ferris or to MTU. We currently have five students who have taken one or more courses in surveying at MCC.

b) What can be learned from them that would improve the program at Ferris?

Maintain standards when offering courses through distance learning. The efforts of MTU to offer a surveying degree by distance learning proved unfeasible. While it was initially greeted with considerable enthusiasm among prospective students, it proved to be unsustainable. This was because standards were either disregarded or weakly defined in order to maintain enrollment

To be hesitant about offering surveying courses with laboratory components via distance learning. This proved to be an area of major concern within the MTU's distance education program. Watching a hands-on demonstration about using a surveying instrument is not the same thing as actually using the equipment. The State of Michigan Professional Surveying Licensing Board as well as MTU's own advisory board expressed major concerns about this practice. Attempts by MTU to offer alternatives proved to be logistically unfeasible.

Offering distance education courses cannot be done successfully in an Ad hoc basis. Any initiative in this area will require a sizeable financial commitment by the institution if due diligence and pedagogical standards are to be maintained. This will also require a new paradigm for evaluation of productivity, particularly at the onset of any distance education initiative. Our experience in delivering courses both online and face to face is such that the latter method is always superior to the former.

C. PROGRAM RELEVANCE

1) Provide a labor market demand analysis.

The following information is from *"Surveyors, Cartographers, Photogrammetrists and Surveying Technicians"*; Occupational Outlook Handbook; U.S. Department of Labor, Bureau of Labor Statistics; 2012-13 Edition

Significant Points

- *About 2 out of 3 surveying jobs were in architectural, engineering, and related services.* Opportunities *will be best for surveyors, cartographers, and photogrammetrists who have a bachelor's degree and strong technical skills.*
- Applicants *for jobs as technicians may face competition.*

Nature of the Work

Cartographers and photogrammetrists measure, analyze, and interpret geographic information to create maps and charts for political, cultural, educational, and other purposes.

Cartographers are general mapmakers who compile data from multiple sources and then use principles of cartographic design to make maps. Photogrammetrists are specialized mapmakers who use aerial photographs, satellite images, and light-imaging detection and ranging technology (LIDAR) to build 3-D models of the Earth's surface and its features for purposes of creating maps.

Duties
Cartographers typically do the following:

Collect and analyze geographic data, such as population density, demographic characteristics, and annual precipitation patterns
Examine and compile data from ground surveys, reports, aerial photographs, and satellite images to prepare thematic maps
Prepare thematic maps in digital or graphic form for social, environmental, political, business, educational, and design purposes
Revise existing maps and charts to make corrections, adjustments, and updates
Photogrammetrists typically do the following:

Plan aerial surveys to ensure proper coverage of the area in question
Collect and analyze spatial data such as latitude, longitude, elevation, and distance
Develop base maps that make it possible to produce useful cartographic output using a geographic information system (GIS)
Cartographers and photogrammetrists use information from geodetic surveys and remote sensing systems, including aerial cameras, satellites, and technologies such as light-imaging detection and ranging (LIDAR).

LIDAR uses lasers attached to planes and other equipment to digitally map the topography of the Earth. LIDAR is often more accurate than traditional surveying methods and also can be used to collect other forms of data, such as the location and density of forest canopies. Data from LIDAR are used to provide spatial information to specialists in water resource engineering, geology, seismology, forestry, construction, and other fields.

A cartographic professional who creates maps using geographic information system (GIS) technology is known as a geographic information specialist. A GIS is typically used to assemble, integrate, analyze, and display spatial information in a digital format. Maps created with GIS technology link spatial graphic features with non-graphic information. These maps are useful for providing support for decisions involving environmental studies, geology, engineering, land-use planning, and business marketing.

Surveyors establish land, airspace, and water boundaries. They measure the Earth's surface to collect data that are used to draw maps, determine the shape and contour of parcels of land, and set property lines and boundaries. They also define airspace for airports and measure construction and mining sites. Surveyors work with civil engineers, landscape architects, and urban and regional planners to develop comprehensive design documents.

Duties
Surveyors typically do the following:

Measure distances, directions, and angles between points on, above, and below the Earth's surface
Select known reference points and then determine the exact location of important features in the survey area using special equipment
Establish official land and water boundaries
Research land records and other sources of information affecting properties

Look for evidence of previous boundaries to determine where boundary lines are
Travel to locations to measure distances and directions between points
Record the results of surveying and verify the accuracy of data
Prepare plots, maps, and reports
Work with cartographers (mapmakers), architects, construction managers, and others
Present findings to clients, government agencies, and others
Write descriptions of land for deeds, leases, and other legal documents
Provide expert testimony in court regarding their work or that of other surveyors
Surveyors guide construction and development projects and provide information needed for the buying and selling of property. In construction, surveyors determine the precise location of roads or buildings and proper depths for foundations and roads. Whenever property is bought or sold, it needs to be surveyed for legal purposes.

In their work, surveyors use the Global Positioning System (GPS), a system of satellites that locates reference points with a high degree of precision. Surveyors interpret and verify the GPS results. They gather the data that is fed into a Geographic Information System (GIS), which is then used to create detailed maps.

Surveyors take measurements in the field with a crew, a group that typically consists of a licensed surveyor and trained survey technicians. The person in charge of the crew (called the party chief) may be either a surveyor or a senior surveying technician. The party chief leads day-to-day work activities. For more information, see the profile on surveying and mapping technicians.

Some surveyors work in specialty fields to survey particular characteristics of the Earth. Examples include the following:

Geodetic surveyors use high-accuracy techniques, including satellite observations, to measure large areas of the Earth's surface.

Geophysical prospecting surveyors mark sites for subsurface exploration, usually to look for petroleum.

Marine or hydrographic surveyors survey harbors, rivers, and other bodies of water to determine shorelines, the topography of the bottom, water depth, and other features.

Working Conditions

Cartographers and photogrammetrists held about 13,800 jobs in 2010.

As shown in the tabulation below, about one half of cartographers and photogrammetrists worked in architectural and engineering services firms and for local government agencies in 2010.

Architectural, engineering, and related services	*28%*
Local government, excluding education and hospitals	*22*
Management, scientific, and technical consulting services	*6*

Federal government, excluding postal service 5
About 14 percent of cartographers and photogrammetrists were self-employed in 2010.

Cartographers and photogrammetrists spend much of their time in offices using computers with large monitors, so they can easily study and extract information from aerial photographs and other sources. However, certain jobs require extensive fieldwork to acquire data and verify results.

Cartographers typically do fieldwork to collect and verify data used in creating maps. Photogrammetrists do fieldwork to plan ground control for an aerial survey and to validate interpretations.

Surveyors held about 51,200 jobs in 2010. Most worked for private surveying or engineering firms. Some worked for state and local governments:

Architectural, engineering, and related services	*65%*
Local government, excluding education and hospitals	*6*
Heavy and civil engineering construction	*4*
State government, excluding education and hospitals	*4*

About 14 percent of surveyors were self-employed in 2010

Surveying involves both field work and indoor work. Field work involves working outdoors, standing for long periods, and walking considerable distances. Surveyors sometimes climb hills with heavy packs of instruments and other equipment. When working outside, they are exposed to all types of weather, and they may need to stop outdoor work in bad weather.

Surveyors also do many tasks indoors, including researching land records, analyzing field survey data, mapping, presenting information to regulatory agencies, and providing expert testimony in courts of law.

Traveling is sometimes part of the job, and surveyors may commute long distances or stay at project locations for a period of time.

Surveyors usually work full time. They may work longer hours during the summer, when warm weather and long hours of daylight are most suitable for field work.

Training and Other Qualifications and Advancement

Surveyors typically need a bachelor's degree. They must be licensed before they can provide surveying services to the public and certify legal documents.

Education:
Surveyors typically need a bachelor's degree.

About 26 colleges and universities offer a relevant bachelor's degree program, such as surveying technology. A degree in a closely related field, such as civil engineering or forestry, is often acceptable as well.

Some states require the degree to be from a school accredited by ABET (formerly the Accreditation Board for Engineering and Technology). Most states also have a continuing education requirement.

Licenses:
Surveyors who are not licensed can work as survey technicians, but they must work under the supervision of licensed surveyors. For more information, see the profile on surveying and mapping technicians.

All 50 states and the District of Columbia require surveyors to be licensed before they can certify legal documents showing property lines or determine proper markings on construction projects. Licensure requires a number of years of experience working under the direction of a licensed surveyor. It usually takes about 4 years of work experience for a candidate with a bachelor's degree to earn a license.

The process for getting a license varies by state, but the National Council of Examiners for Engineering and Surveying has a generalized process of four steps:

Complete the level of education required in your state.
Pass the Fundamentals of Surveying (FS) exam.
Gain sufficient work experience under a licensed surveyor.
Pass the Principles and Practice of Surveying (PS) exam.
Important Qualities
Communication skills. On the job, surveyors have to give team members clear instructions. After the work in the field is done, surveyors must be able to explain the job's progress to developers, lawyers, financiers, or government authorities.

Detail oriented. Surveyors must work with precision and accuracy because mistakes can be costly.

Interpersonal skills. Surveying is a cooperative operation, so surveyors must be able to work well on a team.

Listening skills. Surveyors receive instructions from designers, such as architects, and they must listen carefully. They also depend on others on their team and must allow team members to respond as needed. They are often required to interview land owners about land boundaries and then interpret this information to resolve land boundary issues.

Physical stamina. Surveyors traditionally work outdoors and often in rugged terrain. They must have the ability to stand on their feet for many hours and over many weeks.

Problem-solving skills. Surveyors must figure out discrepancies between documents showing property lines and current conditions on the land. If there have been changes in previous years, they must figure out why the changes occurred so that property lines can be reestablished.

Time-management skills. Surveyors must be able to plan not only their time on the job but also that of their team members. This is critical when there are pressing deadlines or while working outside during winter months when daylight hours are short.

Visualization skills. Surveyors must be able to envision objects, distances and sizes.

A bachelor's degree in cartography, geography, geomatics, or a related field is the most common path of entry into cartography and photogrammetry. (Geomatics combines the science, engineering, mathematics, and art of collecting and managing geographically referenced information.) Some states require cartographers and photogrammetrists to be licensed as surveyors, and some states have specific licenses for photogrammetrists.

Education
High school students interested in becoming a cartographer or photogrammetrist should take courses in algebra, geometry, trigonometry, drafting, mechanical drawing, and computer science.

Cartographers and photogrammetrists usually have a bachelor's degree in cartography, geography, geomatics, surveying, engineering, forestry, computer science, or a physical science. However, some come into this occupation after working as surveying and mapping technicians. For more information, see the profile on surveying and mapping technicians.

With the development of GIS technology, cartographers and photogrammetrists need more education and stronger technical skills—including more experience with computers—than they did in the past.

Cartographers must also be adept at Web-based mapping technologies including newer modes of compiling data that incorporate the positioning capabilities of mobile phones and in-car navigation systems.

Photogrammetrists also must be adept at remote sensing, image processing, and using the software necessary for these activities.

Important Qualities
Critical-thinking skills. Cartographers work from existing maps, surveys, and other records. To do so, they must be able to determine thematic and positional accuracy of each feature being mapped.

Decision-making skills. Both cartographers and photogrammetrists must make decisions about the accuracy and reliability of the final map. In addition, they must decide what further information they need to meet the client's needs.

Detail oriented. Cartographers must focus on details when including features needed on a final map. Photogrammetrists must pay close attention to detail when interpreting aerial photographs and remotely sensed data.

Problem-solving skills. Cartographers and photogrammetrists must be able to identify and resolve issues with the tools available to them.

Licenses
Licensing requirements for cartographers and photogrammetrists vary by state. A number of states require cartographers and photogrammetrists to be licensed as surveyors, and some states have specific licenses for photogrammetrists.

Although licensing requirements vary in those states requiring licensure, in general, licensing requires formal education and passing a test.

Certification
Cartographers and photogrammetrists may also receive certification from the American Society for Photogrammetry and Remote Sensing (ASPRS) based on experience, education, and passing an exam.

Employment

Surveyors, cartographers, photogrammetrists, and surveying technicians held about 131,000 jobs in 2004. The following tabulation shows the distribution of employment by occupational specialty:

Surveying and mapping technicians, 65,000
Surveyors, 56,000
Cartographers and photogrammetrists, 11,000

The architectural, engineering, and related services industry—including firms that provided surveying and mapping services to other industries on a contract basis—provided 2 out of 3 jobs for these workers. Federal, State, and local governmental agencies provided almost 1 in 6 jobs. Major

Federal Government employers are the U.S. Geological Survey (USGS), the Bureau of Land Management (BLM), the National Geodetic Survey, and the Army Corps of Engineers. Most surveyors in State and local government work for highway departments or urban planning and redevelopment agencies. Construction, mining, and utility companies also employ Surveyors, cartographers, photogrammetrists, and surveying technicians. Only a small number were self-employed in 2004.

Job Outlook

Employment of surveyors is expected to grow 25 percent from 2010 to 2020, faster than the average for all occupations. Growth will result from increased construction related to improving infrastructure.

The demand for traditional surveying services is closely tied to construction activity and opportunities will vary by year and geographic region, depending on local economic conditions. When real estate sales and construction slow down, surveyors may face greater competition for jobs. However, because surveyors can work on many different types of *projects, they may have steadier work than others when construction slows.*

An increasing number of firms are interested in geographic information and its applications. For example, a Geographic Information System (GIS) can be used to create maps and information for emergency planning, security, marketing, urban planning, natural resource exploration, construction, and other applications. Surveyors will still be needed for legal reasons to verify the accuracy of the data and information gathered for input into a GIS.

Job Prospects

Although surveyors have traditionally relied on construction projects for many of their opportunities, increased demand for geographic data should mean better opportunities for professionals who are involved in developing and using GIS technology and digital mapmaking. Other opportunities should result from the many surveyors who are expected to retire or permanently leave the occupation for other reasons.

Employment projections data for surveyors, 2010-20

Occupational Title	SOC Code	Employment, 2010
Surveyors	17-1022	51,200

Projected Employment, 2020	Change, 2010-20	
	Percent	Numeric
64,200	25	13,000

SOURCE: U.S. Bureau of Labor Statistics, Employment Projections program

Employment of cartographers and photogrammetrists is expected to grow 22 percent from 2010 to 2020, faster than the average for all occupations.

Increasing use of maps for national security and local government planning will fuel most of the growth. Cartographers and photogrammetrists will be needed to ensure the reliability and accuracy of maps produced and updated.

Cartographers are also being asked to incorporate into the maps they make the data gathered from social media and Internet technologies.

In addition to openings from growth, job openings will arise from the need to replace workers who retire or leave the occupation. Many cartographers are approaching retirement age.

Cartographers primarily will be needed to visualize spatial information and design the final presentation of information for clients.

Job Prospects

Photogrammetrists should have excellent opportunities, because of the limited number of college graduates receiving degrees in this field.

Employment projections data for cartographers and photogrammetrists, 2010-20

Occupational Title	SOC Code	Employment, 2010

Cartographers and Photogrammetrists 17-1021 13,800

Projected Employment, 2010-20

	Percent	Numeric
16,900	*22*	*3,100*

SOURCE: U.S. Bureau of Labor Statistics, Employment Projections program

Earnings

The median annual wage of cartographers and photogrammetrists was $54,510 in May 2010. The median wage is the wage at which half the workers in an occupation earned more than that amount and half earned less. The lowest 10 percent earned less than $33,260 and the top 10 percent earned more than $92,730.

Median annual wages in industries employing the largest numbers of cartographers and photogrammetrists in 2010 were as follows:

Federal government, excluding postal service $82,570
Management, scientific, and technical consulting services 64,620
Local government, excluding education and hospitals 53,650
Architectural, engineering, and related services 52,180

The median annual wage of surveyors was $54,880 in May 2010. The median wage is the wage at which half the workers in an occupation earned more than that amount and half earned less. The lowest 10 percent earned less than $30,800, and the top 10 percent earned more than $89,930.

Median annual wages for surveyors in selected industries in May 2010 were the following:

State government, excluding education and hospitals $71,020
Local government, excluding education and hospitals 60,930
Construction of buildings 56,970
Architectural, engineering, and related services 53,360
Heavy and civil engineering construction 52,060
Surveyors usually work full time. They may work longer hours during the summer, when warm weather and long hours of daylight are most suitable for field work.

Related Occupations

Surveying is related to the work of civil Engineers, architects, and landscape architects because an accurate survey is the first step in land development and construction projects. Cartography and geodetic surveying are related to the work of environmental scientists and hydrologists and geoscientists, who study the earth's internal composition, surface, *and atmosphere. Cartography also is related to the work of geographers and urban and regional planners, who study and decide how the earth's surface is to be used.*

The U.S. Department of Labor: Employment and Training Administration has this to say about the critical need for people trained in Geospatial Technology.

"High Growth Industry Profile Geospatial Technology"

They estimated that the geospatial technology profession will experience a growth of over 330,000 geospatial professionals between 2008 and 2018. This growth figure would bring the number of geospatial professionals to just under 1.2 million and is supported by similar estimates by other geospatial organizations. As quoted by the Geospatial Information & Technology Association (GITA), "uses for geospatial technology are so widespread and diverse, the market is growing at an annual rate of almost 35 percent, with the commercial subsection of the market expanding at the rate of 100 percent each year."

The Department of Labor's Geospatial Industry Profile provides the following projections of 2000-2010 growth for geospatial-related occupations (Department of Labor Geospatial Industry Profile):

Architectural and Civil Drafters +20.8%

Cartographers and Photogrammetrists +18.5%

Civil Engineering Technicians +11.9%

Electrical and Electronic Engineers +10.8%

Electrical Drafters +23.3%

Environmental Engineering Technicians +29.1%

Geoscientists +18.1%

Industrial Engineering Technicians +10.1%

Mechanical Drafters +15.4%

Mechanical Engineering Technicians +13.9%

The Ten-Year Industry Forecast for the remote sensing industry concludes that an estimated 175,000 people are employed in the U.S. remote sensing and spatial information industry. It is a rapidly growing segment of the much larger information industry. Growth in the remote sensing industry is expected to be approximately 9% annually over the next few years.

The majority of firms in the industry are relatively small, having less than 100 employees. The many smaller firms are less able to support internal research and development and workforce development, are more affected by governmental competition with their services, and are less able to meet foreign competition.

The BLS Occupational Outlook Handbook for 2004-05 says that employment of surveying and mapping technicians is expected to grow faster than average through 2012. The short training period to master operating the equipment, the absence of formal testing or licensing, the growing demand for basic GIS-related data-entry work, and relatively lower wages all fuel demand for these technicians. Growth in the use of GPS and GIS may also enhance employment opportunities for surveyors and surveying technicians who have the educational background and technical skills to work with the new systems.

Skills, Competencies, and Training

- *Aligning training in Geospatial applications with industry developed competency models*
- *Developing competency models for new applications of Geospatial technology*
- *Preparing entry-level workers with basic skills to ensure career success*
- *Image and Outreach to the Public*
- *Reaching an industry-wide consensus that defines "Geospatial", its technologies and its applications*
- *Creating a national image campaign that raises awareness about the industry and dispels stereotypes and misperceptions*

Pipeline

Recruiting young workers through apprenticeship and high school/college dual-enrollment, dual-credit agreements

- *Tapping nontraditional labor pools to diversify the workforce*

(Source: ASPRS: The Imaging and Geospatial Information Society)

College preparatory courses that emphasize the sciences are suggested for individuals interested in pursuing careers in photogrammetry, remote sensing, and GIS.

For individuals who do not wish to pursue an advanced degree, there is a substantial demand for technicians in geospatial information technology. Many 2-year academic and technical institutions offer education and training in photogrammetry, remote sensing and GIS, and related fields. Associate degree and certificate programs in geographic information systems (GIS), surveying, photogrammetry, and similar curricula provide a sound foundation for work experience or for transfer to other academic institutions for further education.

It is highly recommended that any individual wishing to pursue a career in photogrammetry, remote sensing, and GIS participate in an internship program to obtain hands-on experience as part of their preparation for employment, in addition to formal education.

*Opportunities for surveyors, cartographers, and photogrammetrists should remain concentrated in architectural, engineering and related services firms. Nontraditional areas, such as urban planning, emergency preparedness, and natural resource exploration and mapping, will likely experience employment growth as they produce maps for the management of emergencies and engage in updating maps with the newly available technology. Continued growth in construction through 2012 will require surveyors to lay out streets, shopping centers, housing developments, factories, office buildings, and recreation areas, while setting aside flood plains, wetlands, wildlife habitats and environmentally sensitive areas for protection. (*U.S. *Department of Labor, Bureau of Labor Statistics. Occupational Outlook Handbook—Surveyors, Cartographers, and Photogrammetrists and Surveying Technicians. 2004-05 Edition).*

A survey conducted by American Forests found that GIS technology has been adopted by many public agencies throughout the U.S. The 1996 survey of 200 cities with greater than 25,000 residents and counties with greater than 50,000 residents, reports that 40% of those local governments had adopted GIS technology, with 87% indicating that they would have the technology by the end of that year.

This set of workforce solutions is based on the geospatial technology industry's priorities that address issues such as:

- *expanding the pipeline of youth;*
- *helping alternative labor pools gain industry-defined skills and competencies;*
- *developing alternative training strategies;*
- *developing tools and curricula for enhancing skill sets;*
- *enhancing the capacity of educational institutions;*
- *developing industry-defined career ladders and lattices;*
- *developing strategies to retain and retrain incumbent workers; and assisting transitioning individuals from declining industries to high growth industries*

Description and assessment of how the program responds to emerging issues in the discipline, changes in the labor force, changes in employer needs, changes in student needs, and other forces of change.

Assessment and response is a cyclical process analogous to "closing a loop." Processes by which assessment results are applied to further develop and improve the program vary depending upon the nature of the proposed improvement. Improvements depending upon significant capital outlays or creating new positions are identified and prioritized on School or College level. Implementation approval is delegated at various levels of authority.

Changes in curriculum or course content are proposed at the program level. Proposed changes require approval by school, college and University curriculum committees, the faculty senate and the Office of the Vice-President of Academic Affairs.

At the program level, the strategic planning process involves the cycle of identifying needs, proposing recommendations, obtaining approvals, implementing changes, evaluating results and then beginning the cycle again by identifying needs.

Changes in curriculum issues are also presented to the surveying advisory committee for input on program direction and trend validation.

Input for identifying needs may come from a variety of sources, e.g., proposed objectives and outcomes, constituent surveys, evaluation results, the market conditions, the advisory committee, an individual student or faculty member, etc. Before a recommendation is developed or proposed an evaluation of the effect of that proposed improvement is made. Topics of consideration may include:

- Required technological infrastructure needed to support the improvement
- Additional personnel needed to support the improvement
- Financial resources needed to support the improvement
- Analysis of expected benefits relative to costs
- Time that the proposed improvement will take to implement
- Time that the proposed improvement will take from other areas of the program

After faculty members reach consensus, the proposed improvement may be implemented immediately if appropriate, identified on a plan, or submitted to the appropriate school, college, or University committee.

When approval is granted, and resourced, the improvement is implemented.

After examining input from the completed surveys performed in the recent past, we have changed both objectives and corresponding outcomes of the program. From the experience we have gained in the last six years we have decided to conduct the following surveys:

Survey Frequency	
Every Year	**Every Five Years**
Student surveys	Alumni survey
Graduate surveys	Employer survey
Advisory Committee surveys	
Faculty surveys	

The faculty group meets every week and the meeting with the Advisory Committee is held twice a year. The input from all the constituents is taken into account to see if the program is meeting its objectives and achieving its outcomes. The loop closure process is continually monitored every year. However, the actual loop closure process may take anywhere between one to five years depending on the nature of the objective and the outcome.

Documentation of Changes that Have Been Implemented to Further Develop and Improve the Program - Qualitative and Quantitative Data Used to Support These Changes.

Since the last APR, we made the following curriculum changes have been made:

- BLAW 221 Business Law was dropped. Critical elements of this course were already being taught or were incorporated into SURE 365 Legal Aspects of Surveying I and SURE 420 Professional Practice of Surveying. This reduced the total number of required credit hours by three.
- CONM 220 Statics and Structures was dropped and then replaced by a new course, CENG 240 Engineering Statics. CENG 240 is calculus based whereas CONM 220 was not. The change was made to better align course content with an engineering curriculum. The number of credit hours was reduced from four to three.
- SURE 272 Programming Applications in Geomatics was reconfigured from three lecture hours per week to one lecture hour and three lab hours per week. Having lab hours with the instructor present was a direct result of comments made on student surveys. Course content was modified to use MATLAB rather than Visual Basic allowing a much more comprehensive experience in programming. The number of credit hours was reduced from three to two.
- The result of these revisions has been a more rigorous degree program with five fewer credit hours. The 137 credit hours formerly required to graduate have been reduced to 132.

In addition to the above mentioned adaptations, minor changes have been made to course designators and numbers without changing the content. This was done to better align the course designators with what content was actually being delivered.

Those courses renamed or renumbered to reflect a Geographic Information Systems (GIS) content are:

SURE 325, Principles of GIS, is now GISC 225, Principles of GIS
SURE 339, Remote Sensing, is now GISC 239, Remote Sensing
SURE 425, Technical Issues in GIS is now GISC 425, Technical Issues in GIS

Assess why students come to FSU for the program. Summarize the results of the graduate exit survey and the student program evaluation.

Students come to the Ferris Surveying Engineering and Surveying Technology programs for a variety of reasons. Chief among these are requirements established by the State of Michigan for licensure as a Professional Surveyor, the reputation these programs have for quality, the ability of graduates of these programs to find meaningful employment related to their field of study after graduation.

PA 299 of 1980, Article 20 requires that in order for an individual to be licensed as a Professional Surveyor, that individual must possess a baccalaureate degree acceptable to the licensing board. Currently, two programs meet that criteria, the Surveying Engineering program at Ferris and the Surveying program at Michigan Technological University (MTU). Approval of the Ferris curriculum was granted by the State of Michigan licensing Board for Professional Surveyors in the summer of 2004.

The Surveying Engineering and the Surveying Technology programs both enjoy excellent reputations at the state, national and international levels.

As has been the norm, 100% of the graduating senior class has found employment in surveying. Each graduate has received multiple offers both in-state and out-of-state. With the exception of those joining the graduate programs, all graduates are employed by both the private sector and various levels of the government including the Federal Government agencies.

Detailed results of the Alumni Survey and the Student Survey are found in Section 2 of this report.

Students come to the Ferris Surveying Engineering and Surveying Technology programs for a variety of reasons. Chief among these are requirements established by the State of Michigan for licensure as a Professional surveyor, the reputation these programs have for quality, the ability of graduates of these programs to find meaningful employment related to their field of study after graduation.

a) How well does the program meet student expectations?

This program meets and in most cases exceeds student expectations. Students arrive with a number of assumptions and conceptions about the nature of the program, about Ferris and about the surveying profession. They soon find that the breadth and depth of all three are much greater than anticipated.

b) How is student sentiment measured?

Student sentiment is measured by a number of means:

1) Student Assessments of Instruction

University policy requires that each faculty member have two courses evaluated each semester. This input provides the faculty member with an individual snapshot view of his or her effectiveness.

2) Academic Advising

Each student is required to see a faculty advisor prior to registering for classes each semester. This provides an opportunity for one on one dialogue between student and faculty.

3) Advisory Committee

The department advisory committee meets twice each academic year. A major portion of these meetings is giving students the opportunity to express their sentiments to advisory committee members without faculty being present. The advisory committee along with student representatives then meets with faculty to relay and discuss student comments.

4) Student Surveys

Students are asked to complete formal surveys at regular intervals.

5) Graduate Surveys

Each graduating class is asked to evaluate its overall experience of the degree program.

D. PROGRAM VALUE

Please refer to the faculty survey.

1) Describe the benefit of the program, facilities, and personnel to the University

The program has state-of-the-art technology surveying equipment such as digital and automatic levels, robotic total stations, optical and digital theodolites, GPS receivers and many other accessories. In addition, the Surveying Engineering Program has a course, SURE 331 Ethics and Professionalism in Engineering and Technology, which is team taught by adjunct faculty. This course is open to all students on campus. There were 68 students enrolled in the spring semester, 2012. Faculty members in the department serve in various college-wide as well as University-wide committees including the Academic Senate.

Describe the benefit of the program facilities, and personnel to the students enrolled in the program

The students enrolled in the program are receiving an up-to-date and high-quality education using equipment and software that are current and adequate. The program has a very well qualified faculty.

What is the assessment of program personnel of the value of the program to employers? Explain how is this value is determined.

The two-year associate degree program was started in 1957 the four-year degree was initiated 1973. The department has produced more than 900 graduates. The alumni work for small and large private firms as well as for local, state and various branches of the federal government. Ferris Surveying Engineering and Surveying Technician graduates are highly sought and are in high demand. For example, all May 2012 graduating students have accepted well-paying positions or have employment offers.

Here are some comments from advisory board committee members regarding the value of the program:

"Ferris prepared me well for my surveying career. As a retired supervising surveyor from MDOT I considered Ferris Grads to be superior in the technical and theoretical aspects of surveying engineering. MTU grads tended to be prepared more for 'land'"

"The Program is one of the best in the country and a credit to the professors and instructors of Ferris State University who have devoted themselves to make it so."

"The Program offers a rich technical background to the students. Graduates of Ferris are very instrumental in promoting the professionalism and appearance of the Surveying Profession not only in Michigan but across the country"

"Licensure requires a BS degree from an accredited (program) university making this program vitally important. Graduates from FSU's program are highly regarded in Michigan and throughout the rest of the US."

Describe the benefit of the program, faculty, staff and facilities to entities external to the University (services that faculty have provided to accreditation bodies, and regional, state, and national professional associations; manuscript reviewing; service on editorial boards; use of facilities for meetings, etc.).

The Surveying Engineering faculty are active professionally and have served in numerous capacities in professional organizations. Currently, one faculty member served as the chair of the State of Michigan Licensing Board for Professional Surveyors. Another faculty member serves as a program evaluator for the Accreditation Board for Engineering and Technology (ABET) and is an active participant in the American Conference on Surveying and Mapping (ACSM) Committee on Accreditation, Registration and Education (CARE). In addition, he was a Commissioner of ABET from 20008 to 2011. It should be noted that he was the first Ferris Faculty to ever serve in the ABET as Commissioner. A number of faculty have been referees for peer-reviewed journal articles that have appeared in a myriad of Geomatics journals. One of the faculty members was recognized with Ralph Moore Berry Education award my Michigan Society of Professional Surveyors (MSPS) in February 2008. In addition, he was also recognized by the US Department of Labor with a certificate of Recognition for his significant contributions on National Occupational Information Network. The same Faculty member was Distinguished Teacher Award winner in 2008.

One of the faculty members was involved with ABET and served as ABET Team Chair for University of Houston Clear Lake 2010/11, served as ABET Team Chair University of Oklahoma, 2009/10 and served as ABET Team Chair University of Alaska, 2008/09.

The program also hosted the bi-annual Conference of the North American Surveying Educators in July 2007. The Conference was perceived to be one of the most successful and well organized in recent times.

These types of activities keep the Surveying Engineering Program in the public view, bringing positive public relational items to the program. It also helps faculty maintain currency within the profession and to give back some of their energy to the betterment of the profession. Students view this level of activity in a very positive way and that helps build a sense of pride in their selection of Ferris as a place to study and learn. Students also begin to recognize that their role within the profession does not end with the degree but is just beginning when they leave Ferris. They start to see that they have a professional responsibility to help the profession to thrive and succeed and that continuing education is just as important in their professional growth as the degree was in their entry into the profession.

What services for extra-University general public groups (e.g., presentations in schools or to community organizations) have faculty, staff or students provided? Describe how these services benefit students, program, and community.

Many of the faculty have been more than generous in their time and support for the Surveying Engineering Program. They have routinely attended college and university events that bring to campus prospective students and family. Moreover, students and faculty within the department visit high schools in various parts of the state in order to recruit new students into the program.

In addition, the department has reviewed and developed customized transfer courses of study for most, if not all, of the community colleges in an order of assisting with the transferability into the Surveying Engineering program. These visits make students aware of Ferris and the possible offerings that Ferris provides. Various faculty members have presented papers and workshops in the conferences of MSPS and ACSM.

Section 2: Collection of Perceptions

The survey sections must include, among others, a discussion of techniques used in collecting the information, difficulties encountered during the surveying process, number, and percent of respondents, and analysis of data in accordance with established methodologies. The survey instruments must be designed and distributed, in consultation with Institutional Research and Testing, to reflect general aspects of program review as well as the specific nature of the program itself. All comments should be included, but the names of individuals mentioned should be deleted.

A. Alumni Follow-Up Survey

The purpose of this activity is to learn from the graduates their perceptions and experiences regarding employment based on program outcomes. The goal is to assess the effectiveness of the program in terms of job placement and preparedness of the graduates for the marketplace.

SURE...Alumni

Frequencies

Prepared by: Institutional Research & Testing, 04/11

Statistics

	N		Mean	Median	Std. Deviation
	Valid	Missing			
Highest degree you received	36	0	1.86	2.00	.351
Professional surveyor or professional engineer	36	0	1.42	1.00	.732
Classify your survey operations	36	0	1.67	1.00	.956
Subdivision of public lands, metes and bounds	33	3	2.88	3.00	.415
Writing and interpreting descriptions of real property	34	2	2.85	3.00	.500
Statue laws regarding surveying such as subdivision control, etc.	34	2	2.79	3.00	.538

Computer applications such as graphics, COGO, etc.	34	2	2.71	3.00	.579
Subdivision design, site design and cost analysis development	34	2	2.32	3.00	.806
Map projections and their applications to state plane coordinates	34	2	2.35	2.00	.597
Least squares adjustment and error analysis	34	2	2.09	2.00	.830
Instrumentation theory and field measurements	33	3	2.67	3.00	.595
Route layout, curves, and earth quantities	33	3	2.61	3.00	.704
Traverse and coordinate geometry	33	3	2.79	3.00	.545
Use of CAD	33	3	2.82	3.00	.528
Leveling and vertical control network	33	3	2.76	3.00	.561
Use of USGS quads of other topo maps	34	2	2.44	2.50	.613
Determination of azimuth from solar and stellar observations	34	2	1.62	1.00	.739
Implementing, data collection, or using GIS and GIS databases	33	3	2.30	2.00	.770
Geodetic datum, datum definition and coordinate transformation	34	2	2.47	2.50	.563
Geometry of the ellipsoid and geodetic inverse and direct problem	32	4	2.00	2.00	.762
Gravity, its potential and various gravity anomalies	34	2	1.65	1.00	.774
GPS and surveying by satellites	33	3	2.76	3.00	.561
Remote sensing and photo interpretation for planning	33	3	1.85	2.00	.755
Photogrammetry	33	3	1.82	2.00	.635

Analytical and digital photogrammetry, airborne GPS	33	3	1.88	2.00	.696
Business aspects	34	2	2.62	3.00	.604
Hydraulics, hydrology, and drainage	33	3	2.18	2.00	.584
Soil identification and classification	33	3	1.88	2.00	.781
Land Information System and multipurpose cadastre	34	2	2.26	2.00	.790
Additional comments	36	0			

Frequency Table

Highest degree you received

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	AAS	5	13.9	13.9	13.9
	BS	31	86.1	86.1	100.0
	Total	36	100.0	100.0	

Professional surveyor or professional engineer

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	26	72.2	72.2	72.2
	No, but passed SIT or EIT	5	13.9	13.9	86.1
	No	5	13.9	13.9	100.0
	Total	36	100.0	100.0	

Classify your survey operations

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Conventional Terrestrial Surveying	21	58.3	58.3	58.3
	GPS and/or GIS	9	25.0	25.0	83.3
	Photogrammetric Surveying	3	8.3	8.3	91.7
	Not engaged in surveying at this time	3	8.3	8.3	100.0
	Total	36	100.0	100.0	

Subdivision of public lands, metes and bounds

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Relevant	1	2.8	3.0	3.0
	Somewhat Relevant	2	5.6	6.1	9.1
	Highly Relevant	30	83.3	90.9	100.0
	Total	33	91.7	100.0	
Missing	System	3	8.3		
Total		36	100.0		

Writing and interpreting descriptions of real property

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Relevant	2	5.6	5.9	5.9
	Somewhat Relevant	1	2.8	2.9	8.8
	Highly Relevant	31	86.1	91.2	100.0
	Total	34	94.4	100.0	
Missing	System	2	5.6		
Total		36	100.0		

Statue laws regarding surveying such as subdivision control, etc.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Relevant	2	5.6	5.9	5.9
	Somewhat Relevant	3	8.3	8.8	14.7
	Highly Relevant	29	80.6	85.3	100.0
	Total	34	94.4	100.0	
Missing	System	2	5.6		
Total		36	100.0		

Computer applications such as graphics, COGO, etc.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Relevant	2	5.6	5.9	5.9
	Somewhat Relevant	6	16.7	17.6	23.5
	Highly Relevant	26	72.2	76.5	100.0
	Total	34	94.4	100.0	
Missing	System	2	5.6		
Total		36	100.0		

Subdivision design, site design and cost analysis development

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Relevant	7	19.4	20.6	20.6
	Somewhat Relevant	9	25.0	26.5	47.1
	Highly Relevant	18	50.0	52.9	100.0
	Total	34	94.4	100.0	
Missing	System	2	5.6		
Total		36	100.0		

Map projections and their applications to state plane coordinates

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Relevant	2	5.6	5.9	5.9
	Somewhat Relevant	18	50.0	52.9	58.8
	Highly Relevant	14	38.9	41.2	100.0
	Total	34	94.4	100.0	
Missing	System	2	5.6		
Total		36	100.0		

Least squares adjustment and error analysis

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Relevant	10	27.8	29.4	29.4
	Somewhat Relevant	11	30.6	32.4	61.8
	Highly Relevant	13	36.1	38.2	100.0
	Total	34	94.4	100.0	
Missing	System	2	5.6		
Total		36	100.0		

Instrumentation theory and field measurements

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Relevant	2	5.6	6.1	6.1
	Somewhat Relevant	7	19.4	21.2	27.3
	Highly Relevant	24	66.7	72.7	100.0
	Total	33	91.7	100.0	
Missing	System	3	8.3		
Total		36	100.0		

Route layout, curves, and earth quantities

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Relevant	4	11.1	12.1	12.1
	Somewhat Relevant	5	13.9	15.2	27.3
	Highly Relevant	24	66.7	72.7	100.0
	Total	33	91.7	100.0	
Missing	System	3	8.3		
Total		36	100.0		

Traverse and coordinate geometry

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Relevant	2	5.6	6.1	6.1
	Somewhat Relevant	3	8.3	9.1	15.2
	Highly Relevant	28	77.8	84.8	100.0
	Total	33	91.7	100.0	
Missing	System	3	8.3		
Total		36	100.0		

Use of CAD

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Relevant	2	5.6	6.1	6.1
	Somewhat Relevant	2	5.6	6.1	12.1
	Highly Relevant	29	80.6	87.9	100.0
	Total	33	91.7	100.0	
Missing	System	3	8.3		
Total		36	100.0		

Leveling and vertical control network

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Relevant	2	5.6	6.1	6.1
	Somewhat Relevant	4	11.1	12.1	18.2
	Highly Relevant	27	75.0	81.8	100.0
	Total	33	91.7	100.0	
Missing	System	3	8.3		
Total		36	100.0		

Use of USGS quads of other topo maps

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Relevant	2	5.6	5.9	5.9
	Somewhat Relevant	15	41.7	44.1	50.0
	Highly Relevant	17	47.2	50.0	100.0
	Total	34	94.4	100.0	
Missing	System	2	5.6		
Total		36	100.0		

Determination of azimuth from solar and stellar observations

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Relevant	18	50.0	52.9	52.9
	Somewhat Relevant	11	30.6	32.4	85.3
	Highly Relevant	5	13.9	14.7	100.0
	Total	34	94.4	100.0	
Missing	System	2	5.6		
Total		36	100.0		

Implementing, data collection, or using GIS and GIS databases

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Relevant	6	16.7	18.2	18.2
	Somewhat Relevant	11	30.6	33.3	51.5
	Highly Relevant	16	44.4	48.5	100.0
	Total	33	91.7	100.0	
Missing	System	3	8.3		
Total		36	100.0		

Geodetic datum, datum definition and coordinate transformation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Relevant	1	2.8	2.9	2.9
	Somewhat Relevant	16	44.4	47.1	50.0
	Highly Relevant	17	47.2	50.0	100.0
	Total	34	94.4	100.0	
Missing	System	2	5.6		
Total		36	100.0		

Geometry of the ellipsoid and geodetic inverse and direct problem

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Relevant	9	25.0	28.1	28.1
	Somewhat Relevant	14	38.9	43.8	71.9
	Highly Relevant	9	25.0	28.1	100.0
	Total	32	88.9	100.0	
Missing	System	4	11.1		
Total		36	100.0		

Gravity, its potential and various gravity anomalies

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Relevant	18	50.0	52.9	52.9
	Somewhat Relevant	10	27.8	29.4	82.4
	Highly Relevant	6	16.7	17.6	100.0
	Total	34	94.4	100.0	
Missing	System	2	5.6		
Total		36	100.0		

GPS and surveying by satellites

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Relevant	2	5.6	6.1	6.1
	Somewhat Relevant	4	11.1	12.1	18.2
	Highly Relevant	27	75.0	81.8	100.0
	Total	33	91.7	100.0	
Missing	System	3	8.3		
Total		36	100.0		

Remote sensing and photo interpretation for planning

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Relevant	12	33.3	36.4	36.4
	Somewhat Relevant	14	38.9	42.4	78.8
	Highly Relevant	7	19.4	21.2	100.0
	Total	33	91.7	100.0	
Missing	System	3	8.3		
Total		36	100.0		

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Photogrammetry

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Relevant	10	27.8	30.3	30.3
	Somewhat Relevant	19	52.8	57.6	87.9
	Highly Relevant	4	11.1	12.1	100.0
	Total	33	91.7	100.0	
Missing	System	3	8.3		
Total		36	100.0		

Analytical and digital photogrammetry, airborne GPS

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Relevant	10	27.8	30.3	30.3
	Somewhat Relevant	17	47.2	51.5	81.8
	Highly Relevant	6	16.7	18.2	100.0
	Total	33	91.7	100.0	
Missing	System	3	8.3		
Total		36	100.0		

Business aspects

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Relevant	2	5.6	5.9	5.9
	Somewhat Relevant	9	25.0	26.5	32.4
	Highly Relevant	23	63.9	67.6	100.0
	Total	34	94.4	100.0	
Missing	System	2	5.6		
Total		36	100.0		

Hydraulics, hydrology, and drainage

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Relevant	3	8.3	9.1	9.1
	Somewhat Relevant	21	58.3	63.6	72.7
	Highly Relevant	9	25.0	27.3	100.0
	Total	33	91.7	100.0	
Missing	System	3	8.3		
Total		36	100.0		

Soil identification and classification

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Relevant	12	33.3	36.4	36.4
	Somewhat Relevant	13	36.1	39.4	75.8
	Highly Relevant	8	22.2	24.2	100.0
	Total	33	91.7	100.0	
Missing	System	3	8.3		
Total		36	100.0		

Land Information System and multipurpose cadastre

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Relevant	7	19.4	20.6	20.6
	Somewhat Relevant	11	30.6	32.4	52.9
	Highly Relevant	16	44.4	47.1	100.0
	Total	34	94.4	100.0	
Missing	System	2	5.6		
Total		36	100.0		

Additional comments

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		23	63.9	63.9	63.9
	Dear Mr. Hashimi, I have been self-employed for the past 30 years in flooring manufacturing and a couple of smaller businesses our family acquired to keep the children working in the UP and not going elsewhere for greener pastures. I hope you are well and the program is strong. If you ever travel North feel free to give a call, Mark Young 1-906-487-5437	1	2.8	2.8	66.7
	Ferris prepared me well for my surveying career. As a retired supervising surveyor from MDOT I considered Ferris Grads to be superior in the technical and theoretical aspects of surveying engineering. MTU grads tended to be prepared more for 'land' surveying only.	1	2.8	2.8	69.4

	Hashimi, quit messing with them kids. BTW take your ADHD meds.	1	2.8	2.8	72.2
	I graduated from Ferris in 1969, and I am still active in the Land Surveying Profession. I have gone from slide rules, steel chain, transit, trig tables to what we have today. What I see from today's graduates are excellent geodetic and cadd technicians, but a lack of "common sense" or "real" boundary principals. Perhaps more focus on legal and boundary issues should be included in your curriculum. Thanks. Wallace Muscott	1	2.8	2.8	75.0
	I graduated in 1980. There was not much emphasis on the Public Lands Survey System which is highly relevant to my job, and I had to learn most of what I know on the job. This subject may now be treated more thoroughly than it was in 1980, but I think there should be considerable emphasis in teaching these fundamental concepts, especially with the recent publication of the 2009 "Manual of Surveying Instructions For the Survey of the Public Lands of the United States".	1	2.8	2.8	77.8
	I wish that I would have had more project management and business classes. Most graduates will begin their careers in a technical capacity, but the longer someone remains in this career field the more important business and management skills become. A good surveyor won't necessarily make a good business person.	1	2.8	2.8	80.6
	In the early 80's the program was fantastic. I hope it still is. I know many students now graduate without having real programming experience but I think that is a serious detriment. This ability opens up a huge world of possibilities.	1	2.8	2.8	83.3
	Many of the items that I marked highly relevant did not seem to be a priority of the program when	1	2.8	2.8	86.1

	I attended while the opposite could be said of many of the items I marked not relevant. I recognize the importance of being exposed to GIS, geodesy, photogrammetry, remote sensing,... etc... the reality is that most graduates end up working in much more traditional surveying positions.				
	My answers represent all the various positions I have held in my career, not just the current one.	1	2.8	2.8	88.9
	Question #3 is really flawed. Are you trying to classify surveying operations in 3 categories? Most companies are performing some sort of combination of the 1st and 2nd choice. Not sure what that question accomplishes. Overall, Ferris is an excellent program. Most all surveying subjects are very valuable in the profession. Students should have more requirements in business and management courses though. The thing I was least prepared for was the business management and people management end of the business.	1	2.8	2.8	91.7
	Some of the topics and program subject areas came into existence after my graduation in 1979, but I have scored their relevance based on the business that we run now.	1	2.8	2.8	94.4
	The business aspects did not cover enough.	1	2.8	2.8	97.2
	There is a great need for the application of network adjustments within the 3D Laser Scanning aspect of Surveying.	1	2.8	2.8	100.0
	Total	36	100.0	100.0	

An analysis of the results indicates that the alumni perceive the content of our curriculum is very useful and relevant

B. Employer Follow-Up Survey

The following activity was performed to assess the employers' experiences with graduates and their perceptions of the program itself.

SURE Employer

Frequencies

Prepared by: Institutional Research & Testing, 04/11

Statistics

	N		Mean	Median	Std. Deviation
	Valid	Missing			
The graduates have adequate theoretical knowledge	15	0	4.13	5.00	1.356
The graduates have adequate technical skills	15	0	4.47	5.00	.915
The graduates have ability to apply knowledge in practical situations	15	0	4.00	4.00	1.069
The graduates were prepared to assume entry level duties	15	0	4.47	5.00	1.060
The graduates exhibit willingness to learn and apply new experiences	15	0	4.33	5.00	1.397
The graduates are competent in problem solving	15	0	4.00	4.00	1.195
The graduates have grown and developed since hired	15	0	4.47	5.00	1.125
The graduates are prompt in arriving for appointments	15	0	4.47	5.00	1.125
The graduates are prompt in completing assignments	15	0	4.27	4.00	1.033
The graduates exhibit an adequate level of ethical behavior	15	0	4.27	5.00	1.163

The graduates demonstrate an adequate level of enthusiasm	15	0	4.33	5.00	1.047
The graduates effectively communicate orally with others	15	0	3.73	4.00	1.223
The graduates use written communication effectively	15	0	3.53	4.00	1.060
The graduates possess adequate computer competency	15	0	4.53	5.00	1.060
The graduates recognize teamwork and work well in a team	15	0	3.93	4.00	1.335
The graduates demonstrate leadership	15	0	4.13	4.00	1.060
If the opportunity arose, please indicate your willingness...	15	0	3.80	4.00	.561
Competencies in any specialty areas should possess	15	0			
Areas curriculum should emphasize	15	0			
Emerging issues in the field	15	0			
Additional comments	15	0			

Frequency Table

The graduates have adequate theoretical knowledge

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	2	13.3	13.3	13.3
	Somewhat Agree	5	33.3	33.3	46.7
	Strongly Agree	8	53.3	53.3	100.0
	Total	15	100.0	100.0	

The graduates have adequate technical skills

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Disagree	1	6.7	6.7	6.7
	Neutral	1	6.7	6.7	13.3
	Somewhat Agree	3	20.0	20.0	33.3
	Strongly Agree	10	66.7	66.7	100.0
	Total	15	100.0	100.0	

The graduates have ability to apply knowledge in practical situations

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	6.7	6.7	6.7
	Neutral	2	13.3	13.3	20.0
	Somewhat Agree	7	46.7	46.7	66.7
	Strongly Agree	5	33.3	33.3	100.0
	Total	15	100.0	100.0	

The graduates were prepared to assume entry level duties

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	6.7	6.7	6.7
	Somewhat Agree	4	26.7	26.7	33.3
	Strongly Agree	10	66.7	66.7	100.0
	Total	15	100.0	100.0	

The graduates exhibit willingness to learn and apply new experiences

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	6.7	6.7	6.7
	Somewhat Disagree	2	13.3	13.3	20.0
	Strongly Agree	12	80.0	80.0	100.0
	Total	15	100.0	100.0	

The graduates are competent in problem solving

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	6.7	6.7	6.7
	Somewhat Disagree	1	6.7	6.7	13.3
	Neutral	1	6.7	6.7	20.0
	Somewhat Agree	6	40.0	40.0	60.0
	Strongly Agree	6	40.0	40.0	100.0
	Total	15	100.0	100.0	

The graduates have grown and developed since hired

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	6.7	6.7	6.7
	Neutral	1	6.7	6.7	13.3
	Somewhat Agree	2	13.3	13.3	26.7
	Strongly Agree	11	73.3	73.3	100.0
	Total	15	100.0	100.0	

The graduates are prompt in arriving for appointments

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	6.7	6.7	6.7
	Neutral	1	6.7	6.7	13.3
	Somewhat Agree	2	13.3	13.3	26.7
	Strongly Agree	11	73.3	73.3	100.0
	Total	15	100.0	100.0	

The graduates are prompt in completing assignments

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	6.7	6.7	6.7
	Somewhat Agree	7	46.7	46.7	53.3
	Strongly Agree	7	46.7	46.7	100.0
	Total	15	100.0	100.0	

The graduates exhibit an adequate level of ethical behavior

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	6.7	6.7	6.7
	Neutral	2	13.3	13.3	20.0
	Somewhat Agree	3	20.0	20.0	40.0
	Strongly Agree	9	60.0	60.0	100.0
	Total	15	100.0	100.0	

The graduates demonstrate an adequate level of enthusiasm

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	6.7	6.7	6.7
	Somewhat Agree	6	40.0	40.0	46.7
	Strongly Agree	8	53.3	53.3	100.0
	Total	15	100.0	100.0	

The graduates effectively communicate orally with others

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Disagree	4	26.7	26.7	26.7
	Neutral	1	6.7	6.7	33.3
	Somewhat Agree	5	33.3	33.3	66.7
	Strongly Agree	5	33.3	33.3	100.0
	Total	15	100.0	100.0	

The graduates use written communication effectively

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Disagree	4	26.7	26.7	26.7
	Neutral	1	6.7	6.7	33.3
	Somewhat Agree	8	53.3	53.3	86.7
	Strongly Agree	2	13.3	13.3	100.0
	Total	15	100.0	100.0	

The graduates possess adequate computer competency

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	6.7	6.7	6.7
	Somewhat Agree	3	20.0	20.0	26.7
	Strongly Agree	11	73.3	73.3	100.0
	Total	15	100.0	100.0	

The graduates recognize teamwork and work well in a team

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	6.7	6.7	6.7
	Somewhat Disagree	2	13.3	13.3	20.0
	Neutral	1	6.7	6.7	26.7
	Somewhat Agree	4	26.7	26.7	53.3
	Strongly Agree	7	46.7	46.7	100.0
	Total	15	100.0	100.0	

The graduates demonstrate leadership

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	6.7	6.7	6.7
	Neutral	1	6.7	6.7	13.3
	Somewhat Agree	7	46.7	46.7	60.0
	Strongly Agree	6	40.0	40.0	100.0
	Total	15	100.0	100.0	

If the opportunity arose, please indicate your willingness...

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Unwilling	1	6.7	6.7	6.7
	Somewhat Willing	1	6.7	6.7	13.3
	Very Willing	13	86.7	86.7	100.0
	Total	15	100.0	100.0	

Competencies in any specialty areas should possess

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		2	13.3	13.3	13.3
	Basic understanding of boundary law. Detailed and thorough field note skills. Ability to convey information and ideas clearly and with tact and diplomacy.	1	6.7	6.7	20.0
	Better field notes - not everything should be in a data collector. Better manual drafting skills - this translates to better CADD skills and ability to review others' documents. Business skills - ability to understand budgets, accounting standards, business practices and ethics. Ability to compose written documents that are technically and grammatically correct and of professional quality.	1	6.7	6.7	26.7
	Better understand of the Public Land Survey System	1	6.7	6.7	33.3
	Ethics is a difficult area, ethical dilemmas are great problem solving opportunities. Business	1	6.7	6.7	40.0

	and budget are necessary topics.				
	GIS/LIS and layers with accuracies.	1	6.7	6.7	46.7
	GPS, GIS and boundary law will all be a big part of our business in the short term future. After that, who knows.	1	6.7	6.7	53.3
	I feel that an increased competency in legal description analysis, a stronger focus on the Public Lands Survey System, and understanding the hierarchy of evidence would benefit a Ferris graduate.	1	6.7	6.7	60.0
	IN MOST STATES INCLUDING MICHIGAN THE GRADUATE DOES NOT UNDERSTAND THE THERORETICAL ASPECT OF WHAT TO LOOK FOR IN STARTING A SURVEY. THE SECTION CORNERS OF THE RETRANGLER SYSTEMS.	1	6.7	6.7	66.7
	Integration of Surveying knowledge with the rapidly changing on line GIS and mapping resources.	1	6.7	6.7	73.3
	More experience with Microstation.	1	6.7	6.7	80.0
	Need more written communication experience. Better technical, proposal and contract preparation.	1	6.7	6.7	86.7
	Public speaking skills! too many college grads use "um" in every sentence when speaking/communicating!	1	6.7	6.7	93.3
	They need more real world type experience while in school, most students are not capable of running a crew right out of school.	1	6.7	6.7	100.0
	Total	15	100.0	100.0	

Areas curriculum should emphasize

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		2	13.3	13.3	13.3
	All aspects of running a business. Accounting, public speaking, report writing, handling human resources issues, etc.	1	6.7	6.7	20.0
	Ferris graduates would be well served to meet the demands of the surveying and mapping industry if they were to understand how to perform tasks efficiently and understand management of projects. This is often learned on the job, but an introduction to these concepts would help.	1	6.7	6.7	26.7
	Geodesy and GIS applied to boundaries	1	6.7	6.7	33.3
	GIS, and the tradition core (PLS, route and site, descriptions, equipment, etc.)	1	6.7	6.7	40.0
	GLO as it relates to Remonumentation, State Plane Coordinates; Grid vs. ground and shape files into a GIS program.	1	6.7	6.7	46.7
	GPS Laser Scanning Understanding employment laws	1	6.7	6.7	53.3
	Laser Scanning and concepts along with GIS	1	6.7	6.7	60.0
	Math, math, and more math. Along with some humanities to round out the student. Consider requiring a foreign language for the modern, global market. And definitely, business and economics. These kids are very proficient in surveying but need to be prepared to handle the business world as well. Dendrology shouldn't be forgotten either - it's still an important mapping component.	1	6.7	6.7	66.7
	More exposure to construction layout of various types. How to approach complicated plans and	1	6.7	6.7	73.3

	avoid errors and liability.				
	Professional ethics, historical methods of past surveys, importance of proper field notes & record keeping. That is an art being lost.	1	6.7	6.7	80.0
	see #3	1	6.7	6.7	86.7
	Understanding of boundary law, geomatics/GIS Systems	1	6.7	6.7	93.3
	WE ARE IN THE ELECTRONIC AGE. THE GRADUATES I HAVE ENCOUNTERED HAVE NO IDEA WHAT TO DO IF THE BATTERIES DIES.	1	6.7	6.7	100.0
	Total	15	100.0	100.0	

Emerging issues in the field

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		1	6.7	6.7	6.7
	By their fee structure many surveyors have reduced themselves to tradesmen. They are degrading the entire profession by selling their services as professional surveyors at crew chief's wages. This issue has always existed on our profession, but is now rampant with this economic climate we are in.	1	6.7	6.7	13.3
	Fine tuning of GPS for use in Intelligent Transportation Systems, Intelligent grading, etc. Data reduction and feature recognition from Mobile data collectors.	1	6.7	6.7	20.0
	GIS & laser scanning applications for surveyors	1	6.7	6.7	26.7

	GIS and "cloud" resource use	1	6.7	6.7	33.3
	Global applications. I think WATER LAW is going to become a huge issue in the future. Other fields are taking over mapping applications. Surveyors must find their niche in this explosive field. I would recommend any student consider attending an ESRI User's Conference - in particular the Survey Summit - in San Diego. We need to assert our relevance to emerging technologies.	1	6.7	6.7	40.0
	How to handle remon section corners when they are not in the same location as previous corners, lack of experience in day to day work.	1	6.7	6.7	46.7
	I foresee a shortage of qualified surveyors in the next 15 years.	1	6.7	6.7	53.3
	Laser scanning technology and GIS.	1	6.7	6.7	60.0
	Mapping With GPS becoming more common, better maps will need to be made.	1	6.7	6.7	66.7
	MORE GIS, AND ANYTHING AFFILIATED WITH GIS	1	6.7	6.7	73.3
	Other sectors or groups taking the lead and or taking over the GIS business.	1	6.7	6.7	80.0
	Scanning and mobile mapping. These are not issues, but are more knowledge and exposure will be very useful for many.	1	6.7	6.7	86.7
	Technology. It seems the better the technology gets the more people think they do not need surveyors.	1	6.7	6.7	93.3
	Urban Mass Transit & corridors involved.	1	6.7	6.7	100.0
	Total	15	100.0	100.0	

Additional comments

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		9	60.0	60.0	60.0
	All Ferris graduates are different. I have had 10 or more of them work for me over the years. Some have been great and are very successful but on the other hand I have fired a couple of them. You need to have a quality person to go with the quality education.	1	6.7	6.7	66.7
	Emphasis on teamwork and cooperation are skills that are critical to a graduate's success. We found the two graduates we employed had trouble relating to others and were over confident and condescending. Both exhibited styles that were dictatorial rather than open and collaborative.	1	6.7	6.7	73.3
	From the students I have talked to it seems that too much time is spent on computer programing etc. and not enough time on real world surveying problems	1	6.7	6.7	80.0
	Pete Jenkins is an outstanding employee.	1	6.7	6.7	86.7
	The surveying program at Ferris is very well run.	1	6.7	6.7	93.3
	Your school does a great job.	1	6.7	6.7	100.0
	Total	15	100.0	100.0	

C. Graduating Student Exit Survey

Graduating students are surveyed every year to obtain information regarding quality of instruction, relevance of courses and satisfaction with program outcomes based upon their own expectations. The survey given this spring 2011 graduates is shown below.

FERRIS STATE UNIVERSITY

Dec 2011 Graduate Information Survey

Demographic Information (Please Print Clearly)

Name	
Address	
Program	
Ferris ID #	
e-mail address	

Please take a few minutes to fill out this survey about your activities **after** your graduation from Ferris State University. Your responses will help us to provide employment information to prospective students. Your answers will be kept confidential, only statistical averages will be reported. For each question, **please mark an "X" through the response square that best represents your situation.**

1. **Will you be registered for classes for academic credit at a college or university after your graduation?**

☐ Yes, Full-time (12 or greater credits) ☐ Yes, Part-time (11 or fewer credits) ☐ No **2 →SKIP to Question 4**

2. **Please indicate the name of the educational institution and the program/major you are enrolled in.**

Institution: ______________________________

Major / Program: ______________________________

3. **What is the educational level of the courses?**

☐ **Undergraduate** ☐ **Graduate** ☐ **Personal Enrichment** ☐ **Other Professional Development**

SKIP to Question 11

4. **Which of the following options best represents your current employment status? If you have accepted an offer of employment, please complete the questions with details of the position.**

☐ I will be/am Employed Full-time (30+ hours per week) **5**
☐ I will be/am Employed Part-time (Less than 30 hours per week)
☐ I will be/am Employed in Military Service
☐

I am Unemployed Seeking Employment →**SKIP to Question 11** 3

I am Unemployed Not Seeking Employment →**SKIP to Question 11**

5. To what extent is your position related to your Ferris State University Degree or Certificate?

Highly Related **5** Somewhat Related **2** Not Related at All

6. How long did it take for you to locate your job?

Before Graduation **1-3 months** **4-6 months** **7-9 months** **10-12 months** **1year**

7

Please Turn Survey Over and Complete the Questions on the Back of the Page. Thank You!

7. What is your ANNUAL salary? This information, when combined with salaries from others in your field of study, will provide valuable information for students selecting their program.

Annual Salary: $ **Median Salary $43000**

8. Did you participate in an Internship experience while attending Ferris State University?

No ***4 Yes → If yes, is your current position with the same company*** ***1*** **Yes**

9. Please identify the top three (3) resources you used in your job search.

- Ferris State University Career Services **1**
- Faculty / Advisor **1**
- Off-Campus Advertising **2**
- Networking **5**
- Employment /Temp / Headhunting Agency **1**
- Internship **2**
- Other **3**

10. Please complete the following data about your employer.

Company Name: ______________________________ ***Position:*** ____________________________________

City/State: ___________________________________ *Phone:* ______________________________________

11. If you had the chance to start school over again, would you choose Ferris State University?

☐ Definitely Not ☐ Probably Not ☐ Probably Would ☐ Definitely Would **4**

12. **If you had the chance to start school over again, would you choose the same program of study?**

☐ Definitely Not ☐ Probably Not ☐ Probably Would ☐ Definitely Would **5**

13. **Do you have any additional comments you would like to share? It may be helpful to future students.**

Comments:

I enjoyed the program and all the friends I have made. The world of Surveying is unique and special to be a part of.

Revise the Surveying Engineering curriculum to make it relate to modern methods and practice.

I think we might want more engineering courses and less programming.

D. Student Program Evaluation

Results from the Student Survey for both Associate and Bachelor Degree students

Prepared by: Institutional Research & Testing, 05/11

Statistics

	N		Mean	Median	Std. Deviation
	Valid	Missing			
Curriculum	15	1	1.93	2.00	.258
Challenging and intellectually inspiring	16	0	3.69	4.00	.602
Help me prepare for my future	16	0	3.13	3.00	.957
Provide broad education	16	0	3.19	3.00	.834
Relate to the use of math and science to solve problems	16	0	3.25	3.00	.775
Help me to identify, design, plan & formulate surveying projects	16	0	3.31	3.00	.704
Understand the importance of professional, societal & ethical responsibilities	16	0	3.31	4.00	1.014

Recognize the importance of professional licensure & need for life-long learning	16	0	3.50	4.00	.816
Provide me with the opportunity to develop & improve my written & oral presentation skills	16	0	3.00	3.00	.966
Satisfied with the quality and standard of education	16	0	2.94	3.00	.929
Improvements/changes would you recommend	16	0			
Are available to the students	15	1	3.27	3.00	.594
Describe what you will learn in the course	15	1	3.27	3.00	.458
Are used by the instructor to keep you aware of your progress	15	1	2.67	3.00	.724
Meet your projected career needs, interest and objectives	16	0	3.00	3.00	.730
Provide for adequate supervised activities	16	0	2.94	3.00	.574
There is appropriate monitoring and evaluation of student progress	16	0	3.25	3.00	.577
Know the subject matter and professional requirements	15	1	3.60	4.00	.507
Provide adequate academic advising	15	1	2.93	3.00	.884
Are available to students for help in courses	15	1	3.27	3.00	.594
Faculty provide instruction which is interesting and understandable	15	1	2.60	3.00	.986
Faculty are knowledgeable about the subject matter they teach	14	2	3.71	4.00	.469
Faculty are available to provide help when needed	14	2	3.43	3.00	.514
Faculty provide instruction which is interesting and understandable	14	2	2.86	3.00	.663

Required related courses are relevant to the surveying program	14	2	3.00	3.00	.877
Provide adequate lighting, ventilation, etc.	15	1	2.87	3.00	1.060
Include enough work stations	15	1	3.20	3.00	.676
Computer hardware is sufficient	15	1	3.47	4.00	.743
Computer software is maintained	15	1	2.67	3.00	.976
Are safe, functional and well maintained	15	1	2.73	3.00	.961
Are open for sufficient hours each semester	15	1	2.93	3.00	1.163
Provide adequate lighting, ventilation, etc.	14	2	3.71	4.00	.469
Include enough work stations for students enrolled in course	14	2	3.79	4.00	.426
Are safe, functional and well maintained	14	2	3.64	4.00	.497
Are open for sufficient hours each semester	14	2	3.36	3.50	.842
Current and representative of the surveying profession	14	2	4.00	4.00	.000
In sufficient quantity to avoid long delays in use	14	2	3.57	4.00	.852
Safe and in good operating condition	14	2	4.00	4.00	.000
Are current and meaningful to the subject	14	2	3.57	4.00	.514
Are easily obtainable through the bookstore, library or other sources	14	2	3.64	4.00	.497
Are available to meet your needs and interests	14	2	3.00	3.00	.877
Are provided by knowledgeable, friendly and interested staff members	14	2	3.14	3.00	.663
University library holdings are current and sufficient	14	2	3.14	3.00	.949
Classrooms provide adequate lighting,	14	2	3.43	3.50	.646

ventilation, etc.					
Classrooms contain enough seats and tables for all students	14	2	3.43	4.00	.756
Program faculty encourage students to avail themselves of support services	14	2	3.21	3.50	.893
University is safe, functional and well maintained	14	2	3.29	3.00	.726
Satisfied and proud to have chosen surveying as my profession	14	2	3.64	4.00	.497
Satisfied and proud to have chosen Ferris' surveying program	14	2	3.71	4.00	.469
Program faculty encourage students to participate in professional activities	14	2	3.29	3.50	.914
Additional comments	16	0			

Frequency Table

Curriculum

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Surveying Technology (Associate's)	1	6.3	6.7	6.7
	Surveying Engineering (Bachelor's)	14	87.5	93.3	100.0
	Total	15	93.8	100.0	
Missing	System	1	6.3		
Total		16	100.0		

Challenging and intellectually inspiring

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Disagree	1	6.3	6.3	6.3
	Somewhat Agree	3	18.8	18.8	25.0
	Strongly Agree	12	75.0	75.0	100.0
	Total	16	100.0	100.0	

Help me prepare for my future

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	2	12.5	12.5	12.5
	Somewhat Agree	8	50.0	50.0	62.5
	Strongly Agree	6	37.5	37.5	100.0
	Total	16	100.0	100.0	

Provide broad education

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	6.3	6.3	6.3
	Somewhat Disagree	1	6.3	6.3	12.5
	Somewhat Agree	8	50.0	50.0	62.5
	Strongly Agree	6	37.5	37.5	100.0
	Total	16	100.0	100.0	

Relate to the use of math and science to solve problems

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	6.3	6.3	6.3
	Somewhat Agree	9	56.3	56.3	62.5
	Strongly Agree	6	37.5	37.5	100.0
	Total	16	100.0	100.0	

Help me to identify, design, plan & formulate surveying projects

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Disagree	2	12.5	12.5	12.5
	Somewhat Agree	7	43.8	43.8	56.3
	Strongly Agree	7	43.8	43.8	100.0
	Total	16	100.0	100.0	

Understand the importance of professional, societal & ethical responsibilities

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	6.3	6.3	6.3
	Somewhat Disagree	3	18.8	18.8	25.0
	Somewhat Agree	2	12.5	12.5	37.5
	Strongly Agree	10	62.5	62.5	100.0
	Total	16	100.0	100.0	

Recognize the importance of professional licensure & need for life-long learning

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	6.3	6.3	6.3
	Somewhat Agree	5	31.3	31.3	37.5
	Strongly Agree	10	62.5	62.5	100.0
	Total	16	100.0	100.0	

Provide me with the opportunity to develop & improve my written & oral presentation skills

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	6.3	6.3	6.3
	Somewhat Disagree	4	25.0	25.0	31.3
	Somewhat Agree	5	31.3	31.3	62.5
	Strongly Agree	6	37.5	37.5	100.0
	Total	16	100.0	100.0	

Satisfied with the quality and standard of education

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	6.3	6.3	6.3
	Somewhat Disagree	4	25.0	25.0	31.3
	Somewhat Agree	6	37.5	37.5	68.8
	Strongly Agree	5	31.3	31.3	100.0
	Total	16	100.0	100.0	

Improvements/changes would you recommend

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		6	37.5	37.5	37.5
	Get more professors to 1. Represent a variety of areas in Surveying 2. Offer classes in the spring and fall (not “fall only” or “spring only” classes) semesters to fit students with unique schedules and help students' schedules flow smoothly	1	6.3	6.3	43.8
	I feel as though some of the required courses that aren't so much related to the core of surveying and are more of "side" courses that are just "nice to have knowledge of" are emphasized too much rather than the more "core" fundamental courses. I believe that there is also a large amount of redundancy in many courses. It seems as though some courses are so similar that one or the other could be omitted from the program or replaced with a more dynamic course.	1	6.3	6.3	50.0
	I feel Calculus 3 and Differential Equations courses would greatly assist in the higher level surveying courses.	1	6.3	6.3	56.3
	I would add a higher level geometry class. The intro to computer mapping class (sure 115) should be more related to surveying not just AutoCAD drawings of random objects. Also the schools cultural enrichment and social awareness classes are pointless and should be replaced with something useful like a class that dealing with Microsoft office programs(I have used a lot of Microsoft word, excel, power point, and I think access would beneficial). Chemistry is a class that I don’t think is beneficial. I also think that there should be an intro-mid level civil engineering class that gives and overview of civil engineering.	1	6.3	6.3	62.5

	Finally I think that sure 272 and 373 is based mostly on computer programing and not the actual material.				
	I would suggest revising the curriculum to make it more relevant to modern times. I would combine both photogrammetry classes into one class and consider adding a second remote sensing course. Also, I would like to see more use of software such as AutoCAD and ArcGIS rather than MathCAD, MatLab, and ERDAS. I feel we are more likely to use AutoCAD and ArcGIS throughout our professional career and more experiences with these softwares would help with employment. The last change I would make is to have the higher level classes (beyond sophomore level) use the total stations and GPS equipment in their labs more. Without constant practice on these pieces of equipment, it is easy to forget how they work.	1	6.3	6.3	68.8
	more GIS	1	6.3	6.3	75.0
	More hands on experience in the field	1	6.3	6.3	81.3
	Most of the information provided above comes from the classes provided by carl Shangraw. Hashimi does not teach us real world material but a conceptual computer based program. With the head of the program not attending any of the professional conferences with the students, sheds a bad light on not only the program but his image. It truly shows he does not care about the profession, but just about making the program as hard as humanly possible.	1	6.3	6.3	87.5
	Put much more emphasis on the beginning courses and core courses such as SURE 110, 220, 230. I feel like this is where students get the most knowledge about the profession and what it is about. I feel like all of the students, including	1	6.3	6.3	93.8

	myself, have to put so much time on other classes that aren't as significant like the 272 and 373 classes where it seems that programming is more important than the material itself. I would also like to see at least one of the computer labs open at all times, if possible. I think the younger students need to be more informed about scholarships, internships, and organizations such as MSPS and ACSM. Although much of this can be learned through the weekly Burt and Mullett meetings, I think that the instructors should remind students. Maybe an internship should even be required before graduation.				
	Regarding our GIS program, I would like to see more real world situations in our labs. Rather than plug and chug laboratories.	1	6.3	6.3	100.0
	Total	16	100.0	100.0	

Are available to the students

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Disagree	1	6.3	6.7	6.7
	Somewhat Agree	9	56.3	60.0	66.7
	Strongly Agree	5	31.3	33.3	100.0
	Total	15	93.8	100.0	
Missing	System	1	6.3		
Total		16	100.0		

Describe what you will learn in the course

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	11	68.8	73.3	73.3
	Strongly Agree	4	25.0	26.7	100.0
	Total	15	93.8	100.0	
Missing	System	1	6.3		
Total		16	100.0		

Are used by the instructor to keep you aware of your progress

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	6.3	6.7	6.7
	Somewhat Disagree	4	25.0	26.7	33.3
	Somewhat Agree	9	56.3	60.0	93.3
	Strongly Agree	1	6.3	6.7	100.0
	Total	15	93.8	100.0	
Missing	System	1	6.3		
Total		16	100.0		

Meet your projected career needs, interest and objectives

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Disagree	4	25.0	25.0	25.0
	Somewhat Agree	8	50.0	50.0	75.0
	Strongly Agree	4	25.0	25.0	100.0
	Total	16	100.0	100.0	

Provide for adequate supervised activities

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Disagree	3	18.8	18.8	18.8
	Somewhat Agree	11	68.8	68.8	87.5
	Strongly Agree	2	12.5	12.5	100.0
	Total	16	100.0	100.0	

There is appropriate monitoring and evaluation of student progress

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Disagree	1	6.3	6.3	6.3
	Somewhat Agree	10	62.5	62.5	68.8
	Strongly Agree	5	31.3	31.3	100.0
	Total	16	100.0	100.0	

Know the subject matter and professional requirements

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	6	37.5	40.0	40.0
	Strongly Agree	9	56.3	60.0	100.0
	Total	15	93.8	100.0	
Missing	System	1	6.3		
Total		16	100.0		

Provide adequate academic advising

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Disagree	6	37.5	40.0	40.0
	Somewhat Agree	4	25.0	26.7	66.7
	Strongly Agree	5	31.3	33.3	100.0
	Total	15	93.8	100.0	
Missing	System	1	6.3		
Total		16	100.0		

Are available to students for help in courses

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Disagree	1	6.3	6.7	6.7
	Somewhat Agree	9	56.3	60.0	66.7
	Strongly Agree	5	31.3	33.3	100.0
	Total	15	93.8	100.0	
Missing	System	1	6.3		
Total		16	100.0		

Faculty provide instruction which is interesting and understandable

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	2	12.5	13.3	13.3
	Somewhat Disagree	5	31.3	33.3	46.7
	Somewhat Agree	5	31.3	33.3	80.0
	Strongly Agree	3	18.8	20.0	100.0
	Total	15	93.8	100.0	
Missing	System	1	6.3		
Total		16	100.0		

Faculty are knowledgeable about the subject matter they teach

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	4	25.0	28.6	28.6
	Strongly Agree	10	62.5	71.4	100.0
	Total	14	87.5	100.0	
Missing	System	2	12.5		
Total		16	100.0		

Faculty are available to provide help when needed

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	8	50.0	57.1	57.1
	Strongly Agree	6	37.5	42.9	100.0
	Total	14	87.5	100.0	
Missing	System	2	12.5		
Total		16	100.0		

Faculty provide instruction which is interesting and understandable

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	6.3	7.1	7.1
	Somewhat Disagree	1	6.3	7.1	14.3
	Somewhat Agree	11	68.8	78.6	92.9
	Strongly Agree	1	6.3	7.1	100.0
	Total	14	87.5	100.0	
Missing	System	2	12.5		
Total		16	100.0		

Required related courses are relevant to the surveying program

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Disagree	5	31.3	35.7	35.7
	Somewhat Agree	4	25.0	28.6	64.3
	Strongly Agree	5	31.3	35.7	100.0
	Total	14	87.5	100.0	
Missing	System	2	12.5		
Total		16	100.0		

Provide adequate lighting, ventilation, etc.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	2	12.5	13.3	13.3
	Somewhat Disagree	3	18.8	20.0	33.3
	Somewhat Agree	5	31.3	33.3	66.7
	Strongly Agree	5	31.3	33.3	100.0
	Total	15	93.8	100.0	
Missing	System	1	6.3		
Total		16	100.0		

Include enough work stations

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Disagree	2	12.5	13.3	13.3
	Somewhat Agree	8	50.0	53.3	66.7
	Strongly Agree	5	31.3	33.3	100.0
	Total	15	93.8	100.0	
Missing	System	1	6.3		
Total		16	100.0		

Computer hardware is sufficient

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Disagree	2	12.5	13.3	13.3
	Somewhat Agree	4	25.0	26.7	40.0
	Strongly Agree	9	56.3	60.0	100.0
	Total	15	93.8	100.0	
Missing	System	1	6.3		
Total		16	100.0		

Computer software is maintained

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	2	12.5	13.3	13.3
	Somewhat Disagree	4	25.0	26.7	40.0
	Somewhat Agree	6	37.5	40.0	80.0
	Strongly Agree	3	18.8	20.0	100.0
	Total	15	93.8	100.0	
Missing	System	1	6.3		
Total		16	100.0		

Are safe, functional and well maintained

		Frequency	*Percent*	*Valid Percent*	*Cumulative Percent*
Valid	*Strongly Disagree*	*2*	*12.5*	*13.3*	*13.3*
	Somewhat Disagree	*3*	*18.8*	*20.0*	*33.3*
	Somewhat Agree	*7*	*43.8*	*46.7*	*80.0*
	Strongly Agree	*3*	*18.8*	*20.0*	*100.0*
	Total	*15*	*93.8*	*100.0*	
Missing	*System*	*1*	*6.3*		
Total		*16*	*100.0*		

Are open for sufficient hours each semester

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	3	18.8	20.0	20.0
	Somewhat Disagree	1	6.3	6.7	26.7
	Somewhat Agree	5	31.3	33.3	60.0
	Strongly Agree	6	37.5	40.0	100.0
	Total	15	93.8	100.0	
Missing	System	1	6.3		
Total		16	100.0		

Provide adequate lighting, ventilation, etc.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	4	25.0	28.6	28.6
	Strongly Agree	10	62.5	71.4	100.0
	Total	14	87.5	100.0	
Missing	System	2	12.5		
Total		16	100.0		

Include enough work stations for students enrolled in course

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	3	18.8	21.4	21.4
	Strongly Agree	11	68.8	78.6	100.0
	Total	14	87.5	100.0	
Missing	System	2	12.5		
Total		16	100.0		

Are safe, functional and well maintained

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	5	31.3	35.7	35.7
	Strongly Agree	9	56.3	64.3	100.0
	Total	14	87.5	100.0	
Missing	System	2	12.5		
Total		16	100.0		

Are open for sufficient hours each semester

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	6.3	7.1	7.1
	Somewhat Agree	6	37.5	42.9	50.0
	Strongly Agree	7	43.8	50.0	100.0
	Total	14	87.5	100.0	
Missing	System	2	12.5		
Total		16	100.0		

Current and representative of the surveying profession

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	14	87.5	100.0	100.0
Missing	System	2	12.5		
Total		16	100.0		

In sufficient quantity to avoid long delays in use

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	6.3	7.1	7.1
	Somewhat Agree	3	18.8	21.4	28.6
	Strongly Agree	10	62.5	71.4	100.0
	Total	14	87.5	100.0	
Missing	System	2	12.5		
Total		16	100.0		

Safe and in good operating condition

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	14	87.5	100.0	100.0
Missing	System	2	12.5		
Total		16	100.0		

Are current and meaningful to the subject

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	6	37.5	42.9	42.9
	Strongly Agree	8	50.0	57.1	100.0
	Total	14	87.5	100.0	
Missing	System	2	12.5		
Total		16	100.0		

Are easily obtainable through the bookstore, library or other sources

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	5	31.3	35.7	35.7
	Strongly Agree	9	56.3	64.3	100.0
	Total	14	87.5	100.0	
Missing	System	2	12.5		
Total		16	100.0		

Are available to meet your needs and interests

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	6.3	7.1	7.1
	Somewhat Disagree	2	12.5	14.3	21.4
	Somewhat Agree	7	43.8	50.0	71.4
	Strongly Agree	4	25.0	28.6	100.0
	Total	14	87.5	100.0	
Missing	System	2	12.5		
Total		16	100.0		

Are provided by knowledgeable, friendly and interested staff members

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Disagree	2	12.5	14.3	14.3
	Somewhat Agree	8	50.0	57.1	71.4
	Strongly Agree	4	25.0	28.6	100.0
	Total	14	87.5	100.0	
Missing	System	2	12.5		
Total		16	100.0		

University library holdings are current and sufficient

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	6.3	7.1	7.1
	Somewhat Disagree	2	12.5	14.3	21.4
	Somewhat Agree	5	31.3	35.7	57.1
	Strongly Agree	6	37.5	42.9	100.0
	Total	14	87.5	100.0	
Missing	System	2	12.5		
Total		16	100.0		

Classrooms provide adequate lighting, ventilation, etc.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Disagree	1	6.3	7.1	7.1
	Somewhat Agree	6	37.5	42.9	50.0
	Strongly Agree	7	43.8	50.0	100.0
	Total	14	87.5	100.0	
Missing	System	2	12.5		
Total		16	100.0		

Classrooms contain enough seats and tables for all students

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Disagree	2	12.5	14.3	14.3
	Somewhat Agree	4	25.0	28.6	42.9
	Strongly Agree	8	50.0	57.1	100.0
	Total	14	87.5	100.0	
Missing	System	2	12.5		
Total		16	100.0		

Program faculty encourage students to avail themselves of support services

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Disagree	4	25.0	28.6	28.6
	Somewhat Agree	3	18.8	21.4	50.0
	Strongly Agree	7	43.8	50.0	100.0
	Total	14	87.5	100.0	
Missing	System	2	12.5		
Total		16	100.0		

University is safe, functional and well maintained

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Disagree	2	12.5	14.3	14.3
	Somewhat Agree	6	37.5	42.9	57.1
	Strongly Agree	6	37.5	42.9	100.0
	Total	14	87.5	100.0	
Missing	System	2	12.5		
Total		16	100.0		

Satisfied and proud to have chosen surveying as my profession

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	5	31.3	35.7	35.7
	Strongly Agree	9	56.3	64.3	100.0
	Total	14	87.5	100.0	
Missing	System	2	12.5		
Total		16	100.0		

Satisfied and proud to have chosen Ferris' surveying program

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Somewhat Agree	4	25.0	28.6	28.6
	Strongly Agree	10	62.5	71.4	100.0
	Total	14	87.5	100.0	
Missing	System	2	12.5		
Total		16	100.0		

Program faculty encourage students to participate in professional activities

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	6.3	7.1	7.1
	Somewhat Disagree	1	6.3	7.1	14.3
	Somewhat Agree	5	31.3	35.7	50.0
	Strongly Agree	7	43.8	50.0	100.0
	Total	14	87.5	100.0	
Missing	System	2	12.5		
Total		16	100.0		

Additional comments

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		12	75.0	75.0	75.0
	Current professors need to personally evaluate their teaching styles and adjust accordingly.	1	6.3	6.3	81.3
	It would be very helpful if there were some computers that had the software for some of the projects and assignments we are assigned. Software that would be included are mathcad, matlab, and AutoCAD.	1	6.3	6.3	87.5
	The library weekend hours are awful. For example, on Saturdays the library is only open from 1 pm to 6 pm and Sundays it doesn't open until 1 pm. This is very inconvenient, especially if a student has other obligations such as work.	1	6.3	6.3	93.8
	When one professor highly recommends going to a professional society event (i.e. MSPS), another professor should not dump a large assignment on everyone over that time period and provide exclusive help to only those who stay behind.	1	6.3	6.3	100.0
	Total	16	100.0	100.0	

ADDITIONAL COMMENTS

Get more professors to 1. Represent a variety of areas in Surveying 2. Offer classes in the spring and fall (not "fall only" or "spring only" classes) semesters to fit students with unique schedules and help students' schedules flow smoothly
I feel as though some of the required courses that aren't so much related to the core of surveying and are more of "side" courses that are just "nice to have knowledge of" are emphasized too much rather than the more "core" fundamental courses. I believe that there is also a large amount of redundancy in many courses. It seems as though some courses are so similar that one or the other could be omitted from the program or replaced with a more dynamic course.
I feel Calculus 3 and Differential Equations courses would greatly assist in the higher level surveying courses.
I would add a higher level geometry class. The intro to computer mapping class (sure 115) should be more related to surveying not just AutoCAD drawings of random objects. Also the schools cultural enrichment and social awareness classes are pointless and should be replaced with something useful like a class that dealing with Microsoft office programs(I have used a lot of Microsoft word, excel, power point, and I think access would beneficial). Chemistry is a class that I don't think is beneficial. I also think that there should be an intro-mid level civil engineering class that gives and overview of civil engineering. Finally I think that sure 272 and 373 is based mostly on computer programing and not the actual material.
I would suggest revising the curriculum to make it more relevant to modern times. I would combine both photogrammetry classes into one class and consider adding a second remote sensing course. Also, I would like to see more use of software such as AutoCAD and ArcGIS rather than MathCAD, MatLab, and ERDAS. I feel we are more likely to use AutoCAD and ArcGIS throughout our professional career and more experiences with these softwares would help with employment. The last change I would make is to have the higher level classes (beyond sophomore level) use the total stations and GPS equipment in their labs more. Without constant practice on these pieces of equipment, it is easy to forget how they work.
more GIS
More hands on experience in the field
Most of the information provided above comes from the classes provided by carl Shangraw. Hashimi does not teach us real world material but a conceptual computer based program. From what I have experienced, carl Shangraw is the best professor in the program and cares the most about the students wellbeing and life after this establishment. With the head of the program not attending any of the professional conferences with the students, sheds a bad light on not only the program but his image. It truly shows he does not care about the profession, but just about making the program as hard as humanly possible.
Put much more emphasis on the beginning courses and core courses such as SURE 110, 220, 230. I feel like this is where students get the most knowledge about the profession and what it is about. I feel like all of the students, including myself, have to put so much time on other classes that aren't as significant like the 272 and 373 classes where it seems that programming is more important than the material itself. I would also like to see at least one of the computer labs open at all times, if possible. I think the younger students need to be more informed about scholarships, internships, and organizations

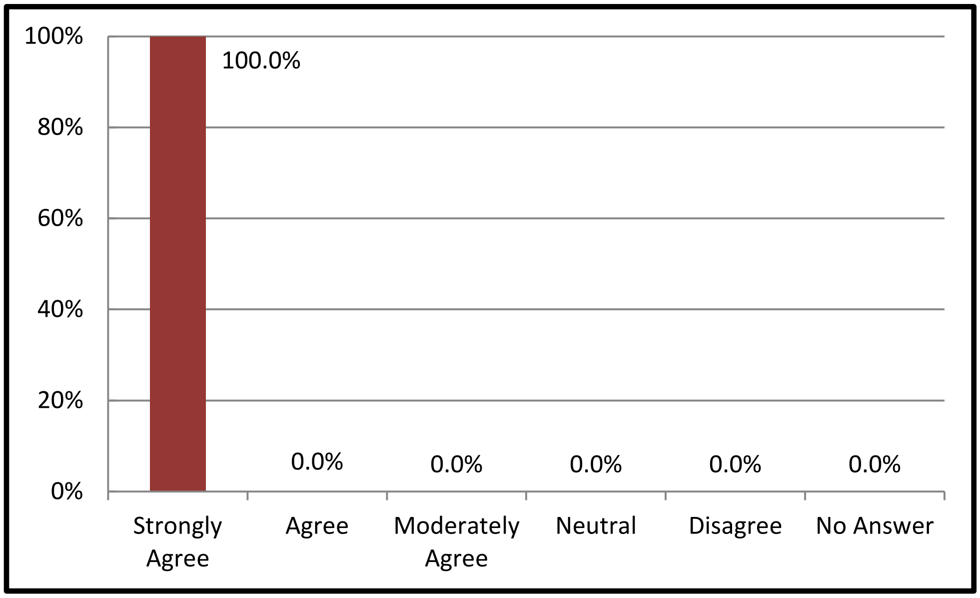
such as MSPS and ACSM. Although much of this can be learned through the weekly Burt and Mullett meetings, I think that the instructors should remind students. Maybe an internship should even be required before graduation.
Regarding our GIS program, I would like to see more real world situations in our labs. Rather than plug and chug laboratories.
Current professors need to personally evaluate their teaching styles and adjust accordingly.
It would be very helpful if there were some computers that had the software for some of the projects and assignments we are assigned. Software that would be included are mathcad, matlab, and AutoCAD.
The library weekend hours are awful. For example, on Saturdays the library is only open from 1 pm to 6 pm and Sundays it doesn't open until 1 pm. This is very inconvenient, especially if a student has other obligations such as work.
When one professor highly recommends going to a professional society event (i.e. MSPS), another professor should not dump a large assignment on everyone over that time period and provide exclusive help to only those who stay behind.

The analysis of the results surveys indicates that in response to each of the questions, the majority of the students either very strongly agreed or agreed with the question. All responses were very positive.

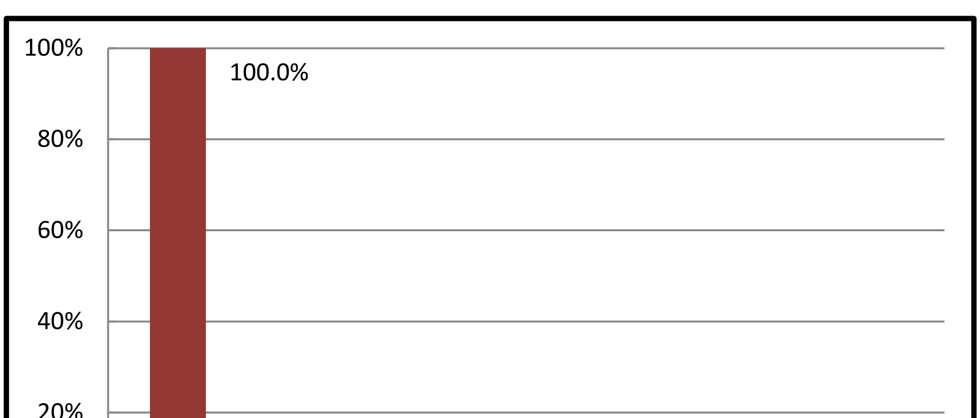
E. Faculty Perceptions:

The Surveying Engineering and the Surveying Technology faculty of the College of Engineering Technology's Surveying Engineering Program were asked to complete a questionnaire, rating their perceptions of program objectives and student outcomes. This survey was needed by ABET to evaluate both objectives and student outcomes of the Program.

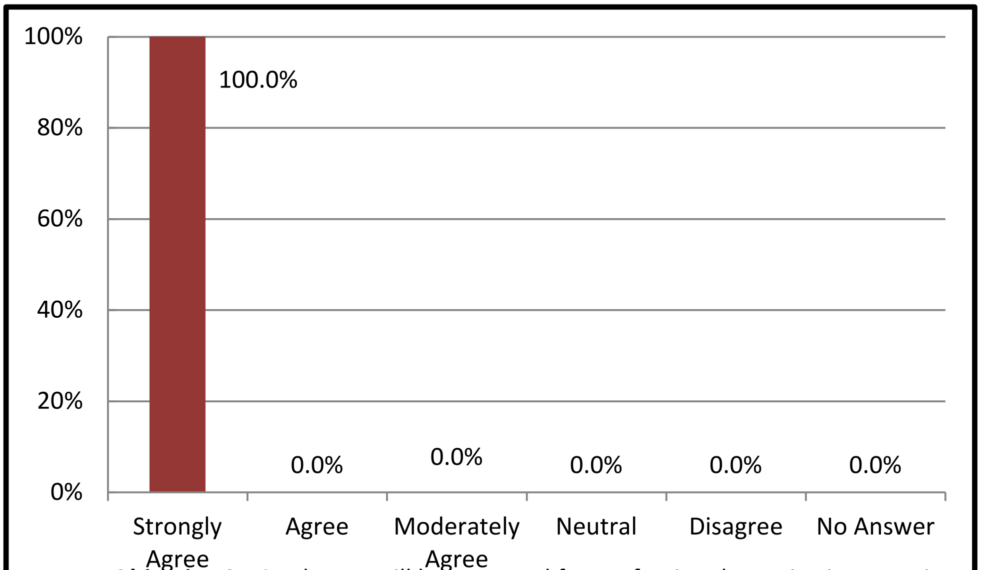
Results of the Faculty Surveys



Program Objective 1: Graduates will be able to analyze and solve surveying engineering problems by applying basic principles of mathematics, science, and engineering. Graduates will be able to use modern surveying engineering techniques, skills, and tools to identify, formulate, and solve surveying engineering problems.

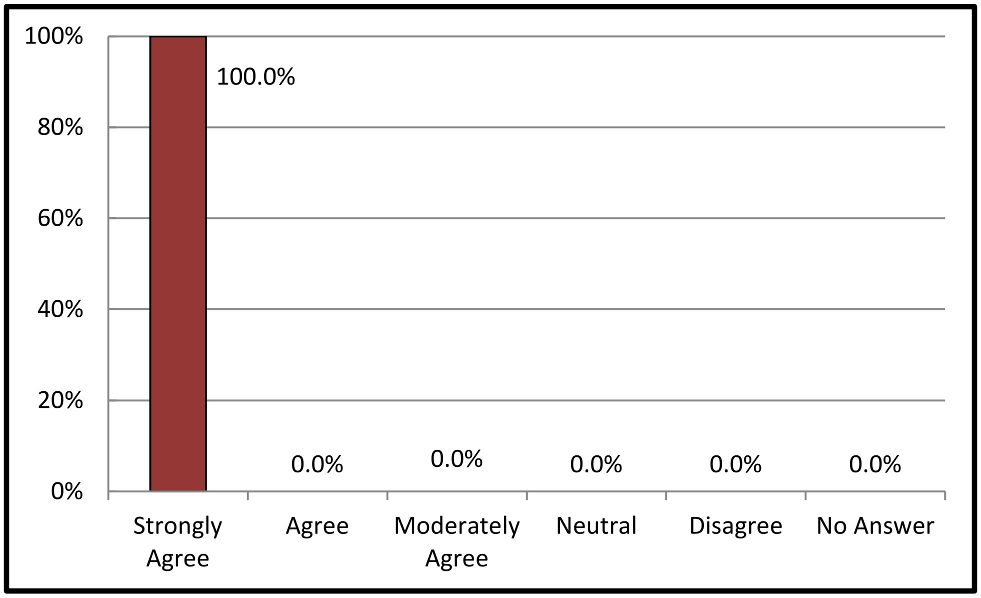


Program Objective 2: Graduates will be able to apply knowledge and skills from a broad education in order to understand the impact of surveying engineering solutions in a global, societal, and environmental context consistent with the principles of sustainable development.



Program Objective 3: Graduates will be prepared for professional practice in surveying engineering. Graduates will demonstrate an understanding of ethical, societal, and professional responsibilities; will recognize the limits of their knowledge and initiate self-directed and life-long learning opportunities; and will be able to function and communicate effectively individually and within multidisciplinary teams.

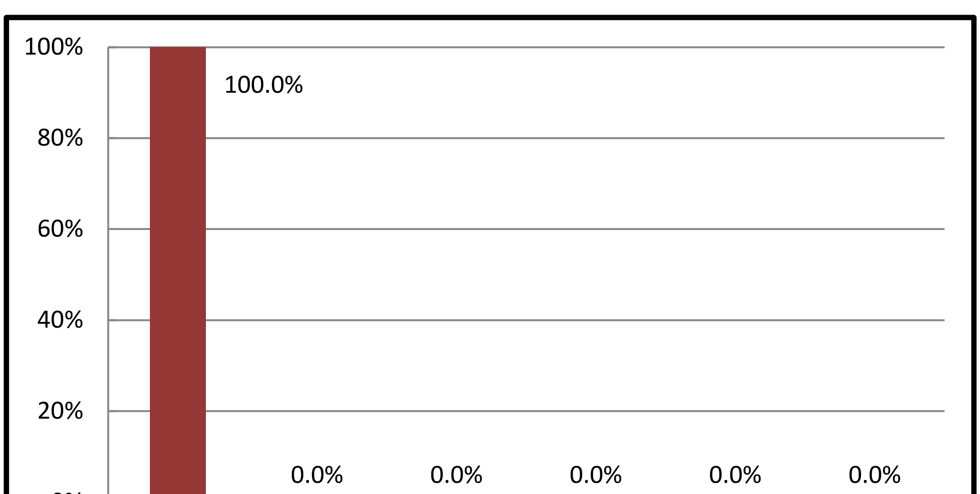
Figure 4.5 Faculty survey for evaluation of objective Four

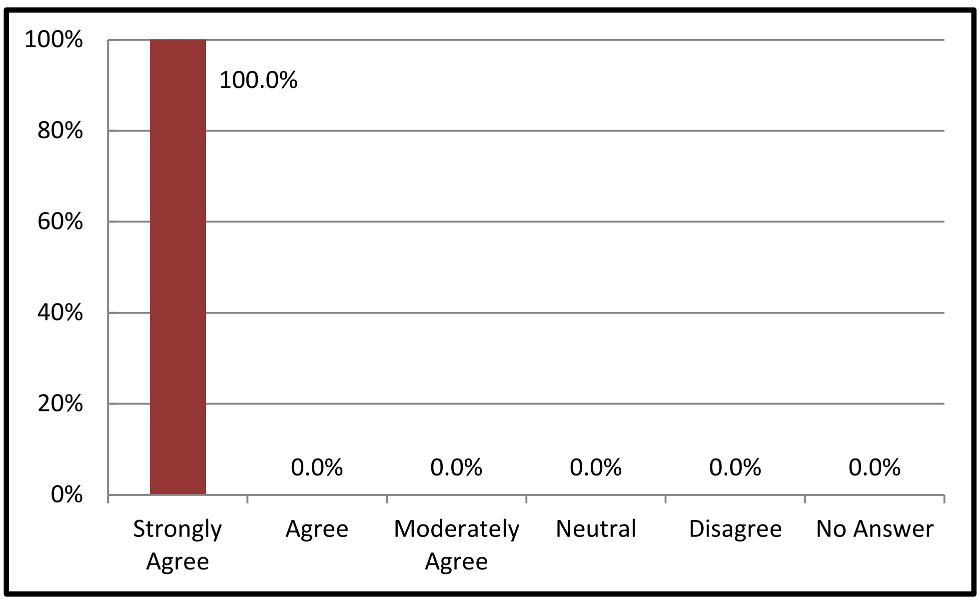


Program Objective 4: Provide the education needed for the graduates to become qualified as licensed professional surveyors.

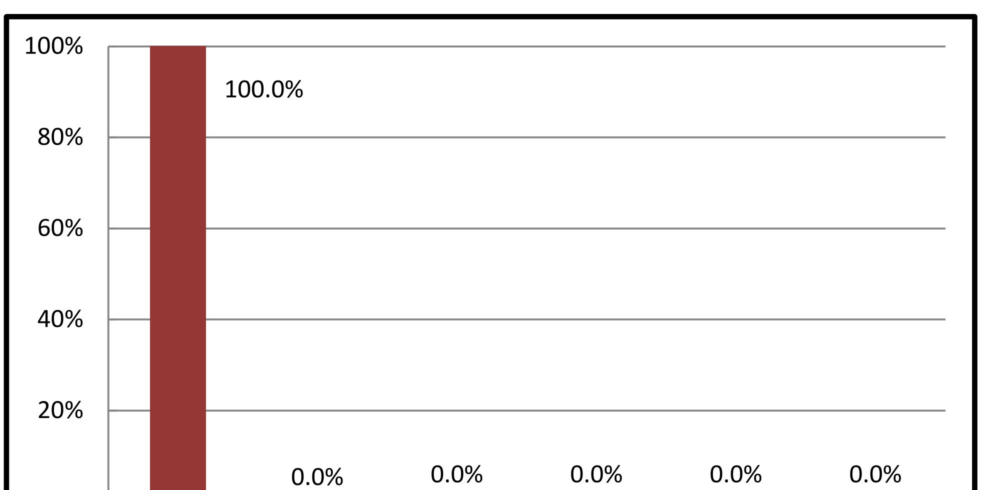
An analysis of the charts given above for all the four educational objectives of the program, it is very clear that 100% of the faculty fully support the educational objectives of the program. It is no surprise since the educational objectives were written by the faculty and approved by the advisory committee. It also indicates that the faculty is unanimous in their support for the program educational objectives.

Faculty Survey for Evaluation of Student Outcomes

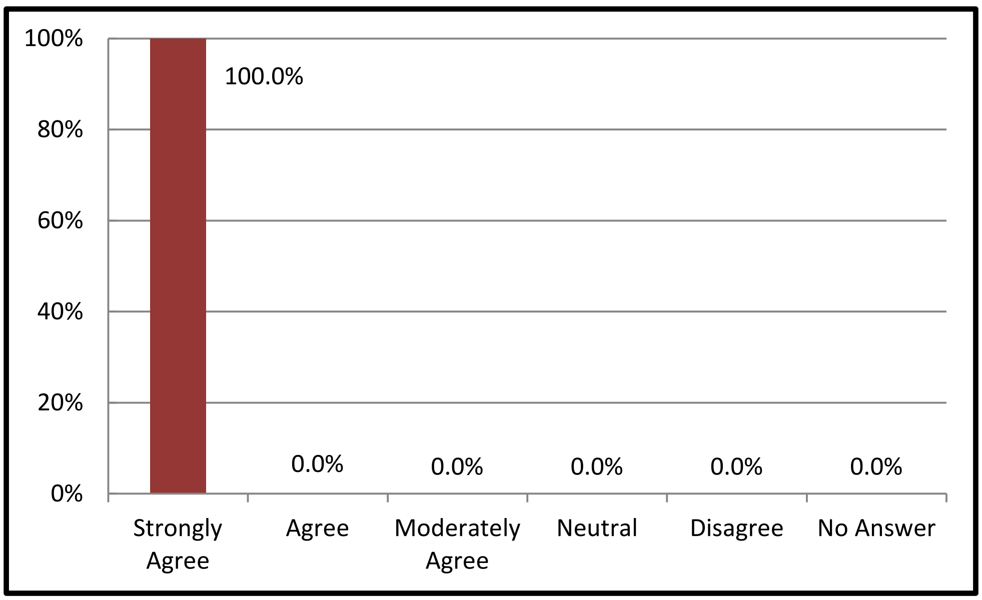




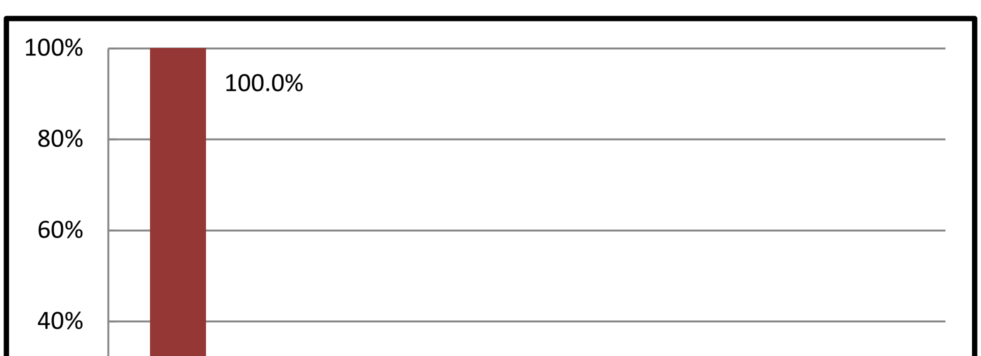
Student Outcome 2: An ability to solve surveying engineering problems in practice by applying fundamental knowledge of mathematics, statistics, science, and by using modern surveying engineering techniques, skills, and tools.



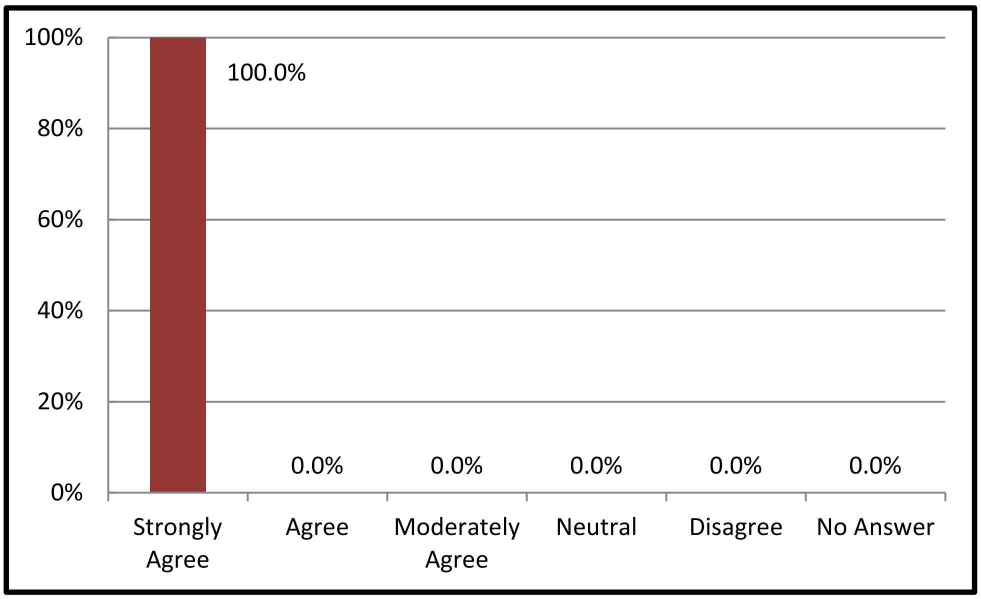
Student Outcome 3: An ability to identify, formulate, and solve surveying engineering problems, particularly the planning, design, establishing horizontal and vertical control, land use design, boundary determination, mapping and field layout of infrastructure that meet standards of accuracy and precision, keeping in mind cost, time, safety and quality needs, and objectives.



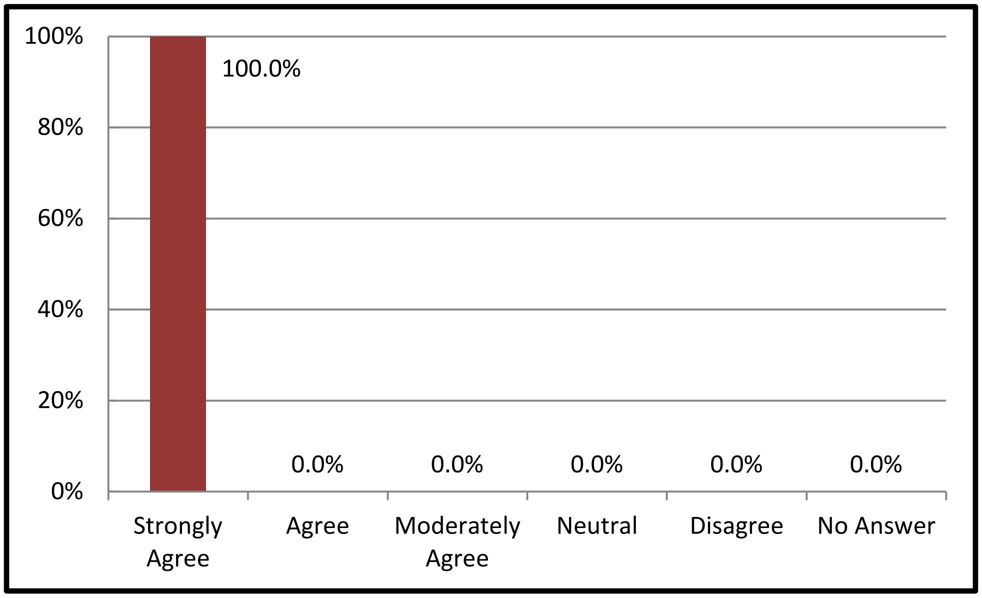
Student Outcome 4: An ability to design and conduct experiments and to analyze and interpret data in engineering surveying, topographic surveying, geodetic surveying, and boundary surveying.



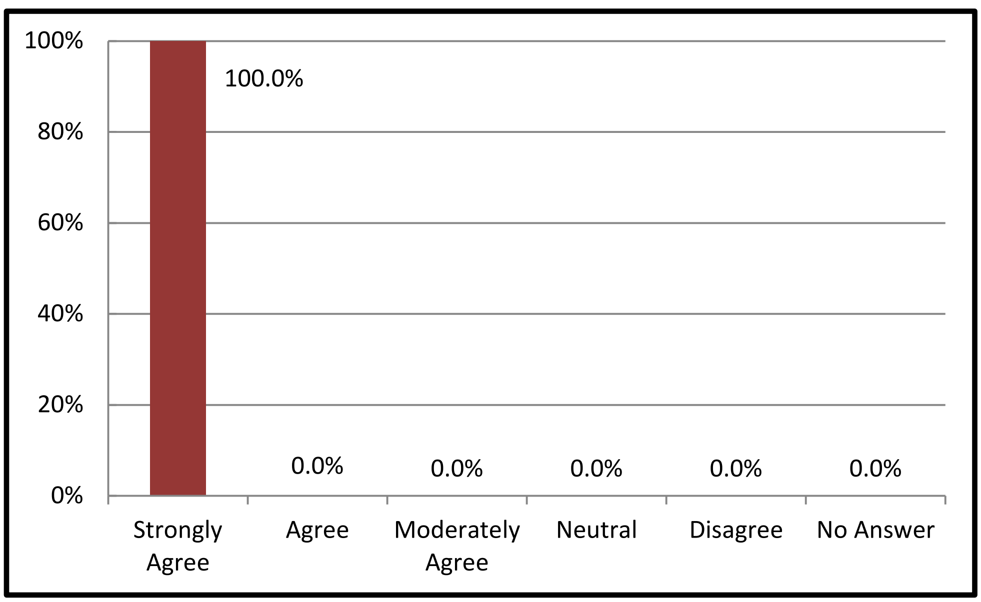
Student Outcome 5: An ability to communicate technical material written papers/reports and oral presentations.



Student Outcome 6: An ability to function within multidisciplinary teams.



Student Outcome 7: An understanding of professional, societyal, and ethical practice and responsibilities.



Student Outcome 8: A recognition of the importance of professional licensure and a recognition of the need for, and an ability to engage in, life-long learning.

An analysis of the charts given above for all the four educational objectives of the program, it is very clear that 100% of the faculty fully support the educational objectives of the program. It is no surprise since the educational objectives were written by the faculty and approved by the advisory committee. It also indicates that the faculty is unanimous in their support for the program educational objectives.

F. Advisory Committee Perceptions

The purpose of this survey is to obtain information from the members of the program advisory committee regarding the curriculum, outcomes, facilities, equipment, graduates, micro- and mega trends that might affect job placement (both positively and adversely), and other relevant information.

Recommendations for improvement must be sought from this group. In the event that a program does not have an advisory committee, a group of individuals may be identified to serve in that capacity on a temporary basis.

SURE ...Advisory Survey

Prepared by: Institutional Research & Testing, 04/11

Statistics

	N		Mean	Median
	Valid	Missing		
The program provides the knowledge and expertise needed	5	0	4.00	5.0
There is a high demand for students from this program	5	0	4.20	5.0
Your company would hire a student from this program	5	0	4.40	5.0
The program producing competent graduates	5	0	4.20	5.0
The program has sufficient physical facilities	5	0	4.00	5.0
The program's curriculum meets the needs of the profession	5	0	4.20	5.0
The program has an adequate number of full time tenure-track faculty	5	0	4.20	4.0
The program's faculty have adequate academic credentials and experience	5	0	4.20	4.0
The program's faculty are given enough financial support	5	0	3.60	3.0
The graduates of the program are technically prepared to go to work	5	0	4.40	5.0
The graduates of the program are prepared to be competitive with graduates of similar programs	5	0	4.20	5.0
The program receives adequate financial support from the university	5	0	3.80	3.0
Surveying Engineering program should expand its curricula to include GIS option	5	0	4.20	4.0
Please elaborate on any of the above	5	0		
Additional comments	5	0		

Frequency Table

The program provides the knowledge and expertise needed

		Frequency	Percent	Valid Percen
Valid	Strongly Disagree	1	20.0	20
	Somewhat Agree	1	20.0	20
	Strongly Agree	3	60.0	60
	Total	5	100.0	100

There is a high demand for students from this program

		Frequency	Percent	Valid Percen
Valid	Somewhat Disagree	1	20.0	20
	Somewhat Agree	1	20.0	20
	Strongly Agree	3	60.0	60
	Total	5	100.0	100

Your company would hire a student from this program

		Frequency	Percent	Valid Percen
Valid	Somewhat Disagree	1	20.0	20
	Strongly Agree	4	80.0	80
	Total	5	100.0	100

The program producing competent graduates

		Frequency	Percent	Valid Percen
Valid	Strongly Disagree	1	20.0	20
	Strongly Agree	4	80.0	80
	Total	5	100.0	100

The program has sufficient physical facilities

		Frequency	Percent	Valid Percen
Valid	Strongly Disagree	1	20.0	20
	Somewhat Agree	1	20.0	20
	Strongly Agree	3	60.0	60
	Total	5	100.0	100

The program's curriculum meets the needs of the profession

		Frequency	Percent	Valid Percen
Valid	Somewhat Disagree	1	20.0	20
	Somewhat Agree	1	20.0	20
	Strongly Agree	3	60.0	60
	Total	5	100.0	100

The program has an adequate number of full time tenure-track faculty

		Frequency	Percent	Valid Percen
Valid	Neutral	1	20.0	20
	Somewhat Agree	3	60.0	60

	N/A	1	20.0	20
	Total	5	100.0	100

The program's faculty have adequate academic credentials and experience

		Frequency	Percent	Valid Percen
Valid	Somewhat Disagree	1	20.0	20
	Somewhat Agree	2	40.0	40
	Strongly Agree	1	20.0	20
	N/A	1	20.0	20
	Total	5	100.0	100

The program's faculty are given enough financial support

		Frequency	Percent	Valid Percen
Valid	Somewhat Disagree	1	20.0	20
	Neutral	2	40.0	40
	Somewhat Agree	1	20.0	20
	N/A	1	20.0	20
	Total	5	100.0	100

The graduates of the program are technically prepared to go to work

		Frequency	Percent	Valid Percen
Valid	Somewhat Disagree	1	20.0	20
	Strongly Agree	4	80.0	80
	Total	5	100.0	100

The graduates of the program are prepared to be competitive with graduates of similar programs

		Frequency	Percent	Valid Percen
Valid	Strongly Disagree	1	20.0	20
	Strongly Agree	4	80.0	80
	Total	5	100.0	100

The program receives adequate financial support from the university

		Frequency	Percent	Valid Percen
Valid	Neutral	3	60.0	60
	Somewhat Agree	1	20.0	20
	N/A	1	20.0	20
	Total	5	100.0	100

Surveying Engineering program should expand its curricula to include GIS option

		Frequency	Percent	Valid Percent
Valid	Neutral	1	20.0	20
	Somewhat Agree	2	40.0	40
	Strongly Agree	2	40.0	40
	Total	5	100.0	100

Please elaborate on any of the above

		Frequency	Percent	Valid Percent
Valid		3	60.0	60
	Hard to remedy, but the graduates would shine even brighter if equipped with a stronger background in math and physics	1	20.0	20
	Technically the graduates are very strong. More exposure to office practice / supervisorial would be a benefit.	1	20.0	20
	Total	5	100.0	100

Additional comments

		Frequency	Percent	Valid Percent
Valid		4	80.0	80
	A GIS option although somewhat desired, should not interfere/compete/undermine the existing Geomatics program	1	20.0	20
	Total	5	100.0	100

Advisory Committee Survey Report

The Surveying Engineering Advisory Committee is responsible for advising faculty concerning both the Surveying Engineering degree and the Surveying Technology degree. There are thirteen members of the advisory committee. Every member of the committee was mailed a questionnaire.

The committee members were asked a range of questions about the knowledge and expertise needed by the profession, demand for the graduates, and the role of the program to produce competent graduates, physical facilities such as survey equipment and computer hardware and software, and nature of the curriculum in terms of meeting the demands of the profession. In addition, they were asked about the qualifications and competency of the faculty, adequacy of the number of faculty needed by the program. Moreover, they were also asked about the competency of our graduates' vis-à-vis the graduates of similar programs in the country.

Further the committee was asked if the program received adequate financial support from the university. They were also asked about the importance of ABET accreditation. Finally, they were also requested to comment on the value of the program to the profession including its strength and weakness. Survey questions were answered on a scale of one to five, as follows:

5 = Strongly Agree 4 = Agree 3 = Neutral 2 = Disagree 1 = Strongly Disagree

There was also a column labeled as N/A as Not Applicable.

There are thirteen members in the committee of which three are ex-officio members as mentioned above. Nine (69%) of the committee members responded to the survey.

Regarding the questions of knowledge and expertise provided by the program and the role played by the program in the profession, 100% of the respondents either strongly agreed or agreed . Similarly, 100% of the respondents agreed or strongly agreed that we had enough physical facilities, computers, and equipment. It should be noted that in terms of the survey equipment
and photogrammetry lab, the program is the best equipped in the nation. Fifty-six percent of the respondents felt that the program did not receive adequate financial support from the University.

Eighty-nine percent of the respondents either agreed or strongly agreed that the program met the demands of the profession.

Eighty-nine percent of the respondents either agreed or strongly agreed on the issue of adequacy of the faculty for the program. It should be noted that one adjunct faculty has been working on staff for over eleven years. One Hundred percent of the respondents agreed or strongly agreed that the program has faculty with sufficient academic credentials and experience. On the question of financial support for faculty development and professional involvement, 78% of the respondents either disagreed (3) or checked (N/A) while 22% felt that the program was given enough financial support from the university.

Unanimously, the respondents strongly agreed that the program produces technically prepared graduates who are competitive with the graduates of the similar programs nationwide. Similarly, 100% of the respondents agreed that ABET accreditation is vitally important for the continued success of the program.

The results of the advisory committee show that we have a very strong and well balanced curriculum. We have adequate resources and facilities. We have 100% placement and our graduates are very competitive.

Section 3: Program Profile:

Include Administrative Program Review document in this section. Provide the number and percentage for the variable addressed for each of the years since inception (for new programs) or the last program review.

A. Profile of Students

1) Student Demographic Profile:

a) Gender, race/ethnicity, age (use annual institutional data)

Surveying Engineering											
		Sex		**Ethnicity**							**Age**
Term	Enrolled	Male	Female	Unknown	Black	Hispanic	Indian / Alaskan	Asian / Pac Islander	White	Multi-racial	Ave. Age
2007F	70	68	2	0	0	0	0	1	68	1	23.9
2008F	73	71	2	1	0	0	0	1	70	1	23.2
2009F	67	63	4	2	0	0	0	1	63	1	23.4
2010F	59	55	4	1	0	0	0	1	56	1	23.4
2011F	42	38	4	0	0	0	0	1	40	1	23.6

Surveying Technology											
		Sex		**Ethnicity**							**Age**
Term	Enrolled	Male	Female	Unknown	Black	Hispanic	Indian / Alaskan	Asian / Pac	White	Multi-racial	Ave. Age
2007F	42	40	2	0	0	1	0	2	39	0	21.4
2008F	31	28	3	0	0	1	0	0	30	0	19.5
2009F	26	24	2	0	0	0	0	0	26	0	22.2
2010F	16	15	1	1	0	0	0	0	15	0	22.3
2011F	14	14	0	1	0	0	0	0	13	0	22.3

b) In state and out-of-state

Approximately 7% of the students in both Surveying Engineering and

3% of our Surveying
Technology programs are out-of-state. Faculty have been recruiting in the Great Lakes States and are currently working with professional organizations in these states for student scholarships.

Surveying Engineering Residency			
Term	**Midwest Compact**	**Out-State**	**In-State**
2007F	2	1	67
2008F	1	2	70
2009F	2	1	64
2010F	4	4	52
2011F	2	3	37

Surveying Technology Residency			
Term	**Midwest Compact**	**Out-State**	**In-State**
2007F	0	1	41
2008F	0	1	30
2009F	0	2	24
2010F	0	0	16
2011F	0	0	14

c) Full-time and part-time

Surveying Engineering		
	Enrollment	
Term	**Full-Time**	**Part-Time**
2007F	118	
2008F	118	
2009F	107	
2010F	98	
2011F	76	

Surveying Technology		
	Enrollment	
Term	**Full-Time**	**Part-Time**
2007F		
2008F		
2009F		
2010F		
2011F		

d) Attend classes during the day, in the evenings, and on weekends

In general, surveying classes are offered during the day, however, some classes are offered during the evening hours to accommodate students and to make use of lab time. In addition, GISC 225 is now offered on-line as an option for our students.

e) Enrolled in classes' on- and off-campus

At this time, the only class offered on-line is GISC 225.

f) Enrolled in 100% on-line and/or mixed delivery courses

Only one of the required courses in both programs is offered on-line or in a mixed delivery mode. The program however, does offer a three-course sequence certificate program in GIS. Only one of these is part of both the Engineering Program and the Technology Program.

g) Discuss how the information presented in (a) through (f) impacts the curriculum, scheduling, and/or delivery methods in the program

We have a number of transfer students who join the program at different levels of their education. It is a challenge to schedule the courses so that transfer students can take the courses at appropriate times so that they do not have to spend extra semester. In addition, our schedule also has to take into account the Physics, Mathematics, and Geology courses

Quality of Students

a) What is the range and average GPA of all students currently enrolled in the program? ACT? Comment on this data

The ACT range for Surveying Engineering students is 19 to 30 with the average being 23.5. The ACT range for Surveying Technology Students is 19 to 25 with the average being 20.

		Surveying Engineering FSU GPA			Surveying Technology FSU GPA	
Term	**Ave. GPA**	**Min. GPA**	**Max. GPA**	**Ave. GPA**	**Min. GPA**	**Max. GPA**
2007F	3.02	1.95	4.0	2.75	0.83	3.79
2008F	2.94	1.62	3.93	2.72	1.53	3.33
2009F	2.99	1.98	4.0	2.88	1.85	3.76
2010F	3.04	1.85	4.0	2.86	1.94	3.75
2011F	3.06	2.04	3.98	2.87	2.29	

The lower ACT students are not directly enrolled in the Surveying Engineering. Admission to the four-year program requires the students' ability to be ready to take MATH 220 Analytical Geometry and Calculus I.

b) What are the range and average GPA's of students graduating from the program? ACT? Comment on this data

The minimum MATH ACT score required for entry into the BS Surveying Engineering is 27. However, a significant number of students in the program spend one or more semesters completing their math deficiencies. The following table is for Surveying Engineering graduates:

	FSU GPA			ACT		
Year	**Ave. GPA**	**Min. GPA**	**Max. GPA**	**Ave. ACT**	**Min. ACT**	**Max. ACT**
2008	2.62	2.47	2.76			
2009	3.21	2.54	3.75			
2010	2.92	2.35	3.23			
2011	3.08	2.11	3.91			
2012	2.74	2.29	3.23			

Surveying Technology						
	FSU GPA			ACT		
Year	**Ave. GPA**	**Min. GPA**	**Max. GPA**	**Ave. ACT**	**Min. ACT**	**Max. ACT**
2008	2.92	2.37	3.51			
2009	3.44	2.85	3.75			
2010	2.89	2.35	3.42			
2011	2.57	2.01	3.64			
2012	2.74	2.3	3.04			

c) In addition to ACT and GPA, identify and evaluate measures that are used to assess the quality of students entering the program

For students who have been out of high school or college for a while (two on more years), we encourage them to take a MATH placement test. High competency level in Math is necessary to successfully complete our curriculum.

d) Identify academic awards (e.g., scholarships or fellowships) students in the program have earned. Comment on the significance of these awards to the program and students

The Surveying Engineering Program is very fortunate to have a VERY strong support from surveying instrument manufacturers, professional societies, surveying and mapping companies, and individuals. Their support includes, among other things, over $20,000 in scholarships. The following is an example of the scholarships that the students received last year.

Burtch, Robert Geodetic Surveying Annual Scholarship ($500)	$ 500.00
Craig and Tamara Amey Surveying Annual Scholarship (They make their own selection)	$1000.00
Dr. Vijay Mahida Surveying Endowment Scholarship ($500)	$1,685.10
Greer, David R Surveying Endowment Scholarship	$2,300.00
John and Lynda Fenn Surveying Scholarship ($2,500)	$3,431.00
Kebs, Inc. Annual Scholarship ($500)	$ 500.00
Leica Geosystems Scholarships, Dr. Richard Sauve III - Does not go through Ferris.	$1,000.00
Don Lowell Scholarship ($1,000)	$1,000.00
Mary C. Feindt Surveying Annual Scholarship ($500)	$2,845.00
Northern Chapter Michigan Society of Professional Surveyors Annual Scholarship (they make selection)	$ 500.00
James D & Katy Moore Heavy Eqt Annual Scholarship ($750)	$ 750.00
Rought, Richard Surveying Annual Scholarship ($1200)	$1,200.00
Rowe Inc. Surveying Annual Scholarship	$2,000.00
Dr. Khagendra Thapa Surveying Annual Scholarship ($500)	$1,523.00

Tingley and Associates Scholarship ($500)	$ 750.00
Urban Land Consultants Surveying Annual Scholarship [NOT AVAILABLE 10/11]	$ 333.00
Woolpert LLP Annual Scholarship ($1,000)	$1,000.00
Total Scholarships	$ 22,317.10

e) What scholarly/creative activities (e.g., symposium presentations, other presentations, or awards) have students in the program participated in? Comment on the significance of these activities to the program and students

The Surveying Engineering students participate in a number of scholarly activities; chief among them is their participation at State and national surveying and mapping conventions. For example, in February 2012, Surveying Engineering students presented the data they had analyzed for the GIS Competition in held during National Society of Professional Surveyors (NSPS) Conference. In addition, students in the program have achieved the following successes in NSPA and ACSM Conferences:

NSPS Conference First place in 4/2006 about a topic on Solar & celestial observation. Again they own First Place about a topic on Railroad surveying event on 03/2007.

NSPS student competion 2006 first Place. Topic: Solar and Celestial Obcervation Instruments.

NSPS student competition 2007 First Place. Topic: Railroad surveying event

NSPS student competition 2008 3rd Place. Topic: Historically significant Surveys.

NSPS student competition 2009 First Place. Topic: Calculating Methods and Devices from around the world.

NSPS student competition 2010 Second Place. Topic: Forensic surveying

Our students are very competitive and knowledgeable in the discipline as is evident from the list of awards they have received. It also reflects well on the quality of the program. In addition, it has given nationwide exposure for the program.

From POB Magazine May 1, 2007 wrote the following comment regarding the NSPS student competiion and the performance of our students as quoted in the following paragraph:

"**Student Surveying Competition**

A total of 117 college and university students attended ACSM this year, many of whom participated in the sixth annual NSPS Surveying Student Competition on Saturday, March 10. This year's field exercise on the theme of historical railroad surveying took place on the national park grounds under the St. Louis Arch. A total of 11 teams participated in the event. For the second year in a row, Ferris State University (Michigan) received first place for its award-winning paper and field exercise. Closely tailing FSU for the third consecutive year was the University of Akron (Ohio), the legendary winners of the optional costume competition. The team from the University of Puerto Rico returned to ACSM for a second year to take third place."

f) What are other accomplishments of students in the program? Comment on the significance of these accomplishments to the program and students

Other student accomplishments Include:

Participation in student organizations; the Burt and Mullet Chapter of the American Congress on Surveying and Mapping (ACSM), and a nationally recognized surveying honor society called Lambda Sigma. Some of the activities that the students conduct include weekly guest speakers, blood drives, the Big Brother/Big Sister Program, tutoring, volunteering to lay out Habitat for Humanity homes, Boy Scouts, and Roll-A-Thons, just to name a few.

Academically, several students opt to pursue graduate work at other institutions. Others have indicated that graduate studies may also be in their future later. At least three graduates joined the graduate programs with scholarships or teaching associate positions this year.

Employability of students

a) How many graduates have become employed full-time in the field within one year of receiving their degree? Comment on this data

Academic Year	Placement Rate	Starting Salary $
2006-2007	100%	45,018
2007-2008	100%	45,243
2008-2009	100%	Not available
2009-2010	100%	Not available
2010-2011	100%	43,000

The average starting salary figure for 2010-2011 graduates revealed a downward spike. The reason for this downward spike is believed to be the overall state of Michigan's economy, where the majority of our graduates have found work. The fact that 100% of our graduates have found employment is encouraging. All spring 2012 graduates were employed before graduation.

b) What is the average starting salary of graduates who become employed full-time in the field since inception (for new programs) or the last program review? Compare with regional and national trends.

See section a) above.

c) How many graduates have become employed as part-time or temporary workers in the field within one year of receiving their degree? Comment on this data

See section a) above.

d) Describe the career assistance available to the students. What is student perception of career assistance?

The students in the surveying programs receive a significant amount of information on career options and career opportunities through the weekly outside speakers, postings of all available employment opportunities for both summer and full time, and the active involvement of some of the advisory committee members. As an example, one advisory committee member spends an entire day during spring semester with students who are in need of summer or fulltime employment. As he identifies the student, he immediately contacts various companies for possible placement. It is highly unlikely that a student in any of the surveying programs does not have a surveying related summer experiences. As a result, the students have a very positive impression regarding career assistance.

e) How many graduates continue to be employed in the field? Comment on this data

Students in both programs have a definite goal of being a member of the surveying profession. They work hard to earn the degree and subsequently the license as a professional surveyor. Therefore, nearly 90% of them stay in their chosen field. Detailed analysis may be found in Section 2A of this document.

f) Describe and comment on the geographic distribution of employed graduates

The majority of the graduates used to stay in Michigan. Occasionally, some used to go to other states. However, in the last few years, our graduates have found employment in many states. For example, of the 21, graduates five of them went to North Dakota. We do not have exact information as to where they were employed. Nevertheless, majority had to look for outside Michigan economy. Historically, we have noticed that they do get employment back in Michigan and come back. One of the hallmarks of the program is that the BS in Surveying Engineering which is one of only seven such programs accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (EAC/ABET). This makes the graduates highly sought after nationally.

g) How many students and/or graduates go on for additional educational training? (Give annual average.) Comment on this data

On average, two or three students each year continue their education in graduate school in one of the surveying and mapping specialties such as geodesy, photogrammetry, geographic information systems (GIS), or pursue law or MBA degrees. Five have obtained PhD degrees. Three graduates from the spring of 2012 joined the graduate program.

h) Where do most students and/or graduates obtain their additional educational training? Comment on this data

The majority of those who pursue a surveying and mapping track go to Purdue University, while some have gone to Ohio State University, and the University of Maine. Those who opt for an MBA or a law degree tend to pursue their studies in Michigan.

B. ENROLLMENT

1) What is the anticipated fall enrollment for the program?

The anticipated new student enrollment in both programs for the fall of 2012 is about 21. Total enrollment is expected to be about 51.

Have enrollment and student credit hour production (SCH) increased or decreased since the last program review? Supply a table and comment on any enrollment trends

As can be seen in the table below, the enrollment in both programs is increasing from 6% to 12% over the last two years. If the expected enrollment of new students continues at the same level for fall of 2006 as it was for fall 2005, the overall enrollment will be approximately 130

	2007/2008	2008/2009	2009/2010	2010/2011	2011/2012
Pre-Surveying Engineering	0	0	0	0	2
Pre-Surveying Technology	2	3	4	2	1
Surveying Engineering	74	73	68	59	16
Surveying Technology	35	31	26	16	42
Total	**111**	**107**	**98**	**77**	**61**

Since the last program review, how many students apply to the program annually?

The enrollment of new students over the last five year is around 31 per year.

Of those who apply, how many and what percentage are admitted?

About 10% of the new applicants that do not meet the program admission requirements are not admitted.

Of those who are admitted, how many and what percentage enroll?

Less than 5% of those admitted will not enroll. This is not necessarily because they choose another school for surveying, but more a change of plan to pursue a career other than surveying on the part of the applicant. Or they did not have the required math competency needed for the successful completion of the degree.

What are the program's current enrollment goals, strategy, and efforts to maintain/increase/decrease the number of students in the program? Please explain.

The goal is to graduate 20 to 25 students in the baccalaureate program. Achieving this goal would require the overall enrollment to be increased to 100 students. Having 100 students in both programs would require additional resources, namely faculty and space. An alternative would be to recruit better students.

C. PROGRAM CAPACITY

1) **What is the appropriate program enrollment capacity, given the available faculty, physical resources, funding, accreditation requirements, state and federal regulations, and other factors? Which of these items limits program enrollment capacity? Please explain any difference between capacity and current enrollment.**

The program capacity used to be 113 students in both programs. That was when we had six full time faculty until two years ago. Now the number of full time faculty has gone down to four. If we apply Ferris State University's faculty student ratio of 1:16, then our enrollment capacity has also reduced to 64 or say about 70. Beyond that, the programs need additional faculty, space, and Supplies and Expenses (S&E) dollars. There are no regulations; state, federal or otherwise limiting the size of the programs. The program is currently running below capacity because the enrollment has gone down every year for the last three years. In fact, we only had 19 continuing students this year. Luckily, we have reversed the course and we took about 22 new students this year. Therefore, our total enrollment is about fifty students. We hope to increase back to 100 students in about three years.

D. RETENTION AND GRADUATION

1) **Give the annual attrition rate (number and percent of students) in the program.**

What are the program's current goals, strategy, and efforts to retain students in the program?

Being an ABET accredited engineering program, students are required to be ready for entry into Math 220 Analytical Geometry and Calculus I. Since the majority of the students, over 80%, are not eligible to start at this level, it takes students, on average, one extra semester (4.5 years) to graduate. Furthermore, the program rigor, requiring a year of calculus based physics, one semester of general chemistry, and the upper division of surveying courses that require the application of higher mathematics, some students tend to repeat one or more courses, change majors, or simply drop out. All these requirements lengthen the students' graduation time, and cause a higher attrition rate for the BS in Surveying Engineering students.

Realistically, the attrition rate for both programs is lower than similar engineering programs at other institutions. The faculty recognizes the difficulty of the program and tries to work with students individually, and through special help sessions to assist those who need it.

Describe and assess trends in number of degrees awarded in the program.

The following table lists the number of graduates for the two programs:

Program	Degrees offered			
	2006-2007	2007-2008	2008-2009	2009-2010
Surveying Engineering	17	22	16	21
Surveying Technology	13	16	12	15

The program capacity used to be about 113 students in both programs. That was when we had six full time faculty until two years ago. Now the number of full time faculty has gone down to four. If we apply Ferris State University's faculty student ratio of 1:16, then our enrollment capacity has also reduced to 64 or say about 70. Beyond that, the programs need additional faculty, space, and Supplies and Expenses (S&E) dollars. There are no regulations; state, federal or otherwise limiting the size of the programs. The program is currently running below capacity because the enrollment has gone down every year for the last three years. In fact, we only had 19 continuing students this year. Luckily, we have reversed the course and we took about 22 new students this year. Therefore, our total enrollment is about fifty students. We hope to increase back to 100 students in about three years.

If one looks at the number of graduates of both programs, it was about 30 graduates per year. It has peaked in the academic year 2011/12. From next year and for the next few years it will go down. Hopefully, it will be back up again since we enrolled over 20 new students this year.

How many students who enroll in the program graduate from it within the prescribed time? Comment on any trends.

Less than 20% of the students finish the program in the time specified.

On average, how long does it take a student to graduate from the program? Please comment.

It takes about 4.6 years on average for a student to finish the BS in Surveying Engineering. The national average for an EAC/ABET engineering program is 5.5 years.

E. ACCESS

1) **Describe and assess the program's actions to make it accessible to students. Use examples such as off-site courses, accelerated courses or other types of flexible learning, use of summer courses, multiple program entry points, e-learning, mixed delivery courses, scheduling.**

Lately, the program has offered some courses in the evenings (from 6:00 p.m. to 9:00 p.m.). Students may also take GISC 225 on-line or over the summer. We do admit students in Spring Semester. Some foreign students join in summer semester to prepare for the English language requirements.

Discuss what effects the actions described in (1) have had on the program. Use examples such as program visibility, market share, enrollment, faculty load, computer and other resources.

Offering courses in the evening has facilitated class scheduling during the day. It has also helped in making computer laboratory facilities more accessible to students as an "open lab" during the day.

How do the actions described in (1) advance or hinder program goals and priorities?

It has helped the students in their scheduling especially for transfer students.

F. CURRICULUM

The curriculum review section must also contain appropriate check sheets and example syllabi, which may be attached as an appendix.

1) **Program requirements. Describe and assess the program-related courses required for graduation.**

The program requirements are prescribed by the Michigan Occupational Code, PA 299 of 1980 - Article 20, Regulating Architects, Professional Engineers, Professional Surveyors; ABET's Engineering Accreditation Commission Program Requirements; and the University requirements for general education.

Islander

a) As part of the graduation requirements of the current program, list directed electives and directed General Education courses. Provide the rationale for these selections.

There is only one directed elective in the BS Surveying Engineering, SURE 331 Ethics and Professionalism in Engineering and Engineering Technologies. This is an approved cultural enrichment course taught jointly initiated by the Humanities and Surveying Engineering Departments. However, in 2010 Humanities Department pulled out of the support for the course. However, the Cultural Enrichment Committee of the General Education Task force has approved the course as satisfying the cultural enrichment component even after the Humanities Department pulled out of the course. The rationale for the course is that all surveying graduates must be aware of ethical issues with respect to the surveying and engineering practices. It is a required course by ABET. All other cultural enrichment and social awareness requirements are free electives. Other directed electives include PHYS 241 General Physics I, and PHYS 242 General Physics II and CHEM 121 General Chemistry.
For the two-year program, the cultural enrichment and social awareness requirements are free electives. The scientific understanding requirement of the program is GEOL 131 Geology and Land-Use. This is because of its relevance to the practice of the surveying profession.

b) Indicate any hidden prerequisites (instances where, in order to take a program-required course, the student has to take an additional course. Do not include extra courses taken for remedial purposes).

By virtue of ABET's Engineering Accreditation Commission requirements, the entry-level mathematics course is MATH 220 Calculus and Analytical Geometry I. Therefore, not all mathematics courses leading to MATH 220 Calculus I count towards graduation. Additionally, students who have not successfully completed chemistry in high school must take the Chem 103
Preparatory Chemistry course prior to enrolling in Chem 121 General Chemistry.

Has the program been significantly revised since the last review, and if so, how?

Since the last APR the following curriculum changes have been made:

- BLAW 221 Business Law was dropped. Critical elements of this course were already being taught or were incorporated into SURE 365 Legal Aspects of Surveying I and SURE 420 Professional Practice of Surveying. This reduced the total number of required credit hours by three.

- CONM 220 Statics and Structures was dropped and then replaced by a new course, CENG 240 Engineering Statics. CENG 240 is calculus based whereas CONM 220 was not. The change was made to better align course content with an engineering curriculum. The number of credit hours was reduced from four to three.

- SURE 272 Programming Applications in Geomatics was reconfigured from three lecture hours per week to one lecture hour and three lab hours per week. Having lab hours with the instructor present was a direct result of comments made on student surveys. Course content was modified to use MATLAB rather than Visual Basic allowing a much more comprehensive experience in programming. The number of credit hours was reduced from three to two.

- The result of these revisions has been a more rigorous degree program with five fewer credit hours. The 137 credit hours formerly required to graduate have been reduced to 132.

In addition to the above mentioned adaptations, minor changes have been made to course designators and numbers without changing the content. This was done to better align the course designators with what content was actually being delivered.

Those courses renamed or renumbered to reflect a Geographic Information Systems (GIS) content are:

SURE 325, Principles of GIS, is now GISC 225, Principles of GIS
SURE 339, Remote Sensing, is now GISC 239, Remote Sensing
SURE 425, Technical Issues in GIS is now GISC 425, Technical Issues in GIS

Those courses renamed or renumbered to reflect Civil Engineering content are:

SURE 220, Engineering Surveying, is now CENG 220, Engineering Surveying
SURE 331, Hydraulics Engineering, is now CENG 321, Hydraulics Engineering
SURE 421, Soils Engineering, is now CENG 421, Soils Engineering
SURE 480, Sustainable Land Use is now CENG 485, Sustainable Land Use

We have made changes to the capstone course SURE 485 in order to make it more reflective of the developments in industry.

Rationale: This is a capstone course where student projects culminate in utilizing computation and analytical skills they have acquired in previous courses throughout the curriculum. The addition of the three hour lab will provide for sufficient coverage of land use controls, land study and development design, site feasibility and utility service, site ecology, and social and psychological analysis of development, project preparation and student presentations. With the new format, the students will be exposed to real world experience and will have to work in collaboration with related industry.

All of the remaining Surveying Engineering designated courses have been reviewed. Although no changes in credit hours or contact hours have been made, most course descriptions and outlines have been revised to reflect the spirit of this revision which is better integration and inclusion of new topics that are relevant and deletion of those which are no longer relevant.

Are there any curricular or program changes currently in the review process? If so, what are they?

Not at this point.

Are there plans to revise the current program within the next three to five years? If so, what plans are envisioned and why?

The program courses are constantly monitored for their relevance and currency. It will take a few years before the full impact of the most recent revisions can be assessed. Meanwhile, other options to include another track in Geographic Information Systems (GIS) will be explored. Or addition of new course on hydrographic Surveying is possible.

G. QUALITY OF INSTRUCTION

1) Discuss student and alumni perceptions of the quality of instruction.

As noted in the compiled Current Student Survey (found in Section 2 of this report), the students seem to have very favorable of the curriculum.. In addition, they felt their faculty advisors were very helpful, and they felt that the surveying engineering faculty members were an asset to the programs. Results were somewhat mixed regarding courses from outside the curriculum. Program alumni (as found in the survey in Section 2) similarly felt that graduates were well- prepared for their career positions. Curricula, relevant coursework, and quality of faculty were all cited as positive elements of the programs.

Discuss advisory committee and employer perceptions of the quality of instruction.

The advisory committees surveys (Section 2) indicate that both the Surveying Engineering and the Surveying Technology programs provide excellent skills and training, have a high demand for graduates, and have excellent lab and teaching facilities. They note a need to change the full- time temporary position into a full time tenure track position.

What departmental and individual efforts have been made to improve the learning environment, add and use appropriate technology, train and increase the number of undergraduate and graduate assistants, etc.?

The learning environment has been vastly improved by the following activities:

- hiring of new faculty members and addition new equipment and software.

Describe the types of professional development have faculty participated in, in efforts to enhance the learning environment (e.g. Writing Across the Curriculum; Center for Teaching and Learning, etc.).

The faculty has been very active in professional development activities, with the overwhelming majority of these activities being at professional meetings and workshops. The information learned from these kinds of activities is brought back to the classroom and help the faculty member immeasurably in the education of the students. Faculty members have been involved in the following activities:

MSPS Annual Conference- several faculty routinely attend this conference and majority of our students also attend the conference.

ACSM Annual Conference – again several members have attended many of these meetings with one member being present at all conferences since the last program review. They have also given workshop in these conferences.

ASPRS Annual Conference and Fall Conference – some faculty members are attendance at all conferences since the last program review.

Faculty's participations in different activities are given in Faculty Resume given in Appendix A.

What efforts have been made to increase the interaction of students with faculty and peers? Include such items as developmental activities, seminars, workshops, guest lectures, special events, and student participation in the Honors Program Symposium.

There is a Burt Mullett Student Chapter of the American Congress on Surveying and Mapping (ACSM), which actively seeks speakers for weekly presentations on issues related to surveying profession. The majority of speakers come from Michigan and they represent large and small companies as well as the governmental agencies. Some of the speakers are from other parts of the country. Some of the speakers are alumni.

Faculty members also regularly attend the annual conferences of the Michigan Society of Professional Surveyors (MSPS) and the ACSM conference the American Society for Photogrammetry, and Remote Sensing (ASPRS). During these conferences, some faculty members give regular workshops and others attend the workshops related to their teaching responsibilities. They learn new technology, which they implement in their lectures. Some of the students also attend both the MSPS and ACSM annual conferences.

Discuss the extent to which current research and practice regarding inclusive pedagogy and curriculum infuse teaching and learning in this program.

Faculty members in the program subscribe to various professional and scientific journals related to surveying, geodesy, photogrammetry, GIS, GPS, etc. These publications along with the participation in annual conferences keep faculty members abreast with the changing technology
in the world of surveying and mapping. New courses are developed and old topics, which are not needed, are removed. The curriculum was completely overhauled in 2007. Individual faculty members incorporate the new technology as it becomes available and useful.

What effects have actions described in (5) and (6) had on the quality of teaching and learning in the program?

As stated above, we have completely overhauled our curriculum about a year ago to incorporate the changes in technology. We are awaiting the results from our last Accreditation Board for Engineering and Technology (ABET) reaccreditation visit in the fall of 2011.

H. COMPOSITION AND QUALITY OF FACULTY

Describe and assess the composition of the faculty teaching courses in the program.

1) **List the names of all tenured and tenure-track faculty by rank.**

a) **Identify their rank and qualifications**

Tenured faculty:

Professors: Khagendra Thapa, Ph.D.

Carl Shangraw, MS, PS

Assistant Professors:

Gabor Barsai, Ph.D.

Sagar Despande, MS, PE

b) **Indicate the number of promotions or merit awards received by program faculty since the last program review.**

Two of the four faculty have received merit increase in the last five years. Two faculty members are new.

c) **Summarize the professional activities of program faculty since inception or the last program review (attendance at professional meetings, poster or platform presentations, responsibilities in professional organizations, etc.)**

Program faculty members have been very active professionally, as shown in the accompanying vitae, which represent a wide array of activity in various types of venues. Some of the more significant professional activities are given as follows:

One faculty members has served on the State of Michigan Licensing Board for Professional Surveyors, and both have served as chair.

One faculty has been involved in the exam writing process by the National Council of Examiners for Engineers and Surveyors (NCEES). This organization is responsible for preparing, conducting, and grading the national examinations leading to licensure as a Professional Surveyor or Professional Engineer.

One faculty member has served as a program reviewer for the Accreditation Board for Engineering and Technology (ABET) and was also a Commissioner from 2008 to 2011 and was team chair for three different universities in Alaska, Oklahoma, and Texas.

Two faculty have served as reviewers for professional journals including the Journal of Surveying Engineering, Surveying and Land Information Science, and Photogrammetric Engineering and Remote Sensing.

The entire faculty has had peer-reviewed papers published, or presented papers and served as panelists at local, state, national, and international conferences.

All faculty members have served on various professional committees at the state and national level.
One faculty member is a licensed professional surveyor in two states and another one is a licensed professional engineer in one state.

Workload

a) What is the normal, annualized teaching load in the program or department? Indicate the basis of what determines a "normal" load. On a semester-by-semester basis, how many faculty have accepted an overload assignment?

The normal annualized teaching load, defined by the FFA contract, is 12/18 (12 credits or 18 contact hours) per semester. The entire faculty and the Program Coordinator/Dept. Chair have been teaching maximum loads. No faculty has ever refused to teach overloads, when there has been a need for overload teaching. We did have some overloads especially when we had our faculty group reduced from six full time to four full time.

b) List the activities for which faculty receive release time

The Surveying Engineering department faculty are engaged in many activities such as serving on professional boards and societies at state and national levels, serving as journal editors, student recruitment, just to name a few. They have not received any release time. For further details, refer to faculty vita section in the Appendix A.

Recruitment

a) What is the normal recruiting process for new faculty?

The recruiting process for faculty consists of:

The faculty as a group draft the qualifications for the position.

Consistent with the University's hiring policies, the position is advertised nationally in the appropriate surveying and mapping publications and is posted online.

The faculty reviews candidate applications and usually two or three finalists are then invited on- campus to visit and interview. During the interview, the candidates are required, among other things, to conduct an oral presentation.

After reviewing the candidates' references, a joint decision, made by the faculty to identify a ranked ordered list of the candidates, which is submitted to the Dean for possible hire.

b) What qualifications (academic and experiential) are typically required for new faculty?

Typically, the qualifications include a minimum of a master's degree in a field related to surveying and mapping, plus three to five years of professional experience in any of the surveying and mapping fields, and eligibility to seek licensure as a professional surveyor, in Michigan or any other state. The last faculty hired in the department was August of 2011 has master's degree in the discipline and has completed all the requirements for Ph.D. in the discipline. He is also a licensed engineer and certified Photogrammetrist.

c) What are the program's diversity goals for both gender and race/ethnicity in the faculty?

The surveying engineering department faculties are diversified ethnically (see faculty Vita section), however, due to the male dominant nature of the profession, at the current time, there is no female representation in the faculty group.

d) Describe and assess the efforts being made to attain goals in (c).

Efforts to attract females into the faculty group have (as of yet) not resulted in females being hired. For the reason stated above, (male dominance nature of the profession) there were female applicants for the position in 2011 and 2012. We offered the position to a female who had already accepted a position in another university. The other female did not have required credentials. In 2012 the female applicant did not have the required experience to be licensed..

Orientation: Describe and assess the orientation process for new faculty.

New faculty members receive extensive support from the University's Center for Teaching & Learning. The process is very effective as it includes, among other things, the following issues vital to teaching and learning:

Effective Teaching
How Students
Learn Preparing a
Course
Lecturing and Using Instructional Technology
Active Learning
Assessing Student Performance
Feedback and Grading

Reward Structure: e.g., salary, professional development funds, travel funds, UCEL and FSUGR incentive money

a) Describe the reward structure in the program/department/college as it relates to program faculty. Indicate the type of reward and eligibility criteria.

The Surveying Engineering faculty members are very active in state and national professional organizations and participate in professional development programs. The departmental travel budget of approximately $300 to $500 per person annually falls significantly short of meeting the needs of the department. However, the department faculty, as a whole, has received substantial funding support through the College to Technology's Faculty Development. Timme grants, the University-wide faculty research fund, and the external applied research funds that some of the faculty have applied in the past. Timme grants were refused to faculty in the program several times.

b) Does the existing salary structure have an impact on the program's ability to recruit and retain quality faculty?

If the current salary structure is maintained when new faculty are hired there will be no significant impact, however, if the current structure is compromised due to budgetary cuts, the impact will be significant.

c) Is the reward structure currently in place adequate to support faculty productivity in teaching, research, and service? If not, what recommendations would you make to correct the situation?

The current reward structure is adequate to maintain the status quo. Further initiatives will require additional compensation.

d) Is enhancing diversity and inclusion a component of the reward structure? Please explain.

No.

Graduate Instruction (if applicable): ***NOT APPLICABLE***

a) List all faculty teaching graduate courses.

b) What percentage of graduate courses is taught by non-tenure-track faculty? Please comment.

c) What are the program's (or department's) criteria for graduate faculty?

d) Have all graduate faculty (including non-tenure-track faculty) met the criteria? Please comment.

Non-Tenure-Track and Adjunct Faculty

a) **Please provide a list for the last academic year of full-time non-tenure-track and adjunct faculty who taught courses in the program. For full-time non-tenure track faculty, indicate the length of their appointments and the number of years of service at the University. Comment on the program's ability to retain non-tenure-track faculty.**

The Department has one full time adjunct faculty. The table below lists his teaching assignments in number of credits/number of contacts for each of the two semesters for the year 2011/12.

Faculty Name	Fall 2011	Winter 2012	Total
Nicholas Melvin	Part time	Part time	18/36

b) **What percentage of program courses is taught by the faculty in (a)? What courses are they teaching? Please comment.**

The adjunct faculty only teaches the first half of SURE 331 Ethics and Professionalism in Engineering and Technology Course. We had one section in fall semester and two sections in the spring semester.

c) **Describe the required qualifications (academic and experiential) for faculty listed in (a). Indicate if all faculty have met the criteria, and if not, what is being done to resolve the situation?**

The adjunct faculty is supposed to have a Ph.D. The one faculty we have been hiring was recommended by the Humanities Department. He only has a master degree. We understand that he has been working on his Ph.D. The first half of the course was used to be taught by them. However, they have decided to discontinue the practice.

Does the program consider the current use of non-tenure-track faculty to be appropriate? Why or why not?

Yes.

e) **If the program is accredited, what position if any does the accrediting body have regarding the use of non-tenured and adjunct faculty?**

The BS in Surveying Engineering program is accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (EAC/ABET). ABET's visiting teams in2011 have identified this as an item of weakness in faculty because we were going to have only three full time faculty. A "weakness" as defined by ABET, is that the program does not satisfies the requirements and therefore will not be accredited. However, the administration responded quickly and a new faculty was hired this summer and ABET has removed the weakness.

I. SERVICE TO NON-MAJORS

Describe and assess the impact that delivery of service courses offered by the program or the department has on the program.

a) Identify and describe the General Education service courses provided by the program faculty for other departments at FSU.

The Surveying Engineering Department offers one Cultural Enrichment designated course the SURE 331 Ethics & Professionalism in Engineering & Technology-3 cr. This course is jointly taught with an adjunct faculty as mentioned in above. This course is taken by students in Heavy Equipment Program, Automotive Engineering technology Program, Energy Systems Engineering Program, and many other programs in the College of Engineering Technology.

b) Identify and describe any non-General Education service courses or courses required for other programs. Comment on your interaction with the departments or programs for which the courses are provided.

The Surveying Engineering Department used to teach all sections of the Construction Surveying course (CONM 122 Construction Surveying and Layout) to the Construction Management program. However, two years ago, the faculty in that program decided to teach the course themselves. However, faculty from the Construction Management program teach two surveying courses (CENG 321 Soils Engineering and CENG 421 Hydraulics Engineering. The collaboration had provided wonderful interaction between programs. Since we just hired a faculty member with PE license, we plan to teach one or both of our courses by ourselves. Moreover, the Surveying Engineering Department offers certificate programs in GIS online. GISC 225 Principles of GIS is taken by students in Environmental Biology Program and Public Administration Program in the College of Arts and Sciences, Information Security Program in the College of Business, and some students in the criminal Justice Program also take this course.

c) Discuss the impact of the provision of General Education and non-General Education courses have on the program.

Since the number of service courses taught by our program is roughly equivalent to the courses taught by others for our students, there is no negative impact on the program.

d) Does the program plan to increase, decrease, or keep constant its level of service courses? Explain.

The Surveying Engineering program developed a proposal for new course, SURE 280 Fundamentals of Geodetic Science course and we were hoping to make it a general education, Scientific Understanding course. Nevertheless, the committee rejected the proposal since the course seems to be too unique and there were concerns that it would not be transferable. We are working on changing the course contents and title of the proposed course to match courses in other community colleges.

J. DEGREE PROGRAM COST AND PRODUCTIVITY DATA

Submit Institutional Research and Testing data. Comment on the data.

Student Credit Hours				
Year	**Summer**	**Fall**	**Winter**	**F+W(a)**
2008-09	0.00	0.00	1088	1088
2009-10	75	911	1041	1952
2010-11	75	806	1010	1816

Full Time Equated Faculty				
Year	**Summer**	**Fall**	**Winter**	**Ave F+W(b)**
2008-09	0.00	0.00	6.92	6.92
2009-10	1.25	6.18	6.26	6.22
2010-11	0.5	4.32	4.87	4.6

SCH/FTEF				
Year	**Summer**	**Fall**	**Winter**	**F+W(a/b)**
2008-09			157.14	314.27
2009-10	60.0	147.40	166.28	313.80
2010-11	150.0	186.36	207.43	395.04

K. ASSESSMENT AND EVALUATION

Describe and evaluate the program's assessment mechanisms.

1) List and describe what variables are tracked and why when assessing the effectiveness of the program (e.g. mastery of essentials of subject area, graduation rates, employment rates, pass rates on professional exams).

Variables used to track program effectiveness are:

a) ABET Accreditation and the Michigan Board of Licensing Recognition

The State of Michigan Board of Licensing for Professional Engineers recognizes the Accreditation Board for Engineering and Technology (ABET) accreditation as meeting the educational requirements for licensure as a professional engineer. The Surveying Engineering program at Ferris is one of a few surveying engineering programs in the nation with Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (EAC/ABET) accreditation.

In the summer of 2004, the Michigan Board of Licensing for Surveying approved the revised curriculum of the Surveying Engineering program at Ferris as meeting the standard for licensure as a Professional Surveyor in the State of Michigan.

b) Licensing Examination Results

This has been a key indicator of the relevance and quality of the Surveying Engineering program. The program graduates have performed well in the National Council of Examiners for Engineers and Surveyors (NCEES) Fundamentals of Surveying (FS) examination which is taken during the last semester of the senior year.

T

he following table gives the detail results for our graduates for the last five years.

Fundamentals of Surveying (FS) Exam					
	Ferris State University Graduates				
Exam Administration	Number of Examinees	Number Passing	**Percent Passing**		
Spring 2007	15	15	**100%**		
Fall 2007	1	1	**100%**		
Spring 2008	19	18	**95%**		
Fall 2008	4	4	**100.0%**		
Spring 2009	11	10	**91%**		
Fall 2009	1	1	**100.0%**		
Spring 2010	17	16	**94%**		
Fall 2010	2	2	**100.0%**		
Spring 2011 (0404)	14	14	**100%**		
Fall 2011 (0410)	2	1	**50.0%**		
Spring 2012	13	12	**92%**		

Source: NCEES

c) Placement Surveys

Placement surveys are conducted by the Ferris Placement Office of graduating seniors to determine how many have found employment in their areas of study and at what rate of compensation.

A downward spike could be seen in starting salaries for the 2008-2009 graduating class. It is believed that this was caused by the state of Michigan’s economy. Starting salaries achieved by current graduates is encouraging.

Placement rates continue to be 100% reflecting the confidence the employers have in Ferris Surveying Engineering graduates from Ferris.

d) Constituent Surveys

Constituents' surveys were taken of students, alumni, faculty, employers, and advisory committee members.

Provide trend data for the variables listed in (1). Compare the data to accreditation benchmark standards if applicable, or provide some other type of assessment of the data.

A) ABET Accreditation and the Michigan Board of Licensing Recognition

a) The guiding principle behind the Accreditation Board for Engineering and Technology /Engineering Criteria 2000 (ABET/EC 2000) and the evaluation process is to ensure that graduates of an accredited program such as the Surveying Engineering program at Ferris are prepared to enter the surveying engineering profession. Moreover, their education should prepare them for the changes that will occur within the profession.

In order for the Surveying Engineering program to be viable, the program must impart an education that is:

Relevant and practical to students for preparing them for their professional lives and careers as well as for lifelong learning involving both formal programs and hands-on experience;

Attractive and challenging in the sense that the challenge, excitement and intellectual content of the program will attract talented students with a wider variety of backgrounds and career interests--particularly women, under-represented minorities, and will empower them to succeed in their professional lives.

connected and useful in the sense that the program has incorporated practical and useful courses which address the needs of the surveying profession through integrated activities with other parts of the educational system, students, alumni, advisory committee, and employers.

The Surveying Engineering program at Ferris State University has evolved in the last 48 years. During this period, even prior to the introduction of the EC 2000 criteria, the consistent and overriding goals have been to provide an education that is relevant, useful, practical, attractive, and connected to protect the health, safety and welfare of the public. Moreover, the program has incorporated the requirements of the State of Michigan Professional Surveyor Licensing Board so that the graduates are prepared to seek licensure if they so desire. The main emphasis has always been upon a rigorous, theoretical education combined with heavy practical use of the theoretical base. In addition, the majority of the program graduates have worked in the field either full time during summers or prior to starting their education at Ferris.

The Desired student Outcomes of the Surveying Engineering Program are repeated here for convenience:

1. A broad education and knowledge of contemporary issues necessary to understand the impact of surveying engineering solutions in a global, societal, and environmental context. (EAC/ABET Criteria 3d, c, h, j) (Program Educational Objectives B and C)
2. An ability to solve surveying engineering problems in practice by applying fundamental knowledge of mathematics, statistics, science, and by using modern surveying engineering techniques, skills, and tools. (EAC/ABET Criteria 3a, k) (Program Educational Objectives A and D)
3. An ability to identify, formulate, and solve surveying engineering problems, particularly the planning, design, establishing horizontal and vertical control, land use design, boundary determination, mapping and field layout of infrastructure that meet standards of accuracy and precision, keeping in mind cost, time, safety and quality needs, and objectives. (EAC/ABET Criteria 3c, e) (Program Educational Objectives A, B and D)
4. An ability to design and conduct experiments and to analyze and interpret data in engineering surveying, topographic surveying, geodetic surveying, and boundary surveying. (EAC/ABET Criteria 3b, j, k) (Program Educational Objectives A and D)
5. An ability to communicate technical material written papers/reports and oral presentations. (EAC/ABET Criterion 3g) (Program Educational Objective C)
6. An ability to function within multidisciplinary teams. (EAC/ABET Criterion 3d) (Program Educational Objective C)
7. An understanding of professional, societal, and ethical practice and responsibilities. (EAC/ABET Criterion 3f) (Program Educational Objectives B and C)
8. A recognition of the importance of professional licensure and a recognition of the need for, and an ability to engage in, life-long learning. (EAC/ABET Criterion 3i) (Program Educational Objectives C and D)

Description of How the Program Outcomes Relate to the Outcome Requirements of ABET Criteria 3, EC 2000

Closing the Loop

ABET Evaluation of a-k criteria

ABET's EC 2000 lists thirteen criteria by which programs are accredited. The EC2000 documents list these alphabetically, "a" through "k". For consistency, the same nomenclature is used here.

Criterion 3a: An ability to apply knowledge of mathematics, science and engineering

Program course requirements that meet this criterion by definition are given below:

Mathematics	Science	Engineering	
MATH 220	CHEM 121	CONM 121	GISC 239
MATH 230	GEOL 131	CONM 221	SURE 340
MATH 322	PHYS 241	SURE 110	SURE 421
SURE 372	PHYS 242	SURE 215	GISC 425
SURE 373		CENG 220	SURE 440
		SURE 230	SURE 452
		SURE 321	SURE 453
		GISC 225	SURE 485

The following table shows the relationships between program outcomes and ABET criteria.

Relationship Among Program Outcomes and ABET Criteria

Criterion	Outcome						
	1	2	3	4	5	6	7
3a.	X	X	X	X			X
3b.	X			X			X
3c.	X	X	X	X			X
3d.			X		X		
3e.		X	X				X
3f.	X		X			X	X
3g.					X	X	X
3h.	X	X	X			X	X
3i.	X					X	X
3j.	X				X		X
3k.		X	X			X	X

The sequence of courses students pursue develops the capacity to use mathematics and science in upper level engineering courses. Figure 3-1 portrays the relation among courses and the outcomes. Note that outcome seven relates to the majority of the courses; therefore, is not indicated in the critical path diagram in Figure 3-1. The numbers shown above in Table 3-1 along the horizontal lines indicate the outcome numbers. For example, the first horizontal line, which includes the required courses GEOL 131 Geology and Land Use Management, and CHEM 121 General Chemistry satisfy the requirements of outcome numbers 2 and 4. Similarly, the last horizontal line covers all the cultural enrichment courses including SURE 331: Ethics and Professionalism in Engineering Technology satisfy the outcome numbers 1 and 6.

Criterion 3b: An ability to design and conduct experiments, as well as to analyze and interpret data

An ability to design and conduct experiments is an integral part of a selected science courses, specifically CHEM 121 General Chemistry, PHYS 241 General Physics 1 and PHYS 242
General Physics 2. These courses set the stage for discipline specific experimental opportunities in CENG 321 Hydraulics Engineering, and CENG 421 Soils Engineering.

The analysis and interpretation of statistical data are integrated into most Surveying Engineering courses. Beginning with SURE 110 Fundamentals of Surveying, students are taught the relationships between surveying engineering operations and the quality of those operations as determined by rigorous numerical analysis. Each succeeding course builds upon the last culminating in SURE 373, Adjustment Computations II, which forms the cornerstone for the higher-level geodesy and photogrammetry courses. Students are taught that each surveying operation, whether establishing control, determining boundaries or designing a Geographic Information System, requires identifying standards to be met, developing specifications to meet those standards then analyzing the results to insure compliance.

Assessments are part of the normal course evaluations. These assessments include student participation, quizzes, laboratory exercises, reports, term papers, and examinations leading to a course grade.

Criterion 3c and 3e: An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, health and safety, manufacturability, and sustainability.
An ability to identify, formulate and solve engineering problems

Design of safe, cost effective processes that will support predetermined survey standards and specifications is the core of the field course sequence of SURE 110 Fundamentals of Surveying, CENG 220 Engineering Surveying, SURE 230 Advanced Surveying, SURE 272 Program Applications in Geomatics, SURE 452 Geodesy 1 and SURE 453 Geodesy 2 introduces students to computer program design using an object oriented, high level language. Students are expected to produce executable routines capable of solving the more common surveying engineering problems.

CENG 321, Hydraulics Engineering, combines hydrology and hydraulics and includes gravity drainage and pressure water supply system design. SURE 421, Soils Engineering explores soil classification systems, weight-volume relationships, permeability, flow nets, dams, lateral earth pressures, shear stresses, loads on buried conduits, slope stability and foundations.

GISC 225 Principles of GIS and GISC 425 Technical Issues in GIS & Cartography explore the fundamental principles of Geographic Information Systems and focus upon system design. The photogrammetry course sequence of SURE 340 Photogrammetry and SURE 440 Advanced Photogrammetry coupled with GISC 239 Remote Sensing, combine theory and practice to the design of different kinds of maps and mapping systems.

SURE 373 Adjustments Computations 2, SURE 452 Geodesy 1 and SURE 453 Geodesy 2 introduce students to Geodesy and Geodetic network design. Topics include determining the size and shape of the earth, exploration of dynamic physical forces such as gravity and orbital mechanics, establishment of datums, map projections and coordinate systems, satellite geodesy, and extensive use of the Global Positioning System, control network design analysis and adjustments.

SURE 366 Evidence & Procedures for Boundary Location and SURE 465 Legal Aspects of Surveying 2 combine the design engineering aspects of surveying with the legal aspects to determine the location of boundaries.

The program culminates in SURE 485, Sustainable Land Use. This is the Capstone course in which students create a detailed development plan integrating the principles of engineering design, environmental concerns, social and psychological aspects within a framework of sustainable development.

Criterion 3d: An ability to function on multi-disciplinary teams

Students work in teams of two, three, or four in the following surveying courses: SURE 110 Fundaments of Surveying, CENG 220 Engineering Surveying, SURE 230 Advanced Surveying, SURE 325 Principles of GIS, SURE 425 Technical Issues of GIS & Cartography, SURE 440
Advanced Photogrammetry, SURE 452 Geodesy 1, and SURE 453 Geodesy 2.

The Surveying Engineering program incorporates several sub disciplines including CAD, computer programming, business aspects, professional ethics, global consciousness, social awareness, cultural enrichment, and issues of race, ethnicity, and gender.

SURE 331, Ethics and Professionalism in Engineering and Technology is team taught by Surveying Engineering and Humanities instructors.

Criterion 3f: An understanding of professional and ethical responsibility

Honesty, loyalty, and integrity are hallmarks of the professional surveyor and therefore these traits are expected of all students and faculty members in all aspects of the educational experience.

SURE 331, Ethics and Professionalism in Engineering and Technology deals specifically with codes of ethics adapted by surveying and engineering societies; explains the meaning and attributes of professionalism along with the ethical, moral and social responsibilities of engineers; discusses standards, law, safety, risks, professional obligations, loyalty, client relationships, global awareness and intellectual property.

SURE 365, Legal Aspects of Surveying I, SURE 366, Evidence & Procedures for Boundary Location and SURE 465, Legal Aspects of Surveying 2 define the quasi-judicial role of the professional surveyor in society. SURE 420, Professional Practice of Surveying stresses the legal obligation to comply with contractual and statutory requirements along with the moral obligation to provide for a decent standard of living for the professional's family and employees.

Membership and active participation in professional societies is encouraged. The Surveying Engineering program provides students opportunities to become involved in student professional and honor society memberships. The Burt and Mullett Student Chapter, affiliated with the American Congress on Surveying and Mapping (ACSM), and the Mary Feindt Chapter of Lambda Sigma are two such organizations designed to foster professional and ethical responsibilities. Student attendance at the annual Michigan Society of Professional Surveyors (MSPS) conference has increased significantly since the last Accreditation Board for Engineering and Technology (ABET) visit and this year the number of Ferris student participants exceeded 50. For each of the past six years there has been Ferris student representation at the annual American Conference on Surveying and Mapping (ACSM) conference. Students have actively participated in conferences sponsored by both organizations by staffing booths and assisting with presentations.

Criterion 3g: An ability to communicate effectively

The following are the fundamental modes of human communication:

1. Graphicacy
2. Articulacy
3. Literacy
4. Numeracy

Communication is the essence of professional surveying. A map communicates features and relative locations, stakes communicate alignment and grade, and monuments communicate the limits of property ownership. The professional surveyor must be able to communicate using all of the above stated modes of communication to a variety of constituents such as clients, partners, superiors, subordinates, attorneys, contractors, business associates, government officials, or the public at large. Students develop the ability to communicate as individuals and as members of teams in a variety of ways. Since Graphicacy is the most powerful mode of communication and it is also an important mode of communication that students learn, it is presented first in the discussion below.

Using Graphics

At the lowest levels, students are required to take the SURE 115 Introduction to Computer Mapping introductory course to Computer Assisted Drafting using AutoCAD and integrated surveying oriented CAD.

Students are introduced to a variety of GIS and photogrammetric mapping software packages throughout their tenure.

Students learn and use graphical systems such as those developed by AutoCAD and C & G software in the 100 level and 200 level field courses and in the capstone design course and in virtually all of the remaining engineering design courses.
An emphasis is placed upon proper field note procedures in the 100 and 200 level field courses and their value as evidence in the legal aspects courses.

Physically

Proper placement and marking of stakes is stressed in the 100 and 200 level field courses. Field targeting strategies are discussed in photogrammetry and remote sensing courses. Requirements for monumentation are studied in geodetic control, legal aspects and the Sustainable Land Development courses.Evaluation of monuments as evidence forms a significant portion of the legal aspects courses.

Using Oral Communication

All students are required to take COMM 121, Fundamentals of Public Speaking.

Oral presentations are required in the Geodesy, Photogrammetry, Ethics, and Professionalism, Professional Practice, and GIS courses.

Students are encouraged to make public presentations as part of their professional activities.

Literacy (Writing)

The two English courses, ENGL 150 English 1and ENGL 250 English 2 form a sequence focusing upon research and upon organizing and developing papers for diverse audiences.

Three surveying engineering courses, SURE 365 Legal Aspects of Surveying 1, SURE 465 Legal Aspects of Surveying 2 and SURE 420 Professional Practice of Surveying are designated by the university as writing intensive. SURE 365 Legal Aspects of Surveying 1 and SURE 465 Legal Aspects of Surveying 2 both include writing fully documented essays about current legal topics relating to surveying focusing upon substance, organization, style and correctness. Students prepare a number of legal property descriptions in various formats. SURE 465 Legal Aspects of Surveying 2 includes six legal case studies. SURE 420 Professional Practice of Surveying requires essays on topics relating to the professional practice of surveying as well as the preparation of “point papers” where students are required to take a stand and defend a position. SURE 420 Professional Practice of Surveying and Legal Aspects of Surveying 2 require project reports. All three courses require extensive use of memoranda and formal business letters.

Term papers are assigned in the GIS, Photogrammetry, and Geodesy courses.

Numeracy

The students must have completed all pre-calculus level courses including advanced algebra and trigonometry even before they are admitted to the program. Besides, they extensively use math to solve problems right from SURE 110 Fundamentals of Surveying to all the way to the capstone course. Therefore, the graduates are very proficient in the use of numeracy as a means of communication.

Criterion 3h: The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

The Surveying Engineering program is committed to providing students with a broad education necessary to understand the impact of surveying engineering solutions in a global, societal, and environmental context consistent with the principles of sustainable development. Strong emphasis is placed upon four areas; academics, professional development, practical experience and stewardship.

Academics

The Bachelor of Science Degree in Surveying Engineering is designed to incorporate professional surveyor licensing requirements of the State of Michigan, professional engineering, and design requirements of the Accreditation Board of Engineering and Technology (ABET)and cultural enrichment and social awareness requirements of Ferris. Key to successful integration is a focus on balance; balance of the theoretical with the practical, balance of the science with the arts, balance of the individual with the whole. Graduation from this program requires 137 semester hours with a minimum 2.0/4.0 grade point average. The course of study is long, rigorous, and challenging and gives graduates a sense of pride and accomplishment along with the confidence and self-assurance that they will make their marks on the world.

Professional Development

Active student participation in professional societies has been discussed. Implicit in all courses and explicit in the legal aspects and professional practice courses is the fact that formal education as a professional surveyor does not end with a baccalaureate degree. Formal education as a professional surveyor begins with a baccalaureate degree. Since the last Academic Program Review, at least six Ferris graduates have graduated with Master of Science degrees in Surveying Engineering from several universities in USA and Canada.

Ferris graduates appear in substantial numbers at local, state, and national survey meetings and conferences. Ferris faculty play a significant role and provide seminars to practicing professionals and offer distance learning opportunities over the Internet and at remote locations such as Grand Rapids, Michigan.

Practical Experience

Ferris graduates must be ready to assume entry-level positions in a “hit the ground running” mode. No program, however, will ever provide all of the tools for all of the graduates to assume all of the roles demanded by all of the constituents. What this program can do and does well is partner with government and industry to meld theory with practice and thus establish a framework within which the individual as well as the profession may grow.

This program makes every effort to provide students with employment in the profession during vacation periods in both public and private sectors. Current demand for students far exceeds supply. Every student who seeks employment gets it. Several graduates and current students
have interned with the Bureau of Land Management, Department of the Interior. Several students spent summers in the past five years with the Michigan Department of Transportation and the National Geodetic Survey observing a vertical control network and GPS control throughout the State of Michigan. There are numerous opportunities for part time and summer jobs for every student.

Stewardship

Surveying Engineering students are involved in a host of activities designed to afford the opportunity to give back to the community. Among the many activities that students volunteer to participate in are blood drives, the Big Brother/Big Sister program, tutoring, volunteering to lay out Habitat for Humanity homes, Boy Scouts, and Roll-A-Thons.

Criterion 3i: A recognition of the need for, and an ability to engage in life-long learning

The volume of writing and research requirements force students to look outside of class notes and textbooks in seeking answers to complex questions as will be required of them as practicing professionals.

Students are strongly encouraged to find employment with surveying/engineering companies during vacation periods and summers to meld theory with practice. Rapid technological change coupled with the increased size and scope of projects being undertaken by the private sector bring home the need for constant continual upgrading of knowledge and skills to remain competitive.

Through active participation in professional societies, students learn the importance that practicing professionals put on continuing competence.

On many Tuesday mornings at 11:00 – 12:00, a number of professionals present seminars to the students. The Burt Mullett Student Chapter of ACSM arranges this activity.

The program focuses on providing sufficient skills for entry-level employment, graduate studies and continued professional competence. As stated above, several graduates have earned postgraduate degrees in geodesy, photogrammetry, business, and law.

Criterion 3j: A knowledge of contemporary issues

The university requires that students complete at least one course in three designated areas: social foundations, global consciousness, and race, ethnicity and gender issues.

The cause and effect relationship between society and engineering is stressed in the capstone course, the legal aspects courses, and the professional practice course. Senior students subscribe to the Wall Street Journal and are required to prepare a series of position papers as part of SURE
420 Professional Practices of Surveying.

Criterion 3k: An ability to use the techniques, skills and modern engineering tools necessary for engineering practice

Strong emphasis is placed on computer applications in all facets of the program

Computer hardware and software are continually being

upgraded. State-of-the-art field equipment is acquired on an

annual basis.

The curriculum is designed to provide integration of different subjects and the exposure to the major areas of surveying practice.

Description of How the Program Outcomes Relate to the Program Educational Objectives

Program educational objectives have been listed previously and are repeated here for convenience.

A. Program graduates will apply communication skills, lifelong learning attitude, and the knowledge of mathematics and basic science to attain advancement within the surveying profession.
B. Program graduates will exhibit creativity, leadership and team-building abilities, cultural appreciation and an understanding of global, societal, and environmental context consistent with the principles of sustainable development.
C. Program graduates will be engaged in the professional practice of surveying engineering with high ethical and professional responsibilities.
D. The program graduates will strive for professional licensure.

The Relationships Among Program Outcomes and Program Objectives

The relationships between program outcomes and program objectives are shown below.

Relationship of Program Objectives to Program Outcomes

Objective	**O**							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
A		X	X	X	X	X		X
B	X		X				X	
C	X		X	X		X	X	X
D		X	X	X				X

Program Educational Objective A

Program graduates will apply communication skills, lifelong learning attitude, and the knowledge of mathematics and basic science to attain advancement within the surveying profession.

All student outcomes except 1 and 7 support this objective. The scope of the profession of surveying engineering continues to expand in both breadth and depth. Constituents demand both knowledge and creative ability with excellent communication skills. Each project encountered in practice brings with it a requirement for the right experience, the right theoretical knowledge, and the right skills all in the right mix. The first two years of the program focus upon fundamental knowledge of sciences, mathematics, engineering, and hands on experience at the technical level. The upper division courses develop and integrate theory and practice at the professional level.

The formal education of a professional surveyor begins with a baccalaureate degree integrating theory with practice, science with art, the individual with the community thus preparing the student for the critical social role the surveyor plays in land use, infrastructure design, and environmental resource management. Surveyors are leaders and therefore must be able to form a vision, to communicate that vision, and to have the strength of character to implement that vision.

This program is designed for students to take the first step in their professional careers and to provide the foundation upon which further steps will be taken. Those further steps must include continuing competence integrating formal education, conferences, seminars, and professional practice. Graduate level education in the theoretical aspects of surveying engineering, management, and business administration is not only becoming more common, but is being recognized as becoming more critical.

Program Educational Objective B

> **Program graduates will exhibit creativity, leadership and team-building abilities, cultural appreciation and an understanding of global, societal, and environmental context consistent with the principles of sustainable development.**

Outcomes 1, 3, and 7 support this objective. The cultural enrichment and social awareness courses required for the curriculum are intended to support this objective. To provide breadth, these courses must be taken in different areas. To provide depth, at least one cultural enrichment course must be taken at the 200 level. Selected courses are designated as addressing global consciousness, social awareness, cultural enrichment, and issues of race, ethnicity, and gender are integrated.

Team building is emphasized at all levels in the general sciences field, surveying, and engineering courses. Students are divided into teams of two or more members. Positions on those teams are rotated to develop both leadership and support roles. Students learn quickly that their success will be measured to a great extent upon their creative ability to identify problems, develop solutions, then execute those solutions as team members and as effective leaders.

The program contains two recognized student organizations, The Burt and Mullett Chapter of ACSM and Mary Feindt Chapter of Lambda Sigma honors society. Both organizations are very active on campus, in the community and within the profession. No single person may hold an office of president and vice president simultaneously in both organizations, thus affording maximum opportunities for primary leadership roles. Numerous ad-hoc committees are formed fostering and nurturing team efforts.

Program Educational Objective C

> **Program graduates will be engaged in the professional practice of surveying engineering with high ethical and professional responsibilities.**

All outcomes except 2, and 5 support this objective. A broad education must meld theory with application. This program receives unparalleled support from industry in the form of surveying equipment and computer software and hardware. Section 4 and Appendix A of this report detail the inventory of instruments. The program has a course SURE 331 which emphasizes on high ethical standards and professionalism. In addition, other courses such as SURE 420 Professional Practice also emphasize the importance of professional responsibilities.

There is more to education, however, than button pushing. Technology provides a means to the desired end. It is not the end in itself. Focus is, therefore, on determining the desired end state and on matching the tools, methods, and procedures to achieve that desired end state.

Program Educational Objective D

The program graduates will strive for professional licensure.

Outcomes 2, 3, 4 and 8 support this objective. All surveying courses address the topics included in the National Council of Examiners for Engineers and Surveyors (NCEES) fundamentals of surveying examination. This test is taken by students in the last semester of their studies.

The State of Michigan requires that *"For admission to the professional surveying fundamentals examination, an applicant shall provide an affidavit stating that a degree acceptable to the board shall be completed no later than six months after the date of the examination."*

B) Licensing Examination Results

The "pass" rate of Ferris State University students on the Fundamentals Surveying Intern examination for the past several academic years is shown in the table below. The results from the table show that the lowest passing rate was 50% and the highest rate was 100%. Please note that the 50% passing rate was when there were only to students taking the test and one failed. On the whole, our passing rate is 95% or higher.

Percentage of FSU Graduates Passing Fundamentals of Surveying Exams

Fundamentals of Surveying (FS) Exam					
	Ferris State University Graduates				
Exam Administration	Number of Examinees	Number Passing	**Percent Passing**		
Spring 2007	15	15	**100%**		
Fall 2007	1	1	**100%**		
Spring 2008	19	18	**95%**		
Fall 2008	4	4	**100.0%**		
Spring 2009	11	10	**91%**		
Fall 2009	1	1	**100.0%**		
Spring 2010	17	16	**94%**		
Fall 2010	2	2	**100.0%**		
Spring 2011 (0404)	14	14	**100%**		

Fall 2011 (0410)	2	1	**50.0%**		
Spring 2012	13	12	**92%**		

Data Source: NCEES

C) Placement Surveys

Placement surveys are conducted by the Ferris State University Placement Office of graduating seniors to determine how many have found employment in their areas of study and at what rate of compensation. The results of the past several years are reflected below.

Placement Rates and Starting Salaries
FSU Surveying Engineering Graduates

Academic Year	Placement Rate	Starting Salary $
2006-2007	100%	45,018
2007-2008	100%	45,243
2008-2009	100%	Not available
2009-2010	100%	Not available
2010-2011	100%	43,000

The average starting salary figure for 2010-2011 graduates revealed a downward spike. The reason for this downward spike is believed to be the overall state of Michigan's economy, where the majority of our graduates have found work. The fact that 100% of our graduates have found employment is encouraging.

D) Constituent Surveys

Constituents' surveys were taken of students, alumni, faculty, employers and advisory committee members. See Section 2 for detailed results.

Describe how the trend data in (2) is used to assess the rigor, breadth, and currency of the degree requirements and curriculum.

Description of the process used to assure that graduates have achieved the program outcomes

At Ferris State University, strategic planning based upon outcomes and assessment is conducted at all levels; university, college, department and program. The process is based upon this strategic planning model.

Educational objectives are formulated and related outcomes

developed. Future direction is assessed in light of the strategic vision.

Educational enhancements and curriculum development initiatives are implemented.

Feedback is sought on curriculum content and delivery from constituent surveys including students, alumni, employers, faculty, and the advisory committee.

Future direction is assessed in light of the feedback from constituent surveys.

This section will focus upon the processes utilized and developed to measure program outcomes.

Describe how the trend data in (2) is used to assess the extent to which program goals are being met.

Application processes by which assessment results are applied to further develop and improve the program vary depending upon the nature of the proposed improvement.

Improvements depending upon significant capital outlays or creating new positions are identified and prioritized on Unit Action Plans. Implementation approval is delegated at various levels of authority.

Changes in curriculum or course content are proposed at the program level. Proposed changes require approval by program, college and university curriculum committees, the faculty senate and the Office of the Vice-President of Academic Affairs.

At the program level, the strategic planning process involves the cycle of identifying needs, proposing recommendations, obtaining approvals, implementing changes, evaluating and then identifying needs.

Input for identifying needs may come from a variety of sources, e.g., proposed objectives and outcomes, constituent surveys, evaluation results, the market conditions, the advisory committee, an individual student or faculty member, etc. Before a recommendation is developed or proposed an evaluation of the effect of that proposed improvement is made. Topics of consideration may include:

Required technological infrastructure needed to support the improvement. Additional personnel needed to support the improvement.

Financial resources needed to support the

improvement. Analysis of expected benefits relative

to costs.

Time that the proposed improvement will take to implement.

Time that the proposed improvement will take from other areas of the program.

After consensus is reached by faculty members, the proposed improvement may be implemented immediately if appropriate or identified on a Unit Action Plan or submitted to the appropriate department, college or university committee.

When approval is granted and resourced, the improvement is implemented.
After examining the input from the complete survey performed in 1999 and 2000, we have added one more objective and corresponding outcome. From the experience we have gained in the last six years we have decided to conduct the following surveys:

Survey Frequency	
Every Year	**Every Five Years**
Student surveys	Alumni survey
Graduate surveys	Employer survey
Advisory Committee surveys	
Faculty surveys	

L. ADMINISTRATION EFFECTIVENESS

1) Adequacy of Administrative and Clerical Support

Administrative and Clerical Support

Administrative and clerical support is currently adequate but one important issue must be addressed, that is the equipment room technician position.

This position is for 32 weeks with no benefits. The individual assigned is responsible for the care, security, availability, accountability, and minor maintenance of well over $3 million worth of state-of-the-art surveying equipment. In addition, this individual assists with major projects such as accreditation reports, academic program review and those endeavors of individual faculty members. This person is very active in supporting student activities in professional societies, assisting faculty with teaching students the proper care and handling of equipment, insuring that adequate lab supplies are on hand and available and a host of other duties too
numerous to mention. This position needs to be reclassified and the assigned individual offered a decent benefits package.

Efficiency of Department/Program Management

Program Management

The Surveying Engineering and Surveying Technology programs are currently managed by a program coordinator with assistance from School Director, a faculty member is given 25% release time during the academia year and a summer stipend of $5,000. This organizational model currently does not serve the program well. Release time is inadequate to perform the myriad duties and responsibilities of the position. The summer stipend is grossly inadequate given the amount of time required. The new administrative is very inefficient and needs to revert back to what it used to be. In fact, our enrollment decline coincided with the restructuring of the College of Engineering Technology. Twenty five percent release time for some in charge of the program is not enough to support the program especially when it takes at least two hours to talk to a student and family visiting the campus.
The Surveying Engineering faculty meets weekly with major decisions made by consensus.

Are class and teaching schedules effectively and efficiently prepared? Please comment.

Class and Teaching Schedules

Developing a class schedule for any given semester has to be the most daunting task facing the program. Classroom and lab spaces are at a premium during normal teaching hours. Schedules for support courses offered by other colleges within the university must be made known in advance and these often take up "prime time." Many courses must be taken in sequence and conflicts in at least block schedules must be avoided. Individual faculty preferences while taken into consideration often cannot be granted which in some cases causes morale issues.

Are students able to take the courses they need in a timely manner? Please comment:

Students Ability to Take Required Courses in a Timely Manner

Critical to a student's ability to graduate when projected is the student's relationship with the advisor. Advisors make every attempt to get and keep students on track. As hard as advisors try, it is still the role of the advisor to advise and the role of the student to follow through. Certain students still find ways to short circuit the system causing themselves to fall out of sequence. Others will fail to meet minimal requirements in a prerequisite course.

Like any engineering degree, math requirements for surveying engineering begin with MATH 220 Analytical Geometry and Calculus I in the first semester of the first year. Many new students for a variety of reasons simply are not ready. For this reason the Surveying Engineering faculty revised the Surveying Technology (AAS) degree so that every course taken for the associate's degree would count toward the bachelor's degree. This provides the student deficient in mathematics the opportunity to gain competence while still working toward the BS degree.
When the student is ready for calculus, a change of program is initiated.

Section 4: Facilities and equipment

A.INSTRUCTIONAL ENVIRONMENT

1) Are current classrooms, labs, and technology (both on-campus and at off-site locations) adequate? Explain.

The following classroom space is available for instruction:

1) Computing Laboratory Swan 206 - 1000 sq. ft.

2) Photogrammetry and GIS Lab, Swan 201- 1980 sq. ft.
Surveying Engineering Classroom Swan 211 - 930 Sq. ft.; with a large screen, projector, and computer available to facilitate computer instruction.

3) Surveying Engineering Classroom Swan 207 - 1100 Sq. ft., with a large screen, projector, and computer available to facilitate computer instruction.

4) Surveying Instrument Room Swan 209 - 600 sq. ft. This area houses all the surveying and surveying related equipment, and also has an equipment dispensing area with counter as well as office space for the dispensing personnel. Space in this vital component is barely adequate.

Swan 211 and Swan 207 classrooms serve the Surveying Engineering program for teaching and other related activities. Both rooms were completely renovated during the Christmas recess of
2005-2006. They are located close to the surveying instrument room, and are convenient for teaching courses which require actual equipment demonstration. The classroom furnishings and space are more than adequate. Classrooms, laboratories, equipment, and infrastructure are up-to- date and provide excellent support to accomplish program objectives. Survey instruments, photogrammetry instruments, and support equipment available to the faculty and students are both modern and representative of the surveying and mapping industry.

University funding, industrial consignment and donations, government funding by the National Geospatial Intelligence Agency and Mapping Agency have enabled the department to acquire many sophisticated surveying instruments, computers, and software. As a result, the program has maintained modern and advanced surveying and mapping laboratories.

Major Surveying Instruments

Instrument	Manufacturer	Condition	Method of acquiring
6 GPS system 1200. (with RTK ability) and with SKI-Pro software	Leica Geosystems	New	Provided on a consignment basis annually
6 GPS 5800 RTK Surveying System	Trimble	New	Provided on a consignment basis annually
6 new robotic total stations, TCR 1250	Leica Geosystems	New	Provided on a consignment basis annually
Six digital levels (DNA10)	Leica Geosystems	New	Provided on a consignment basis annually
25 tripods	Leica Geosystems	New	Bought after a money raising campaign from the surveying engineering community.
Laser Scanner with Cyclone software	Cyra	New	Provided on a consignment basis annually
10 digital theodolites	Leica Geosystems	5 years old	University funding
Several levels and conventional theodolites.	Various	Good Useable Condition	University funding

All field surveying equipment housed in the surveying engineering equipment room is managed and maintained by the surveying equipment room technician.

How does the condition of current facilities impact program delivery? Explain.

Classroom and laboratory space and equipment are sufficient and adequate for the number of students currently enrolled in the program.

Describe the program's projected needs with respect to instructional facilities.

Currently, facilities are adequate to meet current needs. Enhancement will be required for those facilities to remain adequate and to support future initiatives.

Enrollment is at capacity and may exceed capacity. Additional sections of classes requiring use of the computer labs are being added to accommodate growth. Section capacity is limited by the number of computer stations available.

The surveying computer lab and the Fenn lab were upgraded for the 2007-2008 academic year. These computers run very sophisticated proprietary software that is being continually updated and upgraded by the providers. Our experience has been that computers in the surveying labs have a useful life expectancy of three years. At the completion of academic year, 2012-2013 computers in both labs will need to be replaced.

Upgrading the photogrammetry component has been a continuing process. We are still in possession of upgrading this lab. It is being cleaned up this summer. We have removed all old equipment and are in the process of having digital photogrammetry lab.

Facilities and equipment are used to capacity during the fall and spring semesters. They are used little over the summer. To effectively offer any summer courses air conditioning would need to be provided in the classrooms and computer laboratories in the Swan Building and in the faculty offices in Johnson Hall.

A means of monitoring and controlling printed-paper copies in the computer laboratories would contain printing costs and prevent waste.

An area or room set aside in the Swan Building for student use as a study area and/or a meeting area would greatly assist surveying students in their many team assignments, provide them a place to coordinate their many activities under their student society auspices, give them an area to meet on a small scale with visiting professionals or faculty.

Major software such ARC-IFO, GPS equipment and software from Trimble Navigation and Leica and total stations as given in above table are on continual loan basis. If this source of software and equipment is not available anymore, the program will face major difficulties in providing quality education to the students.

Describe current plans for facilities improvements and indicate their status.

As described above we are in the process of upgrading our photogrammetry lab.

Describe how proposed changes or improvements to facilities would enhance program delivery.

These proposed changes and improvements would maintain status quo in offering quality degrees. Coupled with additional personnel resources they would allow this program to expand and add value to its degree programs. Initiatives being discussed are partnering and creating a minor in civil engineering in collaboration with the Construction Management program, increasing summer offerings to include specialized training for non-surveyors and exploring the vast opportunities for this programs' active participation in Geospatial Science.

B.COMPUTER ACCESS AND AVAILABILITY

1) Outside of computers in faculty and staff offices, identify the computing resources (hardware and software) that are allocated to the program.

Surveying Engineering Computer Lab SWAN 206- 1000 sq. ft.

Excluding the computers in faculty and secretarial offices, there are two computer labs with 44 stations allocated to the Surveying Engineering programs. These computers are new (less than a year old), and were bought as part of the new John and Linda Fenn GIS and Photogrammetry lab renovation effort combined, with university funding.

All the computers are loaded with all the software needed for both programs, including word processing, database and spreadsheet packages, AutoCAD, ESRI ArcGIS, Leica GPS and Total Station software, Adjustment software, ERDAS photogrammetric software, land development and C&G surveying tools etc. Both labs are used for instruction. They are available for students use during the evenings, on weekends, and when no classes are scheduled. Every lab has a printer and a plotter.

This lab has been completely upgraded with new computers and software in January of 2004. Tables 1 and 2 describe these changes in hardware and software respectively:

Table 1: Hardware in SWAN 206

Hardware	**Manufacturer**	**Condition**	**Method of acquiring**
19 computers with the following specs: Processors 3.4 GHz RAM 1 Gigabyte HD 150 Gigabyte 17 inch monitors CD/RW	DELL	New/2005	College of Engineering Technology funding
1 Dedicated Server	DELL	New/2009	Ferris's Exceptional Merits Grant
LaserJet HP4100 Printer	HP	2009	Department's Funding
Large format plotter HP750C (36”×48”)	HP	2009	Donation from Surveying firm
HP400	HP	2009	Donation from Surveying firm
Large format plotter HP800 (36’×48”)	HP	New/2005	Donation from John Fenn

Table 2: Software in SWAN 206

Software	By	Version	Method of acquiring
ArcGIS, GIS software with all the extensions	ESRI	9 – new	Donation from ESRI
Erdas and Leica Photogrammetry Suite	Leica Geosystems	8.7– new	Donation from Leica Geosystems
AutoCAD, Map and Cad Overlay	AutoDesk	2009	College of Engineering Technology site
Microsoft Office	Microsoft	2009	FSU site license
Microsoft Visual Studio	Microsoft	2005	FSU site license
C& G Surveying	Carlson	2004	Donation from Carlson Software
Leica Geo Office	Leica Geosystems	20010	Donation from Leica Geosystems
Trimble Geomatics	Trimble	2011	Donation from Trimble
Mathcad	MathSoft	2011	Department's Funding

John R. and Lynda D. Fenn's Digital Photogrammetry and GIS Lab, Swan 201- 1980 sq. ft.

This lab was completely renovated in 2004; old instruments were removed, and the space was used to incorporate 15 new digital mapping work stations– new furniture and computers.

Table 3: Computer Hardware in SWAN 201 lab

Hardware	Manufacturer	Condition	Method of acquiring
15 computers with the following specs: Processors 3.4 GHz RAM 1 Gigabyte HD 150 Gigabyte 17 inch monitors CD/RW	DELL	2009	College of Technology funding
9 computers with the following specs: Processors 3.0 GHz RAM 0.5 Gigabyte HD 40 Gigabyte 17 inch monitors CD/RW	DELL	2007	College of Technology funding

Table 4: Computer Software in SWAN 201 lab

Software	By	Version	Method of acquiring
3 DVP softcopy photogrammetry stations	DVP Geomatic Systems	2008	Bought using Department funding
ArcGIS, GIS software with all the extensions	ESRI	10 – new	Donation from ESRI
Erdas and Leica Photogrammetry Suite	Leica Geosystems	8.7– new	Donation from Leica Geosystems
AutoCAD, Map and Cad Overlay	AutoDesk	20010	Site license
Microsoft Office	Microsoft	2009	Through a FSU Site License
Microsoft Visual Studio	Microsoft	2009	Through a FSU Site License
C& G surveying	Carlson	2010	Donation from Carlson Software
Leica Geo Office	Leica Geosystems	2009	Donation from Leica Geosystems
Trimble Geomatics	Trimble	2011	Donation from Trimble
Mathcad	MathSoft	2009	Department's Funding

Table 5: Analogue and Analytical Photogrammetric Equipment

Type	Condition	Method of acquiring
1 Zeiss P33 Analytical Plotter	Good – 10 years+	Through NSF Grant
1 Leica SD2000 Analytical Plotter	Good – 10 years+	Through NSF Grant
1 Wild A-8	Working – 40 years +	Extended Government Loan
2 Wild A-7	Working – 40 years +	Extended Government Loan
1 Wild AG1	20 years	Donation
1 Zeiss C-8	Working – 40 years +	Extended Government Loan
1 Kelsh	Working – 45 years +	Donation - Used primarily for demonstration purposes

All the computers are networked by a NOVEL Local Area Network. Additional computers stations are available to the students at the Ferris Library for Information, Technology and Education (Flite). As stated in previous sections.

Discuss how these resources are used.

The computers are used in surveying course laboratories (e.g., GISC 225, GISC 425 Geographical Information Systems courses, GISC 239 Remote Sensing, SURE340, and SURE440 photogrammetry classes, SURE272 and SURE215, surveying computation labs CENG 220
Engineering Surveying, SURE 230 Advanced Surveying). Additionally the students for their daily work and homework assignments use the labs.

Discuss the adequacy of these resources and identify needed additional resources.

These labs are adequate for the needs of the students and the surveying engineering program.

Does an acquisition plan to address these needs currently exist? Describe the plan. Has it been included in the department or college's planning documents?

The design of the John R. and Lynda D. Fenn Photogrammetry and GIS Lab was to meet the needs of the surveying programs. Therefore, currently no additional computer resources are needed and, there is no acquisition plan to obtain additional resources. Computers will need to be upgraded or replaced in 3 years but routine equipment replacement will not be addressed here.

Discuss the efficacy of online services (including WebCT) available to the program.

Regarding on-line instruction, WebCT/ Web enhancement technologies are available and used by at least four instructors and in more than ten courses that the department is offering to supplement instruction and provide a means for assessment. In addition, the program offers three GIS certificate courses on-line.

Discuss the adequacy of computer support, including the support for on- line instructions if applicable.

Computer support and on-line capabilities are adequate for the needs of the students and the surveying engineering program.

C.OTHER INSTRUCTIONAL TECHNOLOGY

1) **Identify other types of instructional technology resources that are allocated or available to the program.**

Availability of WebCT and now blackboard are resources we use in the program. The lab. in Granger Center is also useful for the program.

Discuss how these resources are used.

The Soils Laboratory is fully equipped for testing the fundamental properties of soils relevant to engineering design and construction. The laboratory includes approximately 1000 square feet of space with four large workstations and other storage cabinetry. Equipment is available to test soil gradation, Atterberg limits, specific gravity, compaction, permeability, and shear strength. Specialized equipment in the laboratory include two direct/residual shear machines, two unconfined compression machines, three drying ovens, two electronic balances, mechanical
sieve shaker, and Lancaster mixer.

The Materials Laboratory is fully equipped for preparing and testing the fundamental properties of construction materials including aggregate, Portland cement concrete, hot mix asphalt, and mortar. The laboratory includes approximately 1000 square feet of space with four large workstations and other storage cabinetry, as well as an adjoining work area of 500 square feet housing testing equipment and aggregate storage. Equipment is available for testing the following: gradation, specific gravity, and toughness of aggregate; slump, air content, and strength of Portland cement concrete; specific gravity, compaction, density, and asphalt content of hot mix asphalt; and flow and strength of mortar. Specialized equipment in the laboratory and storage area include a Versa tester machine, concrete compressive strength machine, concrete mixer, three mechanical sieve shakers, L.A. Abrasion machine, gyratory compactor, NCAT asphalt content oven, six centrifuges, flow table, large capacity oven along with six smaller ovens, and eight electronic balances.

Discuss the adequacy of these resources and identify needed additional resources.

The computers in Swan 206 and 201 are old and need to be replaced.

Does an acquisition plan to address these needs currently exist? Describe the plan. Has it been included in the department or college's planning documents?

We do not have a plan to replace the computers. Most of the equipment if donated or is continual loan basis.

Discuss the impact of adequacy of other types of instructional technology resources and support of these resources on the program.

Other instructional resources are adequate.

D.LIBRARY RESOURCES

1) Discuss the adequacy of the print, electronic, and other resources available through FLITE for the program.

The Ferris Library for Information, Technology, and Education (FLITE) is a multifaceted, complex organization designed to serve the needs of the students of Ferris State University, the faculty and staff and the community at large. It provides access through various channels to information necessary to the success of students.

The library has a budget that is divided among the 120 or so programs that are offered at Ferris, and books, periodicals and electronic databases are purchased both for specific programs and for the student body at large. Over the past few years, the Surveying Engineering Program has had a book budget of certain unknown amount. . FLITE has purchases as many books and periodicals as it can afford along with a number of databases. FLITE has over 400 professional books in surveying along with numerous government publications. This collection continues to grow as new books are published.

FLITE has purchased or has database access to over 20 journals dealing specifically with surveying engineering and almost 50 dealing with geography and cartography.

For those articles or books to which FLITE does not have direct access (bound periodicals, microfiche, electronic full-text, etc.) FLITE provides interlibrary loan service at no charge to students. Material is typically available within four days after request.

The library also provides access to a number of specialized computer programs for College of Technology student. These include the latest editions of AutoCAD.

Discuss the service and instruction availability provided by the Library faculty and staff with respect to the needs of the program.

Library instruction is available to all surveying students upon request of a faculty member. General library instruction and specialized database/Internet training is also available. With three writing intensive courses in the surveying curriculum FLITE is a critical asset to the success of the program. Librarians familiarize surveying students with materials and services available in
the FSUS 100 Ferris State University Seminar course. Librarians put on special lab sessions for legal research and the Lexis-Nexis database for the SURE 365 Legal Aspects of Surveying 1 and
465 Legal Aspects of Surveying 2 courses. Librarians coordinate with instructors to assure resources are available for specialized research projects in SURE 420 Professional Practice of Surveying. Librarians work with surveying faculty to insure that scholarly material in sufficient quantities is available for technical research that students do in photogrammetry, remote sensing, geodesy, and geographic information systems.

Discuss the impact of the budget allocation provided by FLITE to your program. Is the budget allocation adequate? Explain.

The current budget allocation is adequate. Any reduction would have a serious negative impact on the programs. With advancement in technology especially in the areas of remote sensing and digitized mapping the budget will need to be increases.

Section 5 Conclusions:

Conclusions based on data analysis derived from Sections 2-4 and on the collective wisdom and judgment of the PRP. In arriving at these conclusions, the PRP should summarize the relationship of the program to each of following specific categories and any other categories it deems appropriate

RELATIONSHIP TO FSU MISSION

It is felt that the Ferris State University Surveying Engineering program provides education that is exactly aligned with the Ferris State University mission. Students in the program receive practical, career-oriented education that typically leads to employment

A. PROGRAM VISIBILITY AND DISTINCTIVENESS

The Ferris Surveying Engineering program has a reputation as one of the best programs in the country. The new John R. and Lynda D. Fenn Digital Photogrammetry and GIS Endowed Laboratory, the ABET accreditation, students and faculty presentations at the Michigan Society of Professional Surveyors annual meeting and at national conferences, and job offers for the students from nationally prestigious Surveying Engineering firms all serve to increase Ferris' visibility and effectiveness. Our students' participation in national competitions such as the one organized by the American Congress on Surveying and Mapping (ACSM) in the past and now organized by the National Society of Professional Surveyors (NSPS) has provided a great forum for the national recognition for our program as well as our students. Our student team had won first place or second place in many of these competitions in the last six years. In addition, we have over 17 scholarships given to our students within our program. The total amount of scholarships exceeds $26,000. In addition, our students routinely win national and state level scholarships. All these activities have increased the visibility and distinctness of the program.

B. PROGRAM VALUE

The Ferris Surveying Engineering program provides service courses to Automotive Engineering Technology Program, Heavy Equipment Engineering Technology Program, Environmental Biology Program, Information Security and Intelligence program and the Criminal Justice programs. We also collaborate with Construction Managements program. The University also receives unique exposure because it is the only engineering EAC/ABET accredited program at Ferris.

C. ENROLLMENT

The enrollment in the programs has declined steadily in the last three years. It was especially worst last year when we admitted only six students. However, the enrollment is likely to increase again since we admitted and enrolled 22 students this year.

D. CHARACTERISTICS, QUALITY, AND EMPLOYABILITY OF STUDENTS

Students are typically from Michigan, but there are a significant number of transfer and non-traditional students. ACT scores of incoming freshmen have risen over the past several years. Most students who do not succeed fail because of poor math or reading skills, and often leave before the sophomore year. Those that succeed in their math and physics courses will probably complete the program. Employment rates for graduates are typically 100%, with many students receiving multiple job offers. Our retention rate is high.

E. QUALITY OF CURRICULUM AND INSTRUCTION

The curriculum meets all the requirements of the accrediting body, the Accreditation Board for Engineering and Technology (ABET) and meets the licensing requirements of the State of Michigan. Students typically rate the quality of instruction in technical courses as very high. High passing rate (95%) in the NCEES fundamentals of Surveying Test as given in earlier sections is also an indication of the quality instruction and content of the curriculum.

F. COMPOSITION AND QUALITY OF THE FACULTY

The faculty members are primarily full- time tenured and tenure track individuals who are involved in professional organizations, consulting, and continuing education.

APPENDIX A - FACULTY RESUMES

GABOR BARSAI

1009 Campus Dr., Rm. 408, Big Rapids, MI 49307 231-591-3115 barsaig@ferris.edu

1. Name: GABOR BARSAI

- Academic Rank: Assistant Professor of GIS at Ferris State University

2. DEGREES

- **Ph.D.**, ***Geodetic Science***, The Ohio State University, Columbus, Ohio 2011
- **Master of Science**, ***Geodetic Science***, The Ohio State University, Columbus, Ohio 1997

3. Years of Service at Ferris State University

- 2011-current: Assistant Professor for GIS

4. Related Experiences:

Digital Information Systems, 1999-2006. Geospatial Project Manager

Gotmaps?, 2006-current. GIS consultant, application developer

5. Consulting:

Gotmaps?, 2006-current. GIS consultant, application developer

6. Professional Licenses - N/A

7. Principal Publications in the Last Five Years:

Attended ISPRS 2008, Beijing, China: International archives of Remote Sensing, 2008: Point free object matching using Fourier power spectrum

Attended ASPRS 2007, San Antonio, TX: Point free object matching using Fourier descriptor

8. Scientific and Professional Society Memberships:

Reviewer for Machine vision and applications journal

Reviewer for Photogrammetric Engineering and Remote Sensing journal

9. Honors and Awards:

Honorable mention at NSPS 2011, Portland, OR for Ferris State competition

10. Institutional and Professional Services in the Last Five Years:

- Attended NSPS 2011, Portland, OR for Ferris State competition

11. Professional Development Activities in the Last Five Years:

- Various Blackboard and Faculty training at Ferris State
- Examined the integration of GIS with various remote sensing and GPS techniques and products. Developed mobile mapping systems for 911 data collection for counties throughout the country. Developed creative software using VBA for office use: Excel, Word programming for automating calculations and input tasks. Developed creative software using C++, Matlab and FORTRAN languages:

  - programs that use filters to enhance the quality of digital images
  - an object matching program which uses Fourier descriptors to match map objects
  - programs that convert map coordinates between projections.

1. **Name:** Sagar S. Deshpande
Academic Rank: Assistant Professor

2. **Degrees:**

MS, Geodetic Science, Ohio State University, Columbus, OH
MTech, Geoinformatics, Indian Institute of Technology, Kanpur, India
BE, Civil Engineering, Mumbai University, India
Diploma, Civil Engineering, Maharashtra State Board, India

3. **Years of Service at Ferris State University:** 0 Years

4. **Related Experiences:**
2008-2012, Water Resource Engineer and Mapping Analyst at Leonard Jackson Associates
2005-2008, Research Associate at the Ohio State University (OSU)
2004-2005, Research Fellow at the Indian Institute of Technology Bombay (IITB)
2002-2004, Teaching Assistant at the Indian Institute of Technology Kanpur (IITK)

5. **Consulting:**

6. **Professional Licenses:**
Registered Professional Engineer (PE) Maryland State. Reg # 41405
Certified Photogrammetrist (CP) by ASPRS. Reg # 1527
Certified GIS professional (GISP) by GIS Certification Institute. Reg # 00065617
Certified Floodplain manager (CFM) by ASFPM. Reg #30610

7. **Principal Publications in the Last Five Years:**

Deshpande, S. 2012, Improved Floodplain Delineation Method Using High Density LiDAR Data, (Accepted June 2012: Journal of Computer-Aided Civil and Infrastructure Engineering)

Li, R., X. Niu, C. Liu, B. Wu and S. Deshpande 2009. Impact of Imaging Geometry on 3D Geopositioning Accuracy of Stereo IKONOS Imagery. Photogrammetric Engineering and Remote Sensing, Vol. 75, No. 9, pp. 1119-1125.

Li, R., S. Deshpande, X. Niu, F. Zhou, K. Di, B. Wu 2008. Geometric integration of Aerial and High-resolution satellite imagery and application in shoreline mapping. Journal of Marine Geodesy, Vol.31, No.3, pp.143-159, doi: 10.1080/01490410802265310.

Liu, J-K., R. Li, S. Deshpande, X. Niu, and T-Y. Shih 2008. Estimation of Blufflines using Topographic LiDAR Data and Orthoimages. Journal of Photogrammetric Engineering and Remote Sensing, Vol.75, No.1, pp.69-79.

Deshpande, S., E. Amar, M. Valenzuela, and Z. Momeni. 2010. Fusion of HUC boundaries and USGS DEM for Improved Watershed Delineation in Marsh Land. New Jersey Association for Floodplain Management: 6th annual conference, Somerset NJ, 14-15, 2010.

Chiu, D., S. Deshpande, G. Agrawal and R. Li. 2009 A Dynamic Approach toward QoS-Aware Service Workflow Composition. 2009 IEEE international conference on Web Services, Los Angeles, CA. July 06-10. ISBN: 978-0-7695-3709-2.

Chiu, D., S. Deshpande, G. Agrawal and R. Li. 2008 Composing Geoinformatics Workflows with User Preferences. Proceedings of the 16th ACM SIGSPATIAL international conference on Advances in geographic information systems

Chiu, D., S. Deshpande, G. Agrawal, and R. Li 2008. Cost and Accuracy Sensitive Dynamic Workflow Composition. Proceedings of the 2008 9th IEEE/ACM International Conference on Grid Computing

8. Scientific and Professional Society Memberships:

Member of American Society of Photogrammetry and Remote Sensing (ASPRS)
Member of Association of State Floodplain Manager (ASFPM)

9. Honors and Awards:

2007, Received "Topcon Graduate Student Research Award." Award included $2000 and a certificate.

2006, Received "Mapping and GIS Laboratory Research Award." Award included $700 and a certificate.

10. Institutional and Professional Services in the Last Five Years:

11. Professional Development Activities in the Last Five Years:

Completed several short courses related to National Flood Insurance Program.

1. Name: Carl F. Shangraw, PS, CFedS

2. Academic Rank: Professor

3. Degree: Master of Science, Surveying Engineering, Purdue University, 1993

4. Academic experience –

   Ferris State University, Big Rapids, Michigan

      Date of Hire: August 1995, Assistant Professor

      Promotion: August 2001, Associate Professor
      Promotion: August 2006, Professor

5. Non-academic experience –
      MDOT, Statewide GPS Survey Leader, 1993-1995
      Moore and Bruggink, Inc.; Director, Survey Department; 1989-1991
      Carl F. Shangraw Land Surveyor; Owner; 1986 – 1989
      Michigan National Guard; Full Time Training Officer; 1984-1986
      Moore and Bruggink, Inc.; Professional Surveyor; 1976-1984

6. Certifications or professional registrations

      Professional Surveyor, State of Michigan, 1978 to Present
      Land Surveyor, State of Wisconsin, 1983 to Present
      Certified Federal Surveyor (CFedS), U.S. Department of the Interior, Bureau of Land Management, 2007 to Present

7. Current membership in professional organizations

      Michigan Society of Professional Surveyors, Wisconsin Society of Land Surveyors, Society of American Military Engineers, the Hydrographic Surveying Society of America.

8. Honors and awards N/A

9. Service activities (within and outside of the institution)

   - Within the Institution (current unless otherwise noted)

Founder and Faculty Advisor, Mary Feindt Chapter of Lambda Sigma
Faculty Advisor, Burt and Mullett Chapter of ACSM (2011-2012)
Member, College of Engineering Technology Promotion Committee (2010-2012)
Member, College of Engineering Technology Assessment and Accreditation Committee
Member, College of Engineering Technology Scholarship Committee
Surveying Engineering Program Scholarship Coordinator (1995-2012)
American Democracy Project (2004-2008)

- Outside the Institution
  United States Department of the Interior, Bureau of Land Management; member, CFedS examination review committee (summer, 2012)

Great Lakes Water Studies Institute, Northwestern Michigan College, Traverse City, Michigan.

Assisted in the presentation of a two week, three credit hour course (ENV200) in Hydrographic Surveying. Principle contributions consisted of 3d Laser Scanning, lecturing on datums, coordinate systems and map projections, establishing vertical and horizontal control. (May, 2012)

Assisted in a benthic survey of 120 square miles of Lake Michigan bottomland lying between the Sleeping Bear Dunes and the Manitou Islands to support an environmental study under the auspices of the U.S. Park Service. (May 2011)

State of Michigan Professional Surveyors Licensing Board
Original gubernatorial appointment 2002-2006, reappointed 2006-2010
Served as chair from March of 2005 to March of 2010

NCEES Engineering Faculty Licensing Task Force (2008-2010)

Grand Traverse Land Conservancy, Traverse City Michigan: As a class project, currently reviewing legal descriptions on $100 million worth of real estate.

Disability Advocates of Kent County: Organized student teams to compete in annual Walk and Roll fund raiser (2007-2011).

10. t important publications and presentations from the past five years –

Carl F. Shangraw; *Hydrographic Surveying, An Overview*; Presentation made to the Michigan Society of Professional Surveyors; Ypsilanti, Michigan, February, 2012.

Carl F. Shangraw; *Educational Opportunities at Ferris State University;* Presentation made to the Wisconsin Society of Land Surveyors, Wisconsin Dells, Wisconsin; January,

2012.

Carl F. Shangraw, et.al,; *Michigan Law Project*; Presentation made to the Michigan Society of Professional Surveyors; Lansing, Michigan; February, 2010

Yaron Felus and Carl Shangraw; *Mapping Handicapped Accessibility Facilities at Ferris State University*; Presentation made at ESRI Summit, Redlands, CA, 2007

Carl F. Shangraw; *The Global Positioning System*; Presentation given as part of the Certified Surveyor Technician Program; Ferris State University, 2007

Carl F. Shangraw; *Basic Astronomy*; Presentation given as part of the Certified Surveyor Technician Program; Ferris State University, 2007

Greenview v. Pettis; 2009 Mich. App. Lexis 560; provided expert witness testimony in a boundary dispute on behalf of plaintiffs. Plaintiffs won.

11. Briefly list the most recent professional development activities

Side Scan, Scanning Sonar and Wide-Swath Bathymetry Training for Marine Engineering, Inspection and Underwater Construction Applications; Week long Seminar presented by Nautilus Marine Group at Northwest Michigan College, Traverse City, Michigan; June, 2012

Michigan Society of Professional Surveyors Annual Conferences (2007 through 2012)

Wisconsin Society of Land Surveyors Annual Conference (2011, 2012)

National Council of Examiners for Engineers and Surveyors (NCEES)

Annual Conference (2007, 2009); Board Chairs Assembly (2007)

Carlson Surveying Software Workshop, 8/19-20/2009, Big Rapids, MI

CFedS Training Program (2007)

Continuing CFedS Education: *Discrepancies in the Official Record* (2010); *Non-Rectangular Surveys* (2010); *Swamp Land Grants, Omitted Areas and Island Surveys* (2010); *Special Boundary Problems* (2009).

1. **Name:** Khagendra Thapa

2. **Education:**
   Ph.D. in Geodetic Science and Surveying, the Ohio State University, September 1982 - June 1987.
   Master of Science in Geodetic Science and Surveying, the Ohio State University, Sept. 1982 - December 1985.
   Master of Science in Engineering (M.SC.E.), Surveying Engineering, University of New Brunswick, New Brunswick Canada. September, 1978 - May 1980.
   Bachelor of Science (Honors Degree) CNAA, Land Surveying Sciences University of East London, London, England, September, 1975 - July 1978.
   Master of Science in Statistics (incomplete, attended two semesters)
   Tribhuvan University, Kathmandu, Nepal, July, 1973 - July 1975.
   Bachelor of Science (Physics, Mathematics and Statistics), Tri-Chandra College, Kathmandu, Nepal, June 1971 - June, 1973.

3. **Academic experience:**

   Currently PROFESSOR, Program Coordinator Surveying Engineering Dept., Ferris State University
   Professor and Dept. Chair, Surveying Engineering Department, 9/98 to 12/2000
   LECTURER, Institute of Engineering, Tribhuvan University, Kathmandu, Nepal, 9/ 1980 – 9/1982.
   LECTURER, First Regional Training Course for Hydrology Technicians, Sponsored by HM Government of Nepal, UNESCO, and World Meteorological Organization. November 1981 - August 1982.
   RESEARCH AND TEACHING ASSISTANT, Department of Surveying Engineering, University of New Brunswick, September 1978 - May 1980.

4. **Non-academic experience:**

   Worked for Center for Mapping of the Ohio State University for the US Geological Survey Project as a consultant, July-August, 1990
   Worked for Digital Mapping Project, Department of Geodetic Science and Surveying, Ohio State University, 7/8, 1988
   SUPERVISOR - MAPPING LABORATORY, Department of Geodetic Science and Surveying, Ohio State University 1987
   WORKED PART TIME for TAEC Consult P. Ltd. as a consultant, October 1980 - August 1982. Also field work for (5) water supply projects and (1) paper factory
   Geodetic Survey of Canada, Dept. of Energy Mines and Resources, Ottawa Canada July – September, 1980

5. **Certifications or professional registrations**: None

6. **Current membership in professional organizations:**
   American Association of Geodetic Surveyors
   American Congress on Surveying and Mapping selected as Fellow of ACSM-9/2000
   Institute of Navigation
   American Society for Engineering Education

7. **Honors and awards:**

   FSU Distinguished Teacher Award 2008

   Received Ralph Moore Berry Education Award from Michigan Society of Professional Surveyors, February, 2008

   Received Certificate of Appreciation from the US Dept. of Labor May, 2008

   Outstanding Service Award by Association of Nepalese in Midwest America May, 2003

   FSU Distinguished Teacher Award Finalist, 2002

   Education Outreach Award from IMAGIN, 2002

   Ferris State University, Provost Award for Excellence**,** 1997

   Distinguished Faculty Award from Michigan Association of Governing Boards (MAGB) For Extraordinary Contributions to Michigan Higher Education, Lansing, MI. 1996

   Certificate of Recognition by the Board of Control of Ferris State University, January, 1995 and March, 1996

   Construction Department "Spark Plug Award" given by the Dean of the College of Engineering Technology in 1989

   Certificate of Commendation given by the National Society for Professional Surveyors

8. **Service activities (within and outside of the institution)**

   Member of the Institutional and Strategic Planning Committee 2010- current
   Chair of the Distinguished Teacher Selection Committee 2009/10
   Member of the Distinguished Teacher Selection Committee 2008/09
   College of Engineering Technology, Sabbatical Committee, 2008/09
   Served as Vice President of Senate for 07/08
   Served as Vice President of the Senate for 06/07
   Served as Chair of the All University Sabbatical Committee for 06/07
   Served as a member of the student life committee 04/06
   Commissioner of ABET 2008- 2011

Evaluator of ABET since 1997

9. **Most important publications and presentations from the past five years**:

Thapa, K. (2007) Proceedings: Twenty First North American Surveying and Mapping Educators Conference, Big Rapids, MI. (editor)

Thapa, K. (2007) Global Positioning System; Presentation given as part of the Certified Surveyor Technician Program; Ferris State University

Thapa, K. (2007) Survey Computations; Presentation given as part of the Certified Surveyor Technician Program; Ferris State University, 2007

Thapa, K. (2009) Presented whole day workshop on Geodesy and GPS at 2009 Annual held in March 2009 at Salt Lake City Utah.

10. Most recent professional development activities:

Completed two day LIDAR Training in May 2012

ABET workshop on assessment, Tampa, FL, FEBRUARY, 2011.

Attended the North American Geomatics Teachers and Educators Conference held at San Juan Puerto Rico.

Chair of the XXI North American Surveying and Mapping Educators Conference, Ferris State University, Big Rapids, MI 49307 held- July 11 - 13, 2007

Completed FERRIS-CONNECT TRAINNING (for online teaching) which was held on Nov. 27, 29 and Dec, 4 and 6 2007

Four days Long Training on TDS software in December 12- 16, 2006

Week long training on MATLAB in July 2006 in Detroit

One day Training on Trimble Geomatics Office new GPS software at Ferris in August, 2005

APPENDIX B - COURSE OUTLINES

COURSE: SURE 110 FUNDAMENTALS OF SURVEYING (REQUIRED)

Credits:	4 Hours
Contacts:	2 Lecture, 6 Lab Hours per week
Course Description:	Orientation and introduction in proper field surveying theory and techniques. Subject areas include taping, tape corrections, leveling, angle measurements, traversing, traverse adjustments, contouring, fundamentals of mapping, and proper use and care of surveying instruments.
Course Prerequisites:	MATH 120
Required Textbooks:	Kavanagh, B., (2009) **Surveying: Principles and Application**, 8th Edition, Prentice Hall, New Jersey
Reference Text:	Anderson, J., and Mikhail, E., (1998), **Surveying, Theory and Practice**, 7th Edition, McGraw-Hill, Boston
Required Materials:	Student lab kit

Course Learning Outcomes

Upon completion of the course, the student should be able to

1. understanding of units of measurements and the accuracy of the surveying instruments and the errors associated with them [Program Outcome (PO 1, 3 ABET a)
2. the ability to use various surveying instruments (PO 2, ABET a,k)
3. the ability to perform computations using data taken from field notes (PO 2, ABET a,k)
4. the ability to draw maps & write report from the field and computed data (PO 4,5, ABET a,e)

Topics Covered:

1. Introduction, Orientation & Safety (2 classes)
2. Types of Surveys, Types of Measurement and Fundamental principles of surveying (3 classes)
3. Taping and Tape Corrections (3 classes)
4. Levels and Leveling Definitions (1 class)
5. Leveling Procedures (4 classes)
6. Angle Measurements (5 classes)
7. Traversing and Traverse Adjustment Including Area Computations (4 classes)
8. Detail survey by stadia method (3 classes)
9. Topographic mapping (2 classes)

Computer usage: None

Required Laboratory Schedule

1. Leveling - Instrument Instruction, Differential Leveling Loop, Profile, and Peg Testing (3 weeks)
2. Taping - Tape use, Horizontal Taping, Slope Taping (1 week)
3. Angular Measurements - Angle Measurement Techniques, Traverse (3 weeks)
4. Detail Survey by Stadia (3 weeks)
5. Report writing and plotting of map (3 weeks)

Contribution of the course to meeting the requirements of Criterion 5: This is the first technical course in the program and as indicated above in course outcomes, it partially satisfies Program Outcomes (PO) 1,2,3,4, & 5.

Relationship of the course to Program Outcomes: As indicated above, this course partially satisfies PO 1,2,3,4 &5.

Person who prepared this description and date of preparation: K. Thapa, 12/3/10

Course: SURE 115 Introduction to Computer Mapping

Credits:	1 Hour
Contacts:	3 Lab Hours (6:00-8:50 Swan 206) per week
Course Description:	This course is an introduction to Computer Aided Drafting (CAD) as applied to Surveying Engineering and Computer Aided Mapping (CAM). The emphasis of this course is "hands on" exercises in CAD and CAD integrated surveying software.
Course Prerequisites:	None
Course Outline:	Attached to this document
Required Textbooks:	*Discovering AutoCAD*, by Mark Dix and Paul Riley
Reference Textbooks:	*Carlson 2009 User's Manual*, Volumes 1 and 2, Carlson Software, Inc. 2008
Required Materials:	Student Lab Kit, Some form of memory device such as a USB memory stick, external hard drive, etc.

Student Learning Outcomes

Students satisfactorily completing this course will achieve/complete/demonstrate:

1. an understanding of basic CAD mapping concepts (PO 5)
2. competence in the use of graphic object construction and editing (PO 2)
3. the ability to apply CAD concepts to surveying and mapping (PO 2)

Course Assessments

Course assessment will be performed using examinations, homework, and laboratory exercises.

Person who prepared this description and date of preparation: C. Shangraw

COURSE: SURE 215 SURVEYING COMPUTATIONS (REQUIRED)

Credits:	3 Hours
Contacts:	2 Lecture 3 Lab Hours per week
Course Description:	A study of principles and methods of surveying computation related to Cartesian coordinate systems, coordinate geometry including a four-parameter similarity transformation and an introduction to spherical coordinate systems as applied to spherical astronomy and the use of mathematical software with programming features. Typically Offered Fall, Spring
Course Prerequisites:	SURE 110
Required Textbooks:	**Surveying Theory and Practice**, 7th edition, by Anderson and Mikhail, published by McGraw-Hill
Reference Text:	Lecture Notes by S. Hashimi
Required Materials:	Student lab kit

Course Learning Outcomes

Students satisfactorily completing this course will have an understanding of:

1. traverse computation and two dimensional coordinate geometry calculations (PO 2, 3)
2. horizontal circular curve geometry and layout calculations (PO 2, 3)
3. coordinate geometry, line/line, line/circle, circle/circle 3-point resection (PO 2, 3)
4. the reduction of solar and astronomic observations for azimuth (PO 2, 3)

Topics Covered:

1. Review of traverse computations
2. Two-dimensional coordinate geometry; line/line, line/circle, and circle/circle intersections, three-point resection, area partitioning
3. Circular curve layout by deflection and offsets method
4. Equal tangent vertical curves
5. Four-parameter Coordinate Transformation
6. Solution of PZC spherical triangle for azimuth

7. Solar and Polaris observation reductions to azimuth

Computer usage: Spreadsheet, MathCad

Required Laboratory Schedule

1. Traverse computation and adjustment (1 week)
2. Equation of a line, slope of a line, solution of linear equations (1 week)
3. Line/Line intersection (1 week)
4. Horizontal Circular Curve Geometry (1 week)
5. Line/Circle intersection (1 week)
6. Circle/Circle intersection (1 week)
7. Missing Data Calculation (1 week)
8. Area partitioning (2 weeks)
9. Three-point resection (1week)
10. Four-parameter Coordinate Transformation (1 week)
11. Equal Tangent Vertical Curves (1 week)
12. Polaris and Solar Observations reduction for azimuth (3 weeks)

Contribution of the course to meeting the requirements of Criterion 5: This is the first technical course in the program and as indicated above in course outcomes, it partially satisfies Program Outcomes (PO) 2 & 3.

Relationship of the course to Program Outcomes: This course partially satisfies POs 2 & 3.

Person who prepared this description and date of preparation: S. Hashimi, 04/10/10

Course: SURE 230 ADVANCED SURVEYING

Credits:	4 Hours
Contacts:	2 Lecture 3 Lab Hours per week
Course Description:	An advanced study of the methods and instrumentation used in the surveying profession. The theory and application of electronic distance measuring devices, use of total stations and digital levels, GPS principles and applications, introduction to practical astronomy and the application of state plane coordinates.
Prerequisites:	SURE 110 and SURE 115.
Required Textbooks:	Anderson, J., and Mikhail, E.; (1998); **Surveying, Theory and Practice**, **7th Edition**; McGraw-Hill; Boston, MA. Shangraw, C.; (2009); **Class Notes, SURE 230, Advanced Surveying.**
Reference Textbooks:	Ghilani, C. and Wolf, P.; (2007); **Elementary Surveying, an Introduction to Geomatics, 12th Edition;** Pearson, Prentice Hall; Upper Saddle River, NJ. Ghilani, C. and Wolf, P.; (2006); **Adjustment Computations, Spatial Data Analysis, 4th Edition**; John Wiley and Sons, Inc.; Hoboken, NJ.
Required Materials:	Student Lab Kit, Some form of memory device such as a USB memory stick, external hard drive, etc.

Student Learning Outcomes

Students satisfactorily completing this course will achieve/complete/demonstrate:

5. a basic understanding of the errors and error propagation inherent in surveying operations. (PO 2,3)
6. fundamental knowledge of the design and establishment of vertical and horizontal control networks. (PO 3,4)
7. the ability to act as a member of a team in collecting, assessing, interpreting and presenting survey information in the form of survey reports and a topographic map. (PO 4,5)

Person who prepared this description and date of preparation: C. Shangraw

COURSE: SURE 272 PROGRAMMING APPLICATIONS IN GEOMATICS

Credits:	2 Hours
Contacts:	1 Lecture, 3 Lab Hours per week
Course Description:	Exploring fundamental concepts of visual programming to solve surveying and mapping related problems. Topics covered include: object oriented syntax for looping and if statements, input/output statements, arrays, user-defined functions and procedures, reading and writing text and binary files, and introduction to database programming and graphics. Programming projects may include: angular units conversion; transformation of coordinates from polar to rectangular and rectangular to polar; traverse computation, adjustment and plotting.
Course Prerequisites:	SURE 215 – Surveying Computations MATH 130 – Advanced Algebra and Analytical Trig.
Required Textbooks:	Mastering MATLAB 7, by D. Hanselman and B. Littlefield – Prentice Hall

Student Learning Outcomes

1. Be able to understand how to develop a solution algorithm to solve numerical problems using a high level computer programming language (PO 2, 3, 4).
2. Be able to understand program control; looping, IF and Case statements (PO 2, 3).
3. Be able to understand array concepts and array applications into a programming environment (PO 2, 3)
4.

Topics Covered

1. Relational and Logical Operations
2. Arrays and Array Operations
3. Numeric and Character Data Types
4. Program Control Flow; Loops, IF, and Case statements
5. Import and Export Data
6. Program Graphics User Interface (GUI); Dialog Boxes
7. Objects: properties, methods and event handlers
8. Linking two or more objects

Required Laboratory Schedule

1. The first four to five weeks of the semester consists weekly laboratory assignments dealing with the coverage of the programming language syntax, program controls, object programming concepts
2. The remaining two thirds of the semester the students work on a project culminating into a final presentation by each student. Typical projects over the past few years have consisted of interactive COGO, Reduction of observations using State Plane Coordinates, Solar observations reduction for azimuth where the solar ephemeris is built in the program, Horizontal circular curve calculation and layout.

Contribution of the course to meeting the requirements of Criterion 5: It partially satisfies Program Outcomes (PO) 2 & 3.
Person who prepared this description and date of preparation: S. Hashimi, 04/10/10

COURSE: SURE 331 ETHICS AND PROFESSIONALISM IN ENGINEERING AND TECHNOLOGY

Credits:	3 Hours
Contacts:	3 Lecture, 0 Lab Hours per week
Course Description:	Discusses the codes of ethics which have been adopted by many engineering societies. Explain meaning and attributes of professionalism along with the ethical, moral, and social responsibilities of technologists and engineers. Also standards, law, safety, risks, obligations of loyalty to employer, professional client relationship, global awareness, bribery, contracts, and intellectual property are discussed. This course meets General Education requirements: Cultural Enrichment.
Course Prerequisites:	ENGL 150
Required Textbooks:	**Ethical Issues in Engineering** by D. Johnson, Prentice Hall, NJ.

Student Learning Outcomes

Upon completion of the course, the student should be able

1. To introduce the concepts moral thinking moral theories (PO 1, 7, 8, ABET c,d,f,j)
2. To environmental ethics and ethics and safety obligations (PO 6, 7, 8, ABET c,d,f,j)
3. To introduce the concepts of ethics and professionalism as applied to engineering and technology (PO 5, 7, ABET c,d,f,g,j)
4. To understand the impact of surveying and engineering projects on society (PO 1, 5, 6, 7, 8, ABET c,d,f,g,j)

Topics Covered:

Codes of ethics, attributes of a professional, ethical, moral, and social responsibilities of engineers and technologists, global awareness, bribery, intellectual property.

1. Introduction: Moral Thinking 6

What is morality? Realism vs. Constructivism

2. Moral Theories: 6

Utilitarianism, Kantianism, Virtue Ethics, Divine Command

Social Contract Theories

3. Environmental Ethics 7
   Cost Benefit Analysis, Animal Rights, Biocentric Individualism
   Ecocentric Holism, Deep Ecology
4. Ethics and Safety Obligations 6
   Concern for Safety, Safety and Risk, Risk-Benefit Analysis
   Consequences of not Following Safety Precautions
   Case Studies from different Engineering Disciplines
   Interaction of Law with Professional Engineers, Professional Liability
5. The Definition of a Profession 6
   Attributes of a Profession, Engineers' Creed, Code of Ethics for Engineers
   Professional Licensure
6. Engineers' and Technologists' Responsibilities to the Society 5

Public Health, Public Safety, Trade Secrets, Patents, Intellectual Property

7. Obligations of Loyalty to Employers 4
   Moral status of Loyalty, Whistle-Blowing, Employee Rights,
   Professional Rights, Confidentiality, Moral Justification for Whistle-Blowing
   The Role of Law in Protecting Scientific and Technical Dissent
8. Obligations to Clients and Fair Play in Engineering 2
   Conflict of Interest, Bribery, Gift Giving and Morality,
   International Bribery, Ethics, and Corrupt Practices

Three Tests 3

Total **45**

Contribution of the course to meeting the requirements of Criterion 5: This course satisfies the cultural enrichment in the program. It partially satisfies Program Outcomes (PO) 1, 5, 6, 7 & 8.
Relationship of the course to Program Outcomes: As indicated above, this course partially satisfies (PO) 1, 5, 6, 7, 8.
Person who prepared this description and date of preparation: K. Thapa, 12/3/10

Course: SURE 340 **Photogrammetry**

Credits:	3 Hours
Contacts:	2 Lecture, 3 Lab Hours per week
Course Description:	An introductory course in photogrammetry covering, in part, the history of photogrammetry, aerial cameras and camera calibration, geometry of the aerial photograph, stereoscopy and stereoscopes, parallax, and the theory and techniques of orientation. Students will perform basic mapping tasks in the stereo plotter.
Course Prerequisites:	SURE 110
Required Textbooks:	Photogrammetry: Geometry from Images and Laser Scans, by K. Kraus, de Gruyter.
References:	Elements of Photogrammetry, 3rd edition, by P. Wolf and B. Dewitt, McGraw-Hill Co.
Other Material:	Three photo set of campus, engineers scale, triangles.

Course Learning Outcomes

Students satisfactorily completing this course will have an understanding of:

1. The student will be able to make simple computations on aerial photographs such as scale, ground coordinates (local), and height of objects on vertical and near-vertical photography. (PO 2, 4)
2. The student will be able to apply parallax measurements to determine elevation and basic photographic calculations. (PO 2, 4)
3. The student will be able to describe how imagery is acquired using both analog (film-based) and digital cameras and the possibilities of errors within these image-capture devices. (PO 2,4)
4. The student will be able to explain how to orient a stereo model (interior, relative, and absolute) using stereo plotters of different vintage with particular emphasis on control requirements. (PO 2,4)
5. The student will calculate basic planning parameters, understand basic contracting principles for photogrammetric services, and identify qualifications-based selection. (PO 3)

Topics Covered:

8. Introduction to photogrammetry with history
9. Principles of photography and imaging
10. Aerial camera
11. Geometry of aerial photo – vertical and tilted photography
12. Stereoscopy and parallax
13. Theory and techniques of orientation
14. Topographic mapping, standards and specifications, project planning

Computer usage: Mapping Software, Spreadsheet/MathCAD/Matlab

Required Laboratory Schedule

13. Research paper – 2 total with overview of aerial camera (3 weeks)
14. Geometry of aerial photography and stereoscopy (4 weeks)
15. Plotter orientation (2 weeks)
16. Digital photogrammetry operations (5 weeks)

Contribution of the course to meeting the requirements of Criterion 5: This is the first photogrammetry course in the program and as indicated above in course outcomes, it partially satisfies Program Outcomes (PO) 2, 3, 4.
Relationship of the course to Program Outcomes: This course partially satisfies POs 2, 3, 4.
Person who prepared this description and date of preparation: R. Burtch, 05/30/11

Course: SURE 365 LEGAL ASPECTS OF SURVEYING I

Credits:	3 Hours
Contacts:	3 Lecture hours per week
Course Description:	An introductory study to rights and interests in land, the Public Land Survey System, theory of original survey, resurvey, subdivision survey and the methods of describing real property along with the more important federal statutes affecting the surveyor. This is a writing intensive course. Students will prepare four 3-5 page papers on various topics assigned by the instructor. In addition, students will write a number of legal property descriptions in various formats. Also included will be the use of memoranda and professional correspondence.
Course Prerequisites:	SURE 215, Surveying Calculations (co-requisite); ENGL 250, English 2. It is expected that the student have proficiency in the following areas: English composition, fundamental traverse, coordinate and area calculations, CAD.
Required Textbooks:	Brown, Curtis M.; Robillard, Walter G.; Wilson, Donald A.; *Brown's boundary Control and legal Principles, 6th Ed.*; John Wiley and Sons, Inc.; New York; 2009. Berry, Ralph M.; *Special Instructions to the Deputy Surveyors of Michigan 1808-1854;* Michigan Museum of Surveying; Lansing, MI; 1990 Kramer, Melinda G., et al; *Prentice Hall Handbook for Writers, 12th Ed.;* Prentice Hall, Inc.; Englewood Cliffs, NJ; 1995. C. Shangraw; *Class Notes 2010.*
Reference Textbooks:	Wattles, Gurdon G.; *Writing Legal Descriptions in Conjunction with Survey Boundary Control*; Wattles Publications; Tustin, CA; 1979 *Manual of Instructions for the Survey of the Public Lands of the United States;* Bureau of Land Management, United States Department of the Interior; Washington, D. C., 2009.
Required Materials:	None

Course Learning Outcomes

Students satisfactorily completing this course will achieve/complete/demonstrate…:

1. A basic understanding of and an appreciation for the Public Land Survey System. (SO 3, 8)
2. The quasi-judicial capacity of the surveyor. (SO 7)
3. The fundamentals of writing and interpreting legal property descriptions. (SO 5)
4. The core concepts of the US legal system. (SO 8)

Person who prepared this description and date of preparation: C. Shangraw

Course: SURE 366 Evidence and Procedures for Boundary Location

Credits:	3 Hours (2+2)
Contacts:	2 Lecture (Monday and Wednesday, 8:00-9:50 Swan 211) per week 2 Lab (Thursday, 3:00-4:15 Swan 207) per week
Course Description:	A study of the rules of evidence and their application in conducting boundary surveys. It includes an introduction to littoral and riparian rights and major environmental considerations and their applications to survey projects. The course focuses on statutory law and case studies melding the theoretical with the practical
Course Prerequisites:	SURE 365, Legal Aspects of Surveying I; ENGL 250, English 2. It is expected that the student has proficiency in English composition, basic land boundary theory, history of surveying, basic CAD functions, fundamental traverse, coordinate and area calculations.

Required Textbooks:	*Manual of Instructions for the Survey of Public Lands of the United States;* Bureau of Land Management, United States Department of the Interior; Washington, D.C.; (2009) Keen, John E.; *Land Surveying Law, 2nd Rev.*; Land Surveyors' Workshops; Spruce Pine, NC; 2003.
Reference Textbooks:	Wattles, Gurdon G.; *Writing Legal Descriptions in Conjunction with Survey Boundary Control*; Wattles Publications; Tustin, CA; 1979
Required Materials:	None

Course Learning Outcomes

Students satisfactorily completing this course will achieve/complete/demonstrate…:

5. The importance of research and the proper evaluation of evidence in retracement surveys. (SO 3 and 7)
6. An appreciation of the complexities in dealing with riparian/littoral issues along with environmental impacts. (SO 1)
7. A basic knowledge of Federal case law relating to boundary issues. (SO 8)

SO = Student Outcomes

Course Assessments

Course assessment will be performed using examinations, quizzes, homework assignments and a project.

Person who prepared this description and date of preparation: C. Shangraw

COURSE: SURE 372 ADJUSTMENT COMPUTATIONS I (REQUIRED)

Credits:	3 Hours
Contacts:	3 Lecture, 0 Lab Hours per week
Course Description:	This is the first of the two sequential courses on adjustment computations. Topics to be covered include: use of vectors, set theory, partial differentiation, matrix differentiation, statistical inference and hypothesis testing, an introduction to differential equations, propagation of random errors, and the relationships between variance covariance, weight and cofactor matrices as applied to least squares adjustment.
Course Prerequisites:	SURE 230, Math 322 & SURE 272 or equivalent and/or ability to program in any high level language.
Required Textbooks:	**Advanced Surveying Calculations: Lecture Notes**, 2009. Dr. Khagendra Thapa.
Reference:	**Surveying Theory and Practice,** by Anderson and Mikhail, 7th Edition

Student Learning Outcomes

Upon completion of the course, the student should be able to:

8. Understand statistical concepts such as: measure of central tendency, measures of variability, hypothesis testing of the mean and variance (PO 2, 3, 4, ABET a,b,c,e,k).
9. Comprehend concepts of elementary differential equations (PO 2, 3 ABET a,b,c,e).
10. Understand the application of partial differentiation to the propagation of random errors in surveying (PO 2, 4, ABET a,b,e,j,k).
11. Know the relationship between weight matrix and variance covariance matrix (PO 2, 4, ABET a,b,e,j,k).

Topics Covered:		**Lecture Hours**
1.	Introduction, set theory: sets, elements, set operations & ven diagrams: union, intersection, difference (relative complement), absolute complement, finite and countable sets, classes of sets.	2
2.	Vector and vector Analysis: Vector representation, vector operations, scalar and vector products, use of vectors in Surveying Engineering, vector spaces and subspaces, linear independence and dependence	5

3.	Partial Differentiation: Its application to surveying engineering, differentiation of matrices and vectors, concept of propagation of errors	5
4.	Measures of Central Tendency (mean, mode, median) and their application to Surveying engineering Problems, Measures of Dispersion (range, variance, and standard deviation, skewness, and Kurtosis, frequency distribution) their application to Surveying engineering Problems, graphical representation of data (Pie Charts, Histogram, Frequency Polygon), concept of probability, distribution theory, Normal distribution, estimation, point and interval estimates, hypothesis testing null and alternate hypothesis, type I and type II errors, level of significance, power of a test, one and two tailed tests, sampling Distributions, t –tests, Chi-square and F tests, covariance and correlation coefficient and its use in surveying engineering.	15
5.	Propagation of Random Errors: Formulation of variance/covariance matrix, propagation of error where one variable is a function of one or variables, propagation of error where two or more variables are functions of two or more variables, relationships between weight, covariance and cofactor matrices	10
6.	Solution of ordinary differential equations encountered in surveying engineering.	5
7.	Three unit examinations plus a final.	4
	Total	45

Contribution of the course to meeting the requirements of Criterion 5: This is the first course in adjustment computations and as indicated above in course outcomes, it partially satisfies Program Outcomes (PO) 2, 3, & 4.
Relationship of the course to Program Outcomes: As indicated above, this course partially satisfies PO 2, 3, & 4.
Person who prepared this description and date of preparation: K. Thapa, 4/3/2010

COURSE: SURE 373 ADJUSTMENT COMPUTATIONS II

Credits:	3 Hours
Contacts:	3 Lecture, 0 Lab Hours per week
Course Description:	This is a continuation of Adjustment Computations 1 – SURE 372. Topics covered include: review of error propagation, development and application of least squares, horizontal and vertical control network designs; adjustment of indirect of observations, adjustment of observations and parameters combined. Student adjustment projects include: level network, traversing, triangulation, trilateration, and GPS network.
Course Prerequisites:	SURE 372 - Adjustment Computations 1

Required Textbooks:	**Surveying Theory and Practice**, by Anderson and Mikhail, 7th Edition
Required Materials:	Lecture Notes by Sayed Hashimi

Student Learning Outcomes

a. Be able to understand the laws of propagation of random errors through the application of mathematical and statistical concepts (PO 2, 3).
b. Be able to understand the development and application of least squares principles into surveying (PO 2, 3).
c. Be able to apply design concepts into horizontal and vertical control networks (PO 4).
d. Be able to develop a high level language computer program to perform a least squares adjustment (PO 2, 3).

2.

Instructional Unit Topic Descriptions and Time Allocations

NO.	UNIT TOPIC DESCRIPTION SUMMARY	LECTURE HOURS
I.	Concepts of Measurement and Error, Types of Errors	2
II.	Variance Covariance Propagation	6
III.	Adjustment of Indirect Observations - linear and nonlinear cases	14
IV.	Control Network Design: Level Network, Horizontal network, 3-D network	4
V.	Adjustment of Observations and Parameters Combined	6
VI.	Pre-analysis of Survey Measurements: Distance and angle measurements, Elevation difference using differential leveling	3
VII.	Statistical Analysis: Error Ellipses, Test of Variances using Chi-square distribution	6
VIII.	Four Tests	4
	Total Hours	45

Contribution of the course to meeting the requirements of Criterion 5: This is the first technical course in the program and as indicated above in course outcomes, it partially satisfies Program Outcomes PO 1, 3, & 4.

Relationship of the course to Program Outcomes: As indicated above, this course partially satisfies PO 1, 3, & 4.

Person who prepared this description and date of preparation: S. Hashimi 4/14/10

Course: SURE 420 Professional Practice of Surveying

Credits:	3 Hours
Contacts:	3 Lectures hours per week
Course Description:	A study of business practices as they apply to the organization offering professional engineering and/or surveying practices. This course meets General Education requirements: Writing Intensive Requirement.
Course Prerequisites:	SURE 365, ENGL 250
Required Textbooks:	*The Wall Street Journal*, Dow Jones and Company, New York, NY; *Prentice Hall Handbook for Writers, 13th Ed.*, Kramer, et. al., Prentice Hall, Inc., Englewood Cliffs, New Jersey,2008; C. Shangraw, *Class Notes*, Winter, 2011
Reference Textbooks:	*What Color is Your Parachute;* Richard Nelson Bolles; Ten Speed Press; Berkely, CA.; 1999; *Sample Contracts Manual;* American Congress on Surveying and Mapping; Falls Church, VA.; 1988; *Surveyors and Engineers Small Business Handbook;* CED Technical Services; Tuscaloosa, Alabama; 1995
Required Materials:	Portfolio covers

Student Learning Outcomes

Students satisfactorily completing this course will achieve/complete/demonstrate:

1. the importance and relevance of licensure as a Professional Surveyor and a Professional Engineer along with Michigan requirements for obtaining them and renewing them. (ABET Criteria 3i), (PO 8)
2. the fundamentals of operating a successful professional consulting business (ABET Criteria 3d, 3f, 3g, 3h & 3j)(PO 7).
3. Integrating the practices of surveying engineering with the concepts of ethical conduct and sustainable development (ABET Criteria 3f & 3i)(PO 7).
4. Effective written communication(Abet Criteria 3g) (PO 5)

Person who prepared this description and date of preparation: C. Shangraw

Course: SURE 440 Photogrammetry

Credits:	3 Hours
Contacts:	2 Lecture, 3 Lab Hours per week
Course Description:	This course acquaints the student to advanced photogrammetric concepts that are normally encountered in photogrammetric practice. Topics include an introduction to analytical photogrammetric principles, concepts of the bundle adjustment, principles of advanced sensors, orthophotography, and principles of digital photogrammetry.
Course Prerequisites:	SURE 340, SURE 373
Required Textbooks:	Photogrammetry: Geometry from Images and Laser Scans, by K. Kraus, de Gruyter.
References:	Manual of Photogrammetry, 5th edition, by J. C. McGlone, E. M. Mikhail, and J. S. Bethel, American Society for Photogrammetry and Remote Sensing

Course Learning Outcomes

Students satisfactorily completing this course will have an understanding of:

6. Be able to transform coordinates to photo system and apply corrections to those transformed coordinates . (PO 2, 4)
7. Be able to describe the physical concept of the collinearity condition equation and derive the observation equations for Case 1, Case II, Case III, and Case IV theory. They will also be able to write a least squares adjustment program. (PO 2, 4)
8. Be able to understand the concepts of direct sensor orientation, airborne GPS, and mobile mapping, including the utilization of lidar data (PO 2,4)
9. Be able to understand the process of orthophotography and rectification of digital imagery, including satellite sensors (PO 2,4)
10. Be able to describe the basic principles of digital image processing. (PO 2, 4)

Topics Covered:

15. 2-D and 3-D coordinate transformation theory
16. Atmospheric refractions, lens distortion, earth curvature, film deformation and Third order theory
17. Collinearity and coplanarity conditions and linearization, numerical resection and orientation
18. Airborne GPS, direct sensor orientation, mobile mapping
19. Laser scanning
20. Orthophotography
21. Image processing (resampling, filtering, geometric corrections, image transformation) and digital photogrammetry

Computer usage: Mapping Software, Spreadsheet/MathCAD/Matlab

Required Laboratory Schedule

17. Transformation and correction of photo coordinates
18. Write program for single photo resection and orientation
19. Create orthophotograph of area on campus

Contribution of the course to meeting the requirements of Criterion 5: This is the first photogrammetry course in the program and as indicated above in course outcomes, it partially satisfies Program Outcomes (PO) 2, 4.
Relationship of the course to Program Outcomes: This course partially satisfies POs 2, 4.
Person who prepared this description and date of preparation: R. Burtch, 05/30/11

COURSE: SURE 452 GEODESY I

Credits:	4 Hours
Contacts:	3 Lecture, 3 Lab Hours per week
Course Description:	This is the first of the two sequential courses in geodesy. Topics covered include: ellipsoidal geometry, direct and inverse solution of geodetic line, geodetic datum, coordinate systems, deflections of vertical, celestial sphere, solution of spherical triangles, time systems, astronomical azimuth and Laplace's equation, developable surfaces, basic properties and characteristics of most common map projections with stronger emphasis on the projections used in State Plane Coordinates such as Lambert conformal, transverse Mercator and UTM.
Course Prerequisites:	Sure 230 and Sure 372

Required Textbooks:	**Geodesy and Map Projections**, by K. Thapa, Ph.D. January, 2009
References:	**Geodesy**, by G. Bomford **Geodesy the Concepts,** by Vanicek and Krakiwsky **State Plane Coordinates of 1983,** by James Stem, 1990, NGS

Student Learning Outcomes

Upon completion of the course, the student should be able

1. To understand basic ellipsoidal geometry, and direct and inverse problem. (PO 2, 3, 8, ABET a, c, I, e, k).
2. To understand the concepts of datum, and coordinate systems. (PO 2, 3, 4, ABET a, b, j, k).
3. Be able to reduce observations to the computational surface. (PO 2, 3, ABET a, c, e, k).
4. Be able to understand the theory of map projections and application of map projection to state plane coordinates (PO 2, 3, 4, 8, ABET a, b, j, k).

Topics Covered:

1. History of Geodesy	2	
2. Geometry of sphere & ellipsoid		10
3. Coordinate systems (plane, sphere, ellipsoid)	6	
4. Motions of the Earth, Stars, and Sun	1	
5. Time Systems		2
6. Direct and Inverse Geodetic Problems		2
7. Gaussian Fundamental Quantities		1
8. Theory of Distortions in Map Projection		3
9. Fundamental Methods of Map Projection		6
10. Conformal Projections (State Plane Coordinates)	9	
11. Three Test	3	

Total	45	

Contribution of the course to meeting the requirements of Criterion 5: This is the first course in Geodesy and as indicated above in course outcomes, it partially satisfies Program Outcomes (PO) 2, 3, 4, & 8.
Relationship of the course to Program Outcomes: This course partially satisfies (PO) 2, 3, 4, & 8.
Person who prepared this description and date of preparation: K. Thapa, 12/3/09

Course: **SURE 453** **Geodesy II**

Credits: 4 Hours

Contacts: 3 Lecture, 3 Lab Hours per Week

Course Description: This course is a continuation of SURE 452, Geodesy 1. Topics covered include: introduction to physical geodesy, gravity observations and reduction, Stoke's integral, Bruns formula, basic concepts of positioning by observing satellites, satellite geodesy, Global Positioning System (GPS) including both theoretical and practical aspects, VLBI, lunar and satellite laser ranging, satellite altimetry, and inertial positioning system.

Course Prerequisites: SURE 452 and SURE 373

Required Textbooks: GPS Theory and Practice, by B.Hofmann-Wellenhof, H. Lichtenegger, and J.Collins, Springer Verlag. Fifth Revised Edition, 2001

References: Satellite Geodesy by Gunter Seeber, Walter DeGruyter, New York, 2002
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Student Learning Outcomes

Upon completion of the course, the student should be able to:

1. Comprehend standards & specifications geodetic networks and datum transformation. (PO 2, 3, 4, ABET a,b,c,e, k)
2. Understand Gravity and its potential, gravity anomalies different types of heights (PO 2, 3, 4, ABET a,b,c,e, k)
3. Learn about Theory of Satellite Positioning, GPS, and use of GPS equipment to establish geodetic networks (PO 2,3,4,6,7, ABET a,b,c,d,e,f,k)
4. Understand the concepts of laser ranging, inertial positioning and VLBI and their use in Geodesy. (PO 2, 3,5, 8, ABET a,c,e,g, i,k)

Contribution of the course to meeting the requirements of Criterion 5: This is the second course in Geodesy and it partially satisfies Program Outcomes (PO) 2,3,4, 5,6,7,8.

Relationship of the course to Program Outcomes: This course partially satisfies (PO) 2,3,4, 5,6,7, & 8

Topics Covered:

1. History of Geodesy, Eratosthenes, Ptolemy, Shape and size of the earth	1
2. Importance of Geodesy and its relationship to other disciplines	1
3. Geodetic survey planning standards and accuracy	2
4. Geodetic networks and functions of NGS	1
6. Coordinate systems and transformations	1
7. Gravity and its potential	3
8. Gravity Reductions	3
9. Solution of Laplace equation	1
10. Stoke's and Vening-Meinesz Equations	1
11. Disturbance Potential and Bruns Formula	1
12. Satellite orbits Keplerian elements	3
14. Global Positioning System (GPS)	2
15. Antennas and Receivers	2
16. Biases and errors	
17. GPS survey design and its practical aspects	5
18. Observation Equations	2
19. GPS observations and positioning	6
20. Inertial Positioning system	2
21. VLBI and Laser ranging	2
22. Three Tests	3
Total	45

Required Laboratory Schedule

1. Datum Transformation
2. Baseline Observation
3. Establish a geodetic network in the campus and its vicinity
4. Real Time Kinematic Survey (RTK)

Person who prepared this description and date of preparation: K. Thapa, 12/3/10

Course: SURE 465 LEGAL ASPECTS OF SURVEYING II

Credits:	3 Hours
Contacts:	3 Lecture (M,W, F; 1:00-1:50 Swan 111) per week
Course Description:	A study of the total body of law as it applies to the practice of Land Surveying. Both statute law and common law are covered. A number of court cases are studied for the purpose of defining the land surveyor's role in the judicial process and the use of legal precedent in answering the related questions of law and fact. Practical description writing and interpretation is an essential portion. Writing intensive.
Course Prerequisites:	SURE 365, Legal Aspects of Surveying I; ENGL 250, English 2. It is expected that the student have proficiency in the following areas: English composition, basic land boundary theory, history of surveying, fundamental traverse, coordinate and area calculations CAD.
Required Textbooks:	*Clark on Surveying and Boundaries, 7th Ed*.; Robillard, W.G. et al.; Lexis Law Publishing (VA); (1998); Keen, John E.; *Easements;* Land Surveyors Workshops; Spruce Pine, NC (1998); Shangraw, C.; *Class Notes SURE 465 2010.*
Reference Textbooks:	*Prentice Hall Handbook for Writers, 12th Ed*.,;Kramer, et. al.;Prentice Hall, Inc., Englewood Cliffs, NJ;(1995). *Land Surveying Law, 3d Ed. Manual of Instructions for the Survey of the Public Lands of the United States;* Bureau of Land Management, United States Department of the Interior; Washington, D. C., 2009.
Required Materials:	Some form of memory device such as a USB memory stick, external hard drive, etc.

Student Learning Outcomes

Students satisfactorily completing this course will achieve/complete/demonstrate…:

1. Acquire a working knowledge of the major statutory laws affecting the practice of surveying in the State of Michigan. (P.O. 1, 3 & 7)
2. Know how to research court cases and public documents (P.O. 1, 3 & 7).
3. Have a basic knowledge of Riparian issues in the State of Michigan. (P.O. 1, 3 & 7)
4. Be familiar with advanced concepts of the Public Land Survey System. (P.O. 1, 3 & &)
5. Continue to gain competence in the preparation and interpretation of legal descriptions (P.O 5).
6. Explore the fundamental concepts of easements (P.O. 1, 3 & 7)
7. Further develop effective writing skills (P.O. 5)

Course Schedule and Outline

Date	Lecture Topic	Preparation	Assignment
Week 1	**Effective writing:** Role of writing in professional/academic settings, strategies for determining appropriate document type and style, effective writing for different audiences, organization of papers for various purposes.	Lecture Notes	
Weeks 2 & 3	**Duties and liabilities of the surveyor**: The legal role of the surveyor, the American and Michigan judicial systems, professional liability, negligence, torts.	Lecture Notes Clark, Ch. 2	
Weeks 4 & 5	**Public Land Survey System:** PLSS Datum, State Plane Coordinates with the PLSS, Laying off latitude, restoration of corners.	Lecture Notes Clark, Ch.5, 9, 11, 17	
Weeks 6, 6, & 7	**Legal Descriptions:** Types, Writing and Interpreting, Simultaneous v. Sequential Conveyancing	Lecture Notes Clark, Ch. 12, 16, 20	
Weeks 8 & 9	**Riparian Issues in Michigan** Michigan Riparian Rights, Bottomland ownership, Public Rights in Michigan Waters, islands and swampland grants.	Lecture Notes Clark, Ch.23, 24, 25	
Week 10	**Easements** Creating. Functions, operational effects	Keene	Lab 8
Weeks 11 & 12	**Michigan Public Acts Affecting the Surveyor I**. Part IIB, Certified Surveys, Corner Recordation Act, Michigan Coordinate Systems, Recording Affidavits, Right of Entry, appropriate rules	Lecture Notes	
Weeks 13, 14 & 15	**Michigan Public Acts Affecting the Surveyor II** Condominium Act, Land Division Act, Natural Resources and Environmental Protection Act, State Survey and Remonumentation Act, Land Division Act, Drain Code	Lecture Notes	

Person who prepared this description and date of preparation: C. Shangraw

COURSE: CENG 220 ENGINEERING SURVEYING

Credits:	4 hours
Contacts:	2 lecture, 6 lab hours per week
Course Description:	A continuation of SURE 110. Engineering surveying theory and techniques. Subject areas include state plane coordinates; horizontal, vertical, and easement curve calculations and layout; slope staking; earthworks; introduction to GPS; water levels; and aspects of hydrographic, tunnel, and mine surveying.
Course Prerequisites:	Sure 110 Fundamentals of Surveying

Required Textbooks:	SURVEYING, Principles and Applications, 8th ed., Barry Kavanagh
Course Web Site:	MyFSU/Courses/CENG 220

Course Learning Outcomes

Students satisfactorily completing this course will achieve/complete/demonstrate:

1. Understand procedures for horizontal and vertical measurements for route surveying and engineering projects (PO 2).
2. Appreciate the requirements of good field notes (PO 2).
3. Ability to work effectively and interdependently as a team (PO 6).
4. Knowledge of how to use modern equipment and techniques for field procedures (PO 2).
5. Understand and apply the basics of mapping methods and computer assisted drafting (PO 3).
6. Develop geometry for calculations of surveying and engineering projects (PO 3).

(PO = Program Outcome)

Course: CENG 240 Engineering Statics

Credits: Three Hours

Contacts: Three Lecture, No Lab Hours per Week

Course Description: The first course in mechanics for engineers focuses on rigid bodies and, more specifically, statics. Statics is the study of rigid bodies at rest. Using vector mechanics as appropriate, the principles of mechanics and their application to the solution of engineering problems are explored.

Course Prerequisites: PHYS 241 – General Physics 1 (Can be a co-requisite)
MATH 230 – Analytical Geometry and Calculus 2

Required Textbooks: *Vector Mechanics for Engineers:Statics*, 8th edition, Beer Johnston and Eisenberg, McGraw-Hill, 2007

Required Materials: Calculator with exponential functions
Engineering Paper

Course Learning Outcomes

Students satisfactorily completing this course will have an understanding of:

11. Equilibrium as it relates to rigid body statics (PO 2,3)
12. Drawing free body diagrams for force systems and static equilibrium (PO 2,3)
13. Determining the values of section profile properties (PO 2,3
14. Calculating forces within structural members (PO 2,3)
15. Calculating the forces of friction (PO 5,7,8)

Topics Covered

1. Statics of particles
2. Equivalent force systems of rigid bodies
3. Equilibrium of rigid bodies
4. Centroids and center of gravity
5. Analysis of structures

6. Forces in beams and cables
7. Friction
8. Moments of Inertia

Computer usage: Spreadsheets

16.
17.
18.
19. ____

Contributions of the course to meeting the requirements of Criterion 5: This is a required Civil Engineering course and as indicated in course outcomes it partially satisfies Program Outcomes (PO) 2,3

Relationship of the course to Program Outcomes: This course partially satisfies POs 2,3

Person who prepared this description and date of preparation: D. Hanna, 05/16/11

Required Laboratory Schedule

NO.	UNIT TOPIC DESCRIPTION SUMMARY	LECTURE HOURS	LAB HOURS
I.	Introduction and orientation	1	0
II.	Basic properties of fluids	1	0
III.	Overview of hydrology and hydraulics	0	2
IV.	Viscosity of fluids	1	0
V.	Pressure of fluids	2	2
VI.	Buoyancy	1	2
VII.	Fluid flow and the Bernoulli Theorem	5	2
VIII.	Pressure conduits and flow classification	6	2
IX.	Piping systems and headlosses	6	6
X.	Open channel flow and flow measurement	4	2

XI.	Pumping systems	4	1
XII.	Hydrology	4	1
XIII.	Runoff, precipitation, infiltration	3	2
XIV.	Groundwater	3	2
XV.	Frequency analysis	1	0
XVI.	Drainage systems and culverts	3	0
XVII.	Interview Report	0	0
XVIII.	Examinations	0	6
	Total Hours	45	30

Course: CENG 321 Hydraulics Engineering

Credits:	Four Hours
Contacts:	Three Lecture, Two Lab Hours per Week
Course Description:	Combined presentation of hydraulics and hydrology. Course shall include the natural occurrence of water on the earth and the study of fluid mechanics, kinematics of fluid flow, energy and momentum relating to the movement of water. Open channel flow and pressure conduits leading to gravity drainage design and pressure water supply systems.
Course Prerequisites:	PHYS 242 – General Physics 2 MATH 230 – Analytical Geometry and Calculus 2

Required Textbooks:	*Applied Fluid Mechanics*, R.L.Mott, 6th Edition, Pearson/Prentice Hall
Required Materials:	Calculator with exponential functions Engineering Paper Technical literature supplied by the Instructor

Course Learning Outcomes

Students satisfactorily completing this course will have an understanding of:

1. Fluid properties and characteristics (PO 2,3)
2. Pressure piping flow and headlosses (PO 2,3)
3. Open channel flow and flow measurement (PO 2,3
4. Hydrologic cycle, statistical development, and runoff prediction (PO 2,3)
5. Role of and interaction with Professional Civil Engineers (PO 5,7,8)

Topics Covered

1. Properties and characteristics of fluids
2. Fluid statics, pressure and buoyancy
3. Fluid flow and the Bernoulli theorem
4. Pressure flow of fluids and piping headlosses
5. Open channel flow
6. Pumping systems design
7. Hydrologic estimation of precipitation and runoff
8. Drainage system design

Computer usage: Spreadsheets, MathCad

Required Laboratory Schedule
1. Nature and properties of fluids
2. Pressure if fluids
3. Statics and buoyancy
4. Fluid Energy and the Bernoulli Theorem
5. Energy losses in closed conduits
6. Series and parallel piping systems
7. Hazen Williams equation
8. Pump selection and system curves
9. Open channel flow
10. Flow measurement
11. Hydrology and rainfall
12. Wells, groundwater, drainage

Contributions of the course to meeting the requirements of Criterion 5: This is a required Civil Engineering course and as indicated in course outcomes it partially satisfies Program Outcomes (PO) 2,3,5,7,8

Relationship of the course to Program Outcomes: This course partially satisfies Pos 2,3,5,7,8

Required Laboratory Schedule

NO.	UNIT TOPIC DESCRIPTION SUMMARY	LECTUR E HOURS	LAB HOURS
I.	Introduction and orientation	1	0
II.	Basic properties of fluids	1	0
III.	Overview of hydrology and hydraulics	0	2
IV.	Viscosity of fluids	1	0
V.	Pressure of fluids	2	2
VI.	Buoyancy	1	2
VII.	Fluid flow and the Bernoulli Theorem	5	2
VIII.	Pressure conduits and flow classification	6	2
IX.	Piping systems and headlosses	6	6
X.	Open channel flow and flow measurement	4	2

XI.	Pumping systems	4	1
XII.	Hydrology	4	1
XIII.	Runoff, precipitation, infiltration	3	2
XIV.	Groundwater	3	2
XV.	Frequency analysis	1	0
XVI.	Drainage systems and culverts	3	0
XVII.	Interview Report	0	0
XVIII.	Examinations	0	6
	Total Hours	45	30

Course: **CENG 485** **Sustainable Land Use**

Credits:	3 Hours
Contacts:	3 Lecture3 Lab Hours per Week
Course Description:	A senior capstone course including in part land use controls, land study and development design, site feasibility and utility service, site ecology, and social and psychological analysis of development. The roles and tasks of the site design professional are studied. A major design project will be undertaken. Emphasis will be on subdivision design, site design, cost analysis of development, and use of technical design software.
Course Prerequisites:	Senior Status & Surveying Students only
Required Textbooks:	City Planning for Civil Engineers, Environmental Engineers, and Surveyors, by Kurt Bauer, published by CRC Press, 2010.
References:	Land Development Handbook, 2nd edition, The Dewberry Companies, published by McGraw-Hill.
Other Material:	Additional reference materials, mandatory reading assignments, and other information provided through FerrisConnect and class handouts.

Course Learning Outcomes

Students satisfactorily completing this course will have an understanding of:

5. Acquire an understanding of land use planning, and for the procedures for designing streets, utilities, land divisions, condominiums, and subdivisions. (PO 1, 3, 4)
6. Appreciate the history of urban development and how social, political, demographics, transportation, and economic result in change. (PO 1, 7, 8)
7. Students can draw upon their diverse backgrounds in a major design project. (PO 4)
8. Know how legal restrictions, site conditions, aesthetic, environmental condition, and economic goals of sustainable developments are met. (PO 1, 3, 4)

Topics Covered:

22. History of planning and subdivision design
23. Zoning principles, master plan
24. Subdivision design principles and the Land Division Act
25. Traditional neighborhood design, PUDs, condominium law
26. Transportation systems
27. Sewage systems, drainage, grading and erosion control
28. Water supply systems
29. Social and cultural issues

Computer usage: CAD

Required Laboratory Schedule

20. Certified survey (Act 132 drawing) (3 weeks)
21. Preliminary plat design (4 weeks)
22. Final plat (2 weeks)
23. Right to Farm Act (1 week)
24. Engineering Drawings – plan and profile, sanitary sewer design

Contribution of the course to meeting the requirements of Criterion 5: This is the capstone course in the program and as indicated above in course outcomes, it partially satisfies Program Outcomes (PO) 1, 3, 4, 7, 8.
Relationship of the course to Program Outcomes: This course partially satisfies POs 1, 3, 4, 7, 8.
Person who prepared this description and date of preparation: R. Burtch, 05/30/11

COURSE: GISC 225 PRINCIPLES OF GEOGRAPHIC INFORMATION SYSTEMS (REQUIRED)

Credits: 3 Hours

Contacts: 2 lectures, 3 Lab Hours per week

Course Description: This course explores fundamental principles of Geographic Information Systems (GIS) and its applications including hardware and software. Topics covered include: database concepts, algorithms to manage spatial data, cost benefit analysis, GIS project management, and digital data dissemination methods using internet technologies. Students will work with database management system, raster and vector GIS applications software on various case studies including nature and environmental conservation, real estate administration, marketing and city management

Course Prerequisites: Basic computer skills

Required Textbooks: Tim Ormsby et al. (2008) Getting to Know ArcGIS Desktop, Second Edition, Updated for ArcGIS 9.3 Basics of ArcView, ArcEditor, ArcInfo.

Reference Text:

1. Stephen Wise (2002) GIS basics, London: Taylor & Francis (G70.212 .W57 2002).
2. Kang-Tsung Chang (2009). Introduction to Geographic Information Systems with Data Files CD-ROM, 5th ed. McGraw-Hill

Required Materials: Some form of memory device such as a USB memory stick, external hard drive, etc.

Course Learning Outcomes

Students satisfactorily completing this course will achieve/complete/demonstrate…:

20. Understanding of the role of GIS in the various applications (surveying engineering, homeland security, environmental biology, etc.) and the GIS specialist role in the implementation and maintenance of a GIS (PO 1, 4).
21. Ability to work with GIS software to solve spatial problems (PO 2, 3).
22. Written reports and papers and orally present the research findings in a group environment (PO 5, 6).
23. Knowledge in the effects that a GIS has on society and the economic and legal ramifications that a GIS presents (PO 7, 8).

Topics Covered:

1. Introduction to GIS (1 class)
2. Computer hardware, Binary data (2 classes)
3. Database management systems, SQL - Structured Query Language(2 classes)
4. Algorithms, sequential and binary search. Bubble sort and Quick sort (2 classes)
5. Characteristics of maps: Accuracy, Scale, Coordinate Systems and projections(2 classes)
6. Spatial Data collections techniques(1 class)
7. Spatial Data , vector features(points, lines, polygons) (2 classes)
8. Raster Data (Ascii format), Raster Vs. Vector(1 classes)
9. Topology (Arc-node data model) (2 classes)
10. GIS operations and functions on vector data (line intersection, map overlay) (3 classes)
11. Legal issues in GIS (Liability, digital files as court evidence, Freedom of Information act) (2 classes)
12. Cadastre and land information systems (1 class)
13. Surfaces, Triangulation and Interpolation(2 classes)
14. Cost and benefits of a GIS project (1 class)
15. Management of GIS (Federal, State, County) (2 classes)
16. Environmental applications of GIS (2 classes)
17. Homeland security applications of GIS (1 class)

Computer usage:

Microsoft Access, GIS software (ArcGIS), AutoCAD Map, Excel, GPS

Required Laboratory Schedule

1. Microsoft Access, office management database (3 weeks)
2. Getting to know ArcGIS tutorial (6 week)
3. AutoCAD Map – CAD to GIS project (2 weeks)
4. Mapping and data compilation project (3 weeks)
5. Report writing and project presentation (1 weeks)

Contribution of the course to meeting the requirements of Criterion 5: This is the first course in the chain of Information science courses were the students utilize advanced technologies and data to analyze and solve an engineering problems. The course partially satisfies Program Outcomes (PO) 1-8.
Relationship of the course to Program Outcomes: As indicated above, this course partially satisfies Pos 1-8.
Person who prepared this description and date of preparation: K. Thapa, 2/5/11

COURSE: GISC 239 REMOTE SENSING

Credits:	3 Hours
Contacts:	2 Lecture, 3 Lab Hours per week
Course Description:	This course explores the fundamental principles of remote sensing as they relate to engineering and environmental problems. Topics covered include energy interactions, reflectance, scanning systems, satellite sensors, digital image process, and image classification. Students will work with image processing software.
Course Prerequisites:	PHYS 211 or PHYS 241
Required Textbooks:	**Introduction to Remote Sensing**, J. Campbell, Guilford Press.
Reference Text	1. **Remote Sensing Engineering and Design EM1110-2-2907** (2003), Us Army Corps of Engineers Washington DC. 217 pp 2. **Tutorial: Fundamentals of Remote Sensing**, Canada Centre for Remote Sensing
Required Materials:	**ERDAS IMAGINE Essentials Tour Guides**, Lab tutorial

Course Learning Outcomes

Students satisfactorily completing this course will achieve/complete/demonstrate…:

1. Know the basic principles of remote sensing and how it is utilized in mapping today (PO 1).
2. Be able to evaluate the design necessary for an effective remote sensing data collection strategy (PO 2, 3).
3. Be able to analyze and enhance remote sensing images (PO 2, 4).
4. Prepare written reports and papers and to orally present the findings in a group environment (PO 5, 6).
5. Know the role and applicability of remotely sensed data in society such as the economic role, political role and engineering role (PO 7, 8).

Topics Covered:

1. Introduction to remote sensing (1 class)
2. Electromagnetic radiation and Atmospheric interaction (3 classes)
3. Sensors and telescopic systems (3 classes)
4. Image Interpretation and human vision (2 classes)
5. Satellite orbits (Keplers laws) (2 classes)
6. Satellite remote sensing systems(2 classes)
7. Digital analysis and image processing techniques (5 classes)
8. Image transformations (2 classes)
9. Image classification (3 classes)
10. Microwave remote sensing (1 class)
11. Thermal imaging (1 class)
12. Technologies for acquiring and processing Hyperspectral data (1 class)
13. Bathymetric mapping (1 class)
14. Remote Sensing applications (2 classes)

Computer usage:

Remote Sensing software (ERDAS 9.3), Google Earth, Matlab, GPS

Required Laboratory Schedule

1. Erdas Essentials (8 weeks)
2. Image interpretation with Google Earth (1 week)
3. Matlab image processing (2 weeks)
4. Mapping and image processing project (3 weeks)
5. Report writing and project presentation (1 week)

Contribution of the course to meeting the requirements of Criterion 5: This is the second course in the chain of Information science courses were the students utilize advanced technologies and data to analyze and solve an engineering problems. The course partially satisfies Program Outcomes (PO) 1-8.
Relationship of the course to Program Outcomes: As indicated above, this course partially satisfies POs 1-8.
Person who prepared this description and date of preparation: K. Thapa, 2/5/11

COURSE: GISC 425 TECHNICAL ISSUES IN GEOGRAPHIC INFORMATION SYSTEMS AND CARTOGRAPHY

Credits:	3 Hours
Contacts:	2 Lecture, 3 Lab Hours per week
Course Description:	Advanced concepts of geographic information systems and modern cartography will be studied. Topics covered include: metadata, federal and state spatial databases, map generalization, map labeling, advanced spatial data analysis, Digital Elevation Models (DEM), interpolation methods, DEM analysis such as slope, aspect, watershed, line of sight and grid operations. These topics will be linked to the data collection courses photogrammetry, remote sensing, land surveying and geodesy. Laboratory assignments will be project oriented using existing raster and vector GIS software.
Course Prerequisites:	SURE 227 – Programming Applications in Geomatics, GISC 225 - Introduction to GIS
Required Textbooks:	None
Reference Text	**Introduction to Geographic Information Systems**, Kang-Tsung Chang, McGraw-Hill Science Engineering **Data in Three Dimensions: A Guide to ArcGIS 3D Analyst**, Heather Kennedy OnWord Press
Required Materials:	None

Course Learning Outcomes

Students satisfactorily completing this course will achieve/complete/demonstrate…:

1. Understand the technical aspects of GIS and Cartography including spatial data visualization, surface analysis, and advanced algorithms (ABET Criteria 3a & 3e).
2. Work on the design and implementation of a GIS Project (ABET Criteria 3b & 3c).
3. Understand the role that GIS has in society such as technical design issues required for particular client GIS needs (ABET Criteria 3h & 3k).

Topics Covered:

1. GIS resources, Metadata and spatial data standards (2 classes)
2. Introduction to cartographic enhancement using GIS (2 classes)
3. Generalization/simplification (2 classes)
4. Map conflation, integrating diverse data sources (2 classes)
5. Label placement rules and algorithms (1 class)
6. Introduction to surface analysis (1 class)
7. Local and global interpolation strategies (3 classes)
8. Slope and aspect computation (1 class)
9. Drainage, line of sight, and viewshed analysis (2 classes)
10. Digital Elevation Model (DEM) visualization (2 classes)
11. Map algebra, decision support GIS (2 classes)
12. Raster to vector operation (2 classes)
13. Errors and quality control in GIS (3 classes)
14. Advanced GIS operations (network and pattern analysis) (3 classes)

Computer usage:

ArcGIS software (ArcGIS 9.3), AutoCAD, Matlab, GPS

Required Laboratory Schedule

1. Creating a portfolio of maps from different resources (4 weeks)
2. Using 3D analyst lab tutorials (3 weeks)
3. Matlab geographical data processing (2 weeks)
4. Working on a mapping project (3 weeks)
5. Using Laser Scanning data (1 week)
6. Converting raster to vector using AutoCAD raster design (1 weeks)

5. Report writing and project presentation (1 week)

Contribution of the course to meeting the requirements of Criterion 5: This is the third course in the chain of Information science courses were the students utilize advanced technologies and data to analyze and solve an engineering problems. The course partially satisfies Program Outcomes (PO) 1-8.
Relationship of the course to Program Outcomes: As indicated above, this course partially satisfies Pos 1-8.
Person who prepared this description and date of preparation: K. Thapa, 2/5/11

Course: CONM 121 Materials Properties and Testing

Credits:	Three Hours
Contacts:	Two Lecture, Two Lab Hours per Week
Course Description:	Application and properties of construction materials. The sampling, testing and application of the physical properties of aggregates and Portland cement concrete; bituminous materials, metals and wood.
Course Prerequisites:	Grade of C- or better in MATH 110 or ACT placement of 19 or above

Required Textbooks:	*Basic Construction Materials,* Marotta
Required Materials:	Scientific Calculator Safety glasses

Course Learning Outcomes

Students satisfactorily completing this course will have an understanding of:

1. Types and qualities of aggregates, sampling techniques, gradation, engineering properties, compliance with specifications and laboratory testing methods (PO 1)
2. Properties of Portland Cement Concrete, including engineering properties, mix design methods, mixing placing and curing of concrete, and testing of concrete (PO 1)
3. Properties of steel and other metals, including stress and strain, elasticity, behavior under load, and strength of connections (PO 1, 3)
4. Properties of wood, including terminology, products, grading and preservation (PO 1, 3)
5. Properties of hot mix asphalt, including an understanding of mix design methods, production and placement (PO 4)

Topics Covered

1. English and metric units and conversions of units.
2. Standard ASTM laboratory testing techniques
3. Origins, engineering properties, sampling and testing of aggregates.
4. Properties, types, mix designs, mixing, placing, curing and testing Portland cement concrete.
5. Properties, uses, specifications and mix design methods for asphalt concrete.

6. Properties and uses of masonry and mortar.
7. Properties, uses and testing of steel and other metals.
8. Properties and specifications of wood and wood products.

Computer usage: None

24.
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33. **Required Laboratory Schedule**
34. ____

13. Laboratory techniques, safety and testing procedures.
14. Aggregate sampling and sieve analysis.
15. Aggregate weight/volume and moisture relationships.
16. Aggregate quality testing.
17. Design of Portland cement concrete mixes.
18. Mixing and pouring concrete beams and test cylinders.
19. Testing Portland cement concrete specimens.
20. Mixing and testing mortar specimens.
21. Steel stress-strain calculations and graphing.
22. Determining strength of steel connections.

Contributions of the course to meeting the requirements of Criterion 5: *This is a required Civil Engineering course and as indicated in course outcomes it partially satisfies Program Outcomes (PO) 2,3,5,7,8*

Relationship of the course to Program Outcomes: *This course partially satisfies Pos 2,3,5,7,8*

COMM 121
Fundamentals of Public Speaking

Required Materials:
Textbook: O'Hair, D., Rubenstein, H., & Stewart, R. (2010). A Pocket Guide to Public Speaking (3rd ed). Bedford/St. Martin's: Boston.
Writing materials (Paper, pen, #2 pencil)
Note cards (approx. 40 – 4"x6")
Recordable Mini-DVD (1)

Course Description:
COMH 121 is a 3-credit, general education course aiming to build public communication skills. Speaking opportunities, instructor, peer, and self-evaluation, textbook reading, instructor lecture, class discussion, and class activities accomplish this goal. Informative, persuasive and special occasion speech construction, continual improvement of speech delivery, and audience adaptation are the main focus of study considering such communication elements as empathy, cultural awareness, perception, communication context, and ethics.

General Education Speech Communication Outcomes:
Students should be able to:
1. Identify and describe the components of the human communication process. *(Classroom Discussion, Mid Term Exam, Cumulative Exam)*
2. Identify and describe the literal message content and the relationship variables between communicators in interpersonal, small group or presentational contexts. *(Classroom Discussion, Mid Term Exam, Cumulative Exam, All Speeches and Outlines Informative Speech Video Self-Analysis)*
Select, present, interpret and respond appropriately and effectively to verbal and nonverbal messages in interpersonal, small group or presentational contexts.*(Classroom Discussion, Mid Term Exam, Cumulative Exam, All Speeches, Informative Speech Video Self-Analysis)*
3. Use verbal and nonverbal messages to achieve personal, interpersonal, small group, or presentational goals, while developing and maintaining relationships with others. *(Classroom Discussion, Mid Term Exam, Cumulative Exam, All Speeches, Informative Speech Video Self-Analysis)*

Public Speaking Outcomes:
Students should be able to:

1. Choose and narrow a topic appropriately for the audience and occasion.*(Classroom Discussion, Mid Term Exam, Cumulative Exam, All Speeches, Speech Worksheets)*
2. Communicate the thesis in a manner appropriate for audience and occasion. (*Classroom Discussion, Mid Term Exam, Cumulative Exam, All Speeches, Speech Worksheets and Outlines)*
3. Provide effective supporting material based on the audience and occasion. (*Classroom Discussion, Mid Term Exam, Cumulative Exam, All Speeches, Speech Worksheets and Outlines, Library Research Instruction, Peer Speech Evaluations)*
4. Use an organizational pattern appropriate to topic, audience, occasion and purpose. *(Classroom Discussion, Mid Term Exam, Cumulative Exam, All Speeches, Speech Worksheets and Outlines,*

Peer Speech Evaluations)

5. Use language that is appropriate to the audience, occasion, and purpose. *(Classroom Discussion, Mid Term Exam, Cumulative Exam, All Speeches, Speech Outlines, Informative Speech Video Self-Analysis, Peer Speech Evaluations)*
6. Use vocal variety in rate, pitch and intensity to heighten and maintain interest. *(Classroom Discussion, Mid Term Exam, Cumulative Exam, All Speeches, Informative Speech Video Self-Analysis, Articulation Exercises, Peer Speech Evaluations)*
7. Use pronunciation, grammar, and articulation appropriate to the designated audience. *(Classroom Discussion, Mid Term Exam, Cumulative Exam, All Speeches, Speech Outlines, Informative Speech Video Self-Analysis, Articulation Exercises, Peer Speech Evaluations)*
8. Use physical behaviors that support the verbal message. *(Classroom Discussion, Mid Term Exam, Cumulative Exam, All Speeches, Informative Speech Video Self-Analysis, Peer Speech Evaluations)*

Students should also:

1. Know the criteria for an effective public speech. *(Classroom Discussion, Mid Term Exam, Cumulative Exam, All Speeches, Speech Worksheets and Outlines, Peer Speech Evaluations)*
2. Know and demonstrate appropriate communication anxiety management strategies. *(Classroom Discussion, Mid Term Exam, Cumulative Exam, PRPSA Instrument, All Speeches, Informative Speech Video Self-Analysis. Peer Speech Evaluations)*
3. Know several ways to organize a public speech. *(Classroom Discussion, Mid Term Exam, Cumulative Exam, Speech Worksheets and Outlines, Informative Speech Video Self-Analysis, Informative Speech Rough Outline)*
4. Know and demonstrate appropriate and effective use of visual aids. *(Classroom Discussion, Mid Term Exam, Cumulative Exam, All Speeches, Speech Worksheets, Peer Speech Evaluations)*
5. Know and demonstrate ability to build a persuasive argument, using appropriate and effective evidence. *(Classroom Discussion, Cumulative Exam, Persuasive Speech, Speech Worksheets and Outlines, Peer Speech Evaluations)*
6. Know and demonstrate critical listening. *(Classroom Discussion, Mid Term Exam, Cumulative Exam, Peer Speech Evaluations, Informative Speech Video Self-Analysis)*

Specific Course Outcomes:

All students completing introductory Public Speaking courses will have:

1. Presented at least 3 prepared speeches, including at least one informative speech and one persuasive speech at least 4 minutes 30 seconds long.
2. Written assessed outlines for each 5 to 7 minute prepared speech.
3. At least one prepared speech will require the use of a visual aid.
4. Skills outcomes assessment will be based on standards established by the National Communication Association.

ENGL 150 - English I

1. **DESCRIPTION:** Students will organize and develop papers for diverse audiences and purposes, including how to discover and focus on a topic, develop ideas, provide support, and draft and revise papers effectively. Fundamental language skills will be covered and library research and argumentation will be introduced.

2. **PREREQUISITES:** ACT over 14 or ENGL 074.

3. **TEXTBOOK:** Varies by section.

4. **OBJECTIVES:** By the end of the course students will be able to produce both expository and argumentative papers of at least 1000 words (approximately 4 pages). Students will learn to analyze the context of the writing problem, develop ideas for their writing, and locate reliable information and resources, including library sources. Students will also learn to move from writer centered to reader centered prose, adjust writing so that it is appropriate for a particular audience and to use feedback to improve their content, style, organization, and use of standard conventions. (ABET Criteria 3g, 3h & 3i)

5. **TOPICS:** Awareness and knowledge of audience, purposes for writing, problem solving and researching, developing and organizing ideas, revising, editing, and collaborating.

6. **CLASS/LABORATORY SCHEDULE:**

	Units of Instruction	**Time Weight**
		Lecture Hours
a.	Prewriting and planning strategies.	4
b.	Effective organization strategies.	7
c.	Paragraphing skills.	5
d.	Mastering the conventions of written English.	12
e.	Analytic and reasoning strategies.	7
f.	Self-evaluation and revision skills.	5
g.	Introduction and use of library research materials.	5
	Total	45

7. **RELATIONSHIP TO PROGRAM OBJECTIVES:** To provide broad educational experience including communication skills, mathematics, basic science preparing students for life-long learning.

8. **PREPARED BY:** N. Garrelts **DATE:** May 2011

ENGL 250 - English II

1. **DESCRIPTION:** The second of a two-course sequence, this course focuses on research. Students will learn how to use informational resources to produce a documented paper, to evaluate conflicting claims and evidence, to write an extended argument. The course will stress problem solving, reasoning skills, as well as accepted English usage appropriate to academic writing situations.

2. **PREREQUISITES:** ENGL 150 or equivalent.

3. **TEXTBOOK:** Varies by section.

4. **OBJECTIVES:** Upon completion of English 250, students should be able to analyze and define the purpose of their writing, analyze and define the needs of their intended audience, locate and document information appropriate to their writing, and choose appropriate methods of organization. Students should be able to produce effective written communication, demonstrating appropriate use of language, sentence structure, grammar, and mechanics. Students should also be able to work effectively with others to produce and/or revise written materials. (ABET Criteria 3g, 3h, and 3i)

5. **TOPICS:** Purposes for writing, knowledge of audience, problem solving, researching, documenting, organizing, editing, and collaborating.

6. **CLASS/LABORATORY SCHEDULE:**

	Units of Instruction	Time Weight Lecture Hours
a.	Analyze varieties of argument.	12
b.	Find a workable topic.	5
c.	Gather evidence.	10
d.	Work with evidence located in the library.	9
e.	Report research findings to a professional audience.	4
f.	Presentation techniques.	5
	Total	45

7. **RELATIONSHIP TO PROGRAM OBJECTIVES:** To provide broad educational experience including communication skills, mathematics, basic science preparing students for life-long learning.

8. **PREPARED BY:** N. Garrelts **DATE:** March 2011

10 FALL MATH 220-001 COURSE OUTLINE

COURSE	**Math 220-001** 8:00-8:50 AM M-F, SCI 136
INSTRUCTOR	Dr. Hengli Jiao, Office 2028 ASC, Contact: 591 – 2825, jiaoh@ferris.edu
OFFICE HOURS	10:00AM-11:00 AM MTWR and 11:00 AM- 12:00 Noon MW or by **appointment.**
TEXTBOOK	Calculus, 8th Edition, Larson, Hostetler, and Edwards, Published by Houghton Mifflin
PREREQUISITE	Math130 with a grade of C- or better or equivalent.
GENERAL OVERVIEW	Calculus is the branch of mathematics which studies quantities undergoing change. Calculus is used to study the change in the position of planets with respect to time or the change in demand for gas guzzling cars with respect to the price of gasoline. Since almost everything in the world changes, calculus has applications in every part of science and engineering. Yet, in its narrowest sense, calculus may be regarded as treating two geometric problems: computing the tangent lines to the graphs of functions and computing the area of regions bounded by the graphs of functions. The main delivery method of this course is lecturing. There are online quizzes and worksheets. You are encouraged to form a study or discussion group.
COURSE OBJECTIVES	❖ To become familiar with the major concepts and techniques of differential calculus. ❖ To be introduced to the major concepts of integral calculus. ❖ To develop skills in formulating, solving, and interpreting mathematical problems. ❖ To gain experience with applications of integral and differential calculus concepts. ❖ To learn to use a graphing calculator to explore concepts of calculus. ❖ To practice communicating mathematical ideas to others. ❖ To become a more independent learner and logical thinker.
ATTENDANCE	Students are expected to be present for all classes. Attendance will be taken. This course is a 5 credit hour course. Therefore, students should plan to spend 5 hours in class and more than 15 hours outside of class every week in order to be successful in this course. If you are absent from class, you are responsible for the material covered; arrange to copy another student's notes and be informed of any announcements made during class. Athletes who anticipate missing class due to scheduled events must notify the instructor in advance in writing. In addition, athletes should provide a copy of their performance schedule to the instructor ASAP. If you are not in the room when attendance is taken, you may assume that you have been marked absent. If you walk in late, you must see the instructor after that class to be sure that your presence is noted. Students should realize that **extreme or chronic tardiness** and **bad behavior** are not acceptable and can be expected to affect the final grade.
BEHAVIOR	Do not interrupt the class unless you have a special reason and inform the instructor in advance. The following behaviors are **absolutely not tolerated**: ❖ Talking while the instructor is lecturing. ❖ Using phone in class. When you walk into the class your phone should be **turned off.** ❖ Regularly walking out and in the classroom while class is in session. ❖ Leaving class early without approval from the instructor in advance.
EVALUATION	Grades in the course are based on four tests, quizzes, and worksheets if any. The following grading scale can be used to estimate grades for individual quizzes and exams; however, course grades will be determined from a curve based on point totals, attendance, improvement, effort, attitude, and so on. No make-up exam will be given unless you have a reasonable excuse. No early or late make-up quiz and worksheet will be given for **any reason**. Late assignments will not be accepted. **If you miss one of the four exams, you will be automatically assigned an "F" grade unless you are excused and make it up later.**

10 FALL MATH 220-001 COURSE OUTLINE

	Tests 1-3 100 points each Test 4 150 points Quizzes (in class or online) 10 points each. **Grading Scales** A = 90%-100% A- =87%-89% B+ = 84%-86% B = 81%-83% B- =78%-80% C+ =75%-77% C = 72%-74% C- = 69%-71% D+= 66%-68% D = 63%-65% D- = 60%-62% F=under 60%
CONTENT AND PROBLEMS	The following are sections of chapters we will cover. The problems in each section are for your own practice only. Remember the exam problems are similar to these problems, so practicing more problems will definitely help you get better grade. ***DO THE PROBLEMS***
CHAPTER 1 Limits and Their Properties	**1.1 A Preview of Calculus:** 1-11 **1.2 Finding Limits Graphically and Numerically:** 1-26, 59, 60, 63-67 **1.3 Evaluating Limits Analytically:** 1-88, 113-118 **1.4 Continuity and One-Sided Limits:** 1-72, 83-86, 91-94 **1.5 Infinite Limits:** 1-48, 67-70, **Review :** 5-6, 11-49, 51-68, 70
CHAPTER 2 Differentiations	**2.1 The Derivative and the Tangent Line Problem:** 1-59,71-86, 91-96, 99-103 **TEST ONE** **2.2 Basic Differentiation Rules and Rates of Change:** 1-66, 73-77, 83-88, 93, 109 - 114 **2.3 The Product and Quotient Rules and Higher-Order Derivatives:** 1-83, 93-102 **2.4 The Chain Rule:** 1-74, 81-100, 111, 112, 120-122 **2.5 Implicit Differentiation:** 1-58 **2.6 Related Rate:** 1-46 **Review Exercise:** 1-39, 41-82, 101-112 **TEST TWO**
CHAPTER 3 Applications of Differentiation	**3.1 Extrema on an Interval:** 1-44, 53-58, 60-61, 63-68 **3.2 Rolle's Theorem and the Mean Value Theorem:** 1-36, 39-50, 53-61, 65-85 **3.3 Increasing and Decreasing Functions and the First Derivative Test:** 1-46, 55-72, 95-105 **3.4 Concavity and the Second Derivative Test:** 1-56, 61-63, 76-84 **3.5 Limits at Infinity:** 1-8, 15-34, 39-46, 51-72, 105-106 **3.6 A Summary of Curve Sketching:** 1-34, 47-54, 67-72 **3.7 Optimization Problems:** 3-16, 19-30, 33-36, 39-42, 43-45, 54 **3.8 Differentials:** 1-35, 43-48, 55-58 **Review Exercise:**2-20, 23-28, 33-44, 49-76, 85, 86 **TEST THREE**
CHAPTER 4 Integration	**4.1 Antiderivatives and Indefinite Integration:** 1-48, 55-62, 67-74, 79-83, 87-96 **4.2 Area:** 1-62 **4.3 Reimann Sums and Definite Integrals:** 1-58, 63-72, 75, 77 **4.4 The Fundamental Theorem of Calculus:** 5-50, 53-63, 67-73, 75-91, 101-106 **4.5 Integration by Substitution:** 1-38, 43-92, 99-110, 122-134 **4.6 Numerical Integration:**1-33 odd, **Review Exercise:**1-10, 13-88

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12.

10 FALL MATH 220-001 COURSE OUTLINE

CHAPTER 5 **Logarithmic, Exponential, and Other Transcendental Functions**	**5.1 The Natural Logarithmic Function: Differentiation:** 3-34, 39-88, 93-98 **5.2 The Natural Logarithmic Function: Integration:** 1-42, 47-54, 61-64, 67-74, 83-90, 97-102 **5.3 Inverse Functions:** 1-16, 23-44, 47-52, 63-66, 71-90, 95-109 **5.4 Exponential Functions: Differentiation and Integration:** 1-18, 21-28, 33-72, 85-110, 113-116, **5.5 Bases Other Than e and Applications:** 1-30, 35-72, 81-90, 101-106
CHAPTER 6 **Differential Equations**	**6.1 Slope Fields and Euler's Method:** 1-77, 85-88 **6.2 Differential Equations Growth and Decay:** 1-60, **6.3 Separation of Variables and the Logistic Equation:** 1-58, 67-70, 75-78, 85-88 **TEST FOUR**
STUDY STRATEGIES	❖ Attend all classes and come prepared. Have your homework completed. Bring the text, paper, pen or pencil, and a calculator (scientific or graphing) to each class. ❖ Read the section in the text that is to be covered before class. Make notes about any questions that you have and, if they are not answered during the lecture, ask them at the appropriate time. ❖ Participate in class. As mentioned above, **ask questions**. Also, do not be afraid to answer questions. ❖ Take notes on all definitions, concepts, rules, formulas and examples. After class, read your notes and fill in any gaps, or make notations of any questions that you have. ❖ **DO THE PROBLEMS**!!! You learn mathematics by doing it yourself. Allow at least two hours outside of each class for problems. Remember the methods of solving problems are more important than just getting correct answers. Do not fall behind. ❖ Seek help when needed. Visit your instructor during office hours and come prepared with specific questions; check with school's tutoring service; find a study partner in class; check additional books in the library for more examples if necessary - just do something before the problem becomes insurmountable. ❖ Do not cram for exams. Each chapter in the text contains a chapter review and this study guide contains a practice test at the end of each chapter. (The answers are at the back of the study guide). Work these problems many days before the exam and review any areas of weakness.
EXAM DATES	**1st test:** **2nd test:** **3rd test:** **4th test:** 8-9:40 am, Thur., Dec. 16
REMARK	**The instructor reserves the right to make reasonable changes for the above descriptions.**

INSTRUCTOR'S SCHEDULE

	Monday	Tuesday	Wednesday	Thursday	Friday
8:00-9:00	Math 220-001 Science 136	Math 220-001 Science 136	Math 220-001 Science 136	Math 220-001 Science 136	Math 220-001 Science 136
9:00-10:00	Math 130-001 Science 136	Math 130-001 Science 136	Math 130-001 Science 136	Math 130-001 Science 136	
10:00-11:00	Office Hour	Office Hour	Office Hour	Office Hour	
11:00-12:00	Office Hour	Meeting	Office Hour	Meeting	
12:00-1:00	Independent Study	Independent Study	Independent Study	Independent Study	Independent Study
1:00-2:00					Project Meeting

3

13.

Math 230 – Fall, 2010

Course Information: Math 230 Analytical Geometry and Calculus 2, Section 1, 5 credits
Prerequisites: Math 220
Spring, 2010
Monday - Friday: 9:00 am – 9:50 am STR 236

Robert McCullough
ASC 2042

Office Hours: M 8:30 am – 9:00 am; 12:30 pm – 1:00 pm
T 9:00 am – 9:30 am
W 8:30 am – 9:00 am; 12:30 pm – 1:00 pm
Th 9:00 am – 9:30 am
F 8:30 am – 9:00 am; 12:30 pm – 1:00 pm
Other times by appointment

Phone: 591-5876 (office)
796-3986 (home)

Required Textbooks and Materials: Calculus by Larson, Hostetler and Edwards
Houghton Mifflin, 8th edition

Course Outcomes: At the end of this course, students should be able to:

1. compute derivatives and integrals for common transcendental functions, and analyze their graphs.
2. find indefinite and improper integrals using different integration techniques and apply L'Hopital's rule for indeterminate forms.
3. use various tests to determine series convergence, perform standard operations with convergent power series, and find Taylor series representations.
4. employ techniques from analytic geometry and calculus to work with parametric equations.
5. graph the classic conic sections.
6. convert between polar and rectangular coordinates and graph polar equations.
7. apply the methods from this course to real-world applications they may encounter in the future.

14.
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Course Description: This is the second of a three-semester sequence in analytical geometry and calculus. Topics include: applications of integration, integration techniques, infinite series, conic sections, parametric equations and polar coordinates.

Policies: Attendance is optional, will only be used to help determine extreme borderline grades. If you come to class, please try to get to class on time and stay for the entire class. You are responsible for finding out what goes on in class if you are absent, including any changes in test dates.

Unless you are on emergency call, please turn off all cell phones, pagers, etc. while in class.

Grades: 5 tests - 100 points each
1 final - 100 points
The lowest of these six scores will be dropped and the average computed using the remaining five scores. Make up tests will only be given for valid, verifiable reasons. Notification must be received before test is given. Otherwise, the missed test becomes the score that is dropped. ***Be prepared to show your ID when taking tests.***

Grading scale:

100.0 - 92.5	A
92.4 - 90.0	A-
89.9 - 87.5	B+
87.4 - 82.5	B
82.4 - 80.0	B-
79.9 - 77.5	C+
77.4 - 72.5	C
72.4 - 70.0	C-
69.9 - 67.5	D+
67.4 - 62.5	D
62.4 - 60.0	D-
59.9 - 0.0	F

Calculators: A simple scientific calculator may prove useful in this course. No graphing or programmable calculators are allowed.

Course Requirements: Your grade is determined totally be your performance on the tests.

Course Calendar: see attached outline

Optional Information: See enclosed Syllabus Attachment for other policies dealing with incompletes, academic misconduct, etc.

17.

Math 230 – Fall, 2010

Date		Topic	Assignment (odd problems only)		
M	8/30	Calc 1 review	in class		
T	8/31	5.6	p.	377	1-17
W	9/ 1	5.6	p.	378	41-55
Th	9/ 2	5.7	p.	385	1-19
F	9/ 3	5.7	p.	390	21-37
T	9/ 7	7.1	p.	452	1-9
W	9/ 8	7.1	p.	452	17-29
Th	9/ 9	7.2	pp.	463-464	1-27
F	9/10	7.2	pp.	463-464	1-27
M	9/13	7.3	p.	472	1-23
T	9/14	7.3	p.	472	1-23
W	9/15	7.3	p.	472	1-23
Th	9/16	Review		-	
F	9/17	Test 1		-	
M	9/20	7.4	p.	483	1-7, 15-23 (a, b only)
T	9/21	7.4	pp.	484-485	39-43, 45 (set up only)
W	9/22	7.5	p.	493	1-15
Th	9/23	7.6	p.	504	1-11
F	9/24	7.6	p.	504	13-27
M	9/27	8.1	p.	522	1-43
T	9/28	8.1	p.	522	1-39
W	9/29	8.2	p.	531	1-21, 25-35
Th	9/30	8.2	p.	531	1-21, 25-35
F	10/ 1	8.3	p.	540	5-17
M	10/ 4	8.3	pp.	540-541	25-41, 55-63
T	10/ 5	Review		-	
W	10/ 6	Test 2		-	
Th	10/ 7	8.4	p.	549	1-37
F	10/ 8	8.4	p.	549	1-37
M	10/11	8.5	p.	559	1-17
T	10/12	8.5	p.	559	21-27
W	10/13	8.6	p.	565	1-23
Th	10/14	8.7	p.	574	5-35
F	10/15	8.7	p.	574	37-53
M	10/18	8.8	p.	585	5-45
T	10/19	8.8	p.	585	5-45
W	10/20	9.1	pp.	602-603	1-41, 69-81
Th	10/21	9.1	pp.	602-603	1-41, 69-81
F	10/22	9.2	pp.	612-613	1-65

18.

MATH 322.001 (Linear Algebra)
3 credits, fall 2010
MWF 8:00-8:50 a.m. STR 223

Professor Kent Sun, Ph.D.
Office ASC 2031 & PUT 100D

Phone: 591-2579, Fax: 591-2627
Email: kentsun@ferris.edu

Course Description

An introduction to the theory of vector spaces with emphasis on matrix algebra. Topics included are linear transformation, independence, rank, and inverses. This is a mixed-delivery course.

Course Material and Test Schedule

Chapter 1 Linear Equations and Matrices
- 1.1 Linear Systems
- 1.2 Matrices
- 1.3 Dot Product and Matrix Multiplication
- 1.4 Properties of Matrix Operations
- 1.5 Matrix Transformations
- 1.6 Solutions of Linear Systems of Equations
- 1.7 The Inverse of a Matrix

(Exam I)

Chapter 3 Determinants
- 3.1 Definition and Properties
- 3.2 Cofactor Expansion and Applications
- 3.3 Determinants from a Computational Point of View

Chapter 4 Vectors in R^n
- 4.2 n-vectors
- 4.3 Linear Transformations

(Cumulative exam II containing material up to and including chapter 4)

Chapter 6 Real Vector Spaces
- 6.1 Vector Spaces
- 6.2 Subspaces
- 6.3 Linear Independence

(Cumulative exam III containing material up to and including section 6.3)

- 6.4 Basis and Dimension
- 6.5 Homogeneous Systems
- 6.6 The Rank of a Matrix and Applications
- 6.8 Orthonormal Bases in R^n (If time permits)

Chapter 8 Eigenvalues, Eigenvectors, and Diagonalization
- 8.1 Eigenvalues and Eigenvectors
- 8.2 Diagonalization (If time permits)

(A cumulative final exam is scheduled for Wed., December 15th from 8-9:40 a.m.)

Course Objective

To learn the basics concepts in Linear algebra.

Learning Outcomes

1) Matrix Operations: Students will be able to perform elementary arithmetic with matrices, including matrix multiplication, and list the basic properties of these matrix operations.
2) Solving Systems of Linear Equations with Matrices: Students will be able to determine when a system of linear equations is consistent and be able to compute the solution to the system.
3) Inverse Matrices: Students will be able to calculate the inverse of any invertible square matrix.

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4) Determinants: Students will be able to demonstrate the connection between determinants and invertible matrices.
5) Evaluating Determinants: Students will be able to evaluate a given determinant by co-factor expansion along any of its rows or columns.
6) Cramer's Rule: Students will be able to solve a system of linear equations, which is amenable to such analysis, by the use of Cramer's Rule.
7) Vectors: Students will be able to perform basic operations on vectors in real n-space, where n is any positive integer.
8) Vector Space: Students will be able to define and explain in detail a vector space as well as its many associated concepts including subspaces, spanning sets, linearly independent sets, bases, dimension, and linear transformations; and to prove elementary theorems involving such concepts.
9) Eigenvalues & Eigenvectors: Students will demonstrate the ability to work with the basic definitions and theorems involving eigenvalues, eigenvectors, and diagonalization (optional).

Prerequisite

C- or better in Math 220 or its equivalent

Textbooks

Required: Introductory Linear Algebra: An Applied First Course, 8th edition, Kolman and Hill; Pearson, Prentice Hall.

You are responsible for reading the textbook and doing the HW problems. In particular, pay close attention to the examples in the textbook. If you have questions about these examples then ask for help.

Office Hours

Monday, Wednesday 9 – 11 a.m. (ASC 2031)
and ~~12:00-3:30 p.m.~~ (Honor Students only, PUT 100D)
11:15 to 2:45 pm.

You may also make an appointment to see me. But please be aware that if you make an appointment to see me outside of my normal office hours and do not show up without canceling ahead of time then afterwards I will only consent to see you during my normal office hours or if I am in my office and not busy.

If more than one student shows up during an office hour then I will take turns answering questions. Therefore, do not wait for me outside my office door if I am with a student but make your presence known. If I need to speak with a student on a one-to-one basis because of a sensitive issue such as grades or advising then I will let you know.

Grading Policy

The course consists of approximately 500 points
Homework is worth 3 points each
(The 3 lowest HW grades are dropped)
Three cumulative exams worth 100 points each
The cumulative final exam worth 150 points

If your answer is wrong, partial credit may be given if correct intermediate steps are shown. However, <u>if your answer is right but the intermediate steps are wrong or nonexistent, full credit and perhaps even partial credit may not be given</u>.

Course Grades

93% to 100%	= A	78% to 80%	= B-	61% to 64%	= D+
87% to 92%	= A-	74% to 77%	= C+	58% to 60%	= D
84% to 86%	= B+	71% to 73%	= C	55% to 57%	= D-
81% to 83%	= B	65% to 70%	= C-	54% and below	= F

HW For Math 322 (Linear Algebra)
Introductory Linear Algebra: An Applied First Course (8th Edition) by Kolman and Hill

"ru" means read and understand. You do not hand in the ru problems.

HW #	Section	Page	HW	Due Date
Chapter 1 Linear Equations and Matrices				
1)	1.1	8	1-17odd, 18, 19, 23, 25, 27, T.4	
2)	1.2	19	1-10, T.1, 3, 7, ru T.2, 5, 6	
3)	1.3	34	1-9odd,10,11,15,19-27odd, 28,31,33,T.1,2,7,ru T.4-6	
4)	1.4	49	2-8,10-13,15, T.6,12ab,18,23a,26,27, ru T.24,29,30	
5)	1.6	85	1-9, 17, 19, 21, 27, 29, 41, 43, 47, T.11,12	
6)	1.7	105	1-13odd, 18, 22-26, T.1,8	
Chapter 3 Determinants				
7)	3.1	192	5,6,9,11,13,15-17,19,22,23, T.3,5-10,14,16	
8)	3.2	207	2-6,15-23odd,T.1,10	
Chapter 4 Vectors in R^n				
9)	4.2	244	1-4,6,7,11-21odd,23-27,29,31,34, T.5,6,9,10,13	
10)	4.3	255	1-4,13,14,17-22,25-30, T.3,4,8-11	
Chapter 6 Real Vector Spaces				
11)	6.1	278	1-4,11-19, T.1,3-5	
12)	6.2	287	1-10,14,16-20,25-27, T.3,6,7	
13)	6.3	301	1,2,4,7,10-13,15, T.1,4,5	
14)	6.4	314	1-4,7-21odd,23-25,28,29	
15)	6.5	327	1ab,2ab,3-13,T.1	
16)	6.6	337	1-17odd,18,21-35odd	
17)	6.8	349	1,2,3-9odd,15,19-21, T.6	
Chapter 8 Eigenvalues, Eigenvectors, and Diagonalization				
18)	8.1	420	1-11odd,14,15	

I reserve the right to make needed and appropriate adjustments in this syllabus.

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APPENDIX C - EQUIPMENT LIST

Equipment Inventory
Complete list of surveying equipment used and maintained by the Surveying Engineering Department in alphabetic order

Equipment	S/N	FSU #	Notes
Alidade Plane Table	N/A	N/A	there are 4 of these they go with special tripods
Alidade	67587	38945	these go with Plane tables and tripods
Alidade	642235	17608	
Alidade	661902	31577	
Alidade	GN0666	33894	
Barometer	N/A	40655	American Paulin System
Barometer	N/A	40656	American Paulin System
Barometer	N/A	40657	American Paulin System
Chaining Pin Sets	N/A	N/A	9 sets with rings
Chaining Pin Sets	N/A	N/A	5 sets without rings
Chaining Pin Sets	N/A	N/A	not complete set with ring
Clip Boards	N/A	1,2,3,4,5	for student use
Clip Boards	N/A	N/A	in reserve for student use Qty 1
Clip Boards	N/A	N/A	for clerk use Qty 2
Compass	N/A		Sperti Astro Mark II
Sun Compass	60168	N/A	Brunson Instrument Co. Universal 0 degree to 90 degree N&S Latitudes
Chronograph	N/A	7	
Chronograph Sidereal	AF45D399	45067	stop watch ?
compass (hand)	N/A	S259	for plane table
compass engineering	240777	N/A	
compass	N/A	S360	
Chain Gunther	N/A	N/A	66 ft.
Electric Distance Meter		56961	
Flags	N/A	N/A	Staking Flags 4 bundles
Geodimeter	X590315	N/A	AGA Model 4B NASM-4B
Levels			
NA2	522016	45692	Wild automatic Level
NA2	A55712	71350	Wild automatic Level

NA2	667775		Wild automatic Level

NA2	521698	45693	Wild automatic Level
N3	154712	36084	Wild Level 1st Order
N10	79833	5872	Wild
N10	69499	5865	Wild
NE-20H	710760	71323	Nikon
GK1-A		34974	Kern
Ni-2	45032		Zeiss (wood box K&E)
Ni-2	85987	38974	Zeiss
Ni-2	159422	45130	Zeiss
Electronic Digital Level	GM0292		Top Con series DL 102
Electronic Digital Level	GM1417		Top Con series DL 102
Electronic Digital Level	GM1427		Top Con series DL 102
Electronic Digital Level	GM0773		Top Con series DL 102
Electronic Digital Level	GM1423		Top Con series DL 102
Electronic Digital Level	GM1428		Top Con series DL 102
NA3003 Digital Level	282372		Leica (on Loan?)
Inverted Image	36683	130000	Kern
Level Rods			10 of one & 7 of another
Dumpy Levels	152677	38946	K&E
Dumpy Levels	531336	54560	K&E
Dumpy Levels	531372	54562	K&E
Dumpy Levels	760129	47681	Teledyne Gurley
Dumpy Levels	531373	54561	K&E
Dumpy Levels	651127	14322	Gurley
Dumpy Levels	91411	19576	Dietzgen
Dumpy Levels	84884	19577	Dietzgen
Dumpy Levels	760133	47682	Teledyne Gurley
Dumpy Levels	671035	22225	Gurley
Dumpy Levels	164163	38947	K&E
Dumpy Levels	25790	38943	Buff & Buff
Dumpy Levels	73	38942	K&E
Dumpy Levels	156780	31400	K&E
Dumpy Levels	54739	31523	K&E
Dumpy Levels	651126	14321	Gurley
Laser Ranger	07B1108	1108	?
Lighting	N/A	S721A	Has right angle eye piece
Lighting	N/A	S721B	battery system
Lighting	N/A	S721C	Has right angle eye piece
Lighting	N/A	S721D	battery system
Lighting	N/A	S721E	battery system
Lighting	N/A	S721F	battery system
Lighting	N/A	N/A	battery system for Nikon levels

Magnetic Locator	181255	N/A	Schonstedt model GA 72cd
Magnetic Locator	181256	N/A	Schonstedt model GA 72cd

Magnetic Locator	N/A	45517	Schonstedt model GA52B
Magnetic Locator	N/A	43169	Schonstedt model GA32
Magnetic Locator	N/A	N/A	Schonstedt model ?
Magnetic Locator	N/A	N/A	Metrotech model ? (orange bag)
Prism Poles	--	--	9 Silver ones
Prism Pole Set	N/A	N/A	back center section
Prism right angle	N/A	N/A	in black case
Prism reuloff			2 of them in black case, 1 in wood box
Prism adaptor	N/A	N/A	4 silver, 5 black
Plumb bobs	N/A	N/A	50 total (various sizes)
Radio Motorola PS10		1	Includes charger base and plug.
Radio Motorola PS10		2	Includes charger base and plug.
Radio Motorola PS10		3	Includes charger base and plug.
Radio Motorola PS10		4	Includes charger base and plug.
Radio Motorola PS10		5	Includes charger base and plug.
Radio Motorola PS50		6	Includes charger base and plug.
Radio Motorola PS50		7	Includes charger base and plug.
Radio Motorola PS50		8	Includes charger base and plug.
Radio Spirit MV11C	463HZN0204	1A	Includes charger base and plug.
Radio Spirit MV11C	463HYYJ948	1B	Includes charger base and plug.
Radio Spirit MV11C	463HZN0022	3A	Includes charger base and plug.
Radio Spirit MV11C	463HZN0052	3B	Includes charger base and plug.
Reflector T1 only		31404	Wild
Reflector		36832	Wild
Reflector		US298	Wild
Reflector		22227	Wild
Reflector		2911	Wild
Reflector		US29?	Wild
Reflector		40653	Lietz

Rod turning point base	N/A	N/A	Red (Qty 5)
Rod turning point base	N/A	N/A	Orange (Qty 3) on loan
Rod levels	N/A	N/A	4

Sextant	21900	38959	David White Co.
Spiders Wood	N/A	N/A	Use to set up tripods inside
Spiders Metal	N/A	N/A	Use to set up tripods inside
Safety Cones	N/A	N/A	
Sling Psychrometer	N/A	N/A	not sure if this is a thermometer ?
Safety Vests	N/A	N/A	we have fifty vests on hand
THEODOLITES	--------	--------	----------
DKM 1	66588	5866	Kern
DKM 2	54271	55270	Kern
Ke-Le	662654	31399	K&E 20 sec
NT-2s	365270	58835	Nikon Mark III Series 360 degrees
NT-2s	365071	58836	Nikon Mark III Series 360 degrees
NT-2s	365238	58837	Nikon Mark III Series 360 degrees
NT-2s	365157	58838	Nikon Mark III Series 360 degrees
NT-2s	365347	58839	Nikon Mark III Series 360 degrees
T1	T1-61333	5873	Wild Degree
T2	T2-110061	38975	Wild Old Stlye Degree
T2-E	T2-179929	179929	Wild New Style
T2-Mil Circle	T2-101276	101276	Wild
T2-Mil Circle	T2-101303	101303	Wild
T2-68-Mil	T2-101313	101313	Wild
T2-68-Mil	T2-148219	34978	Wild Old Style Degree
T2-68-Mil	T2-169288	36834	Wild New Style Degree
T3	90976	90976	Wild
T3	74223	74223	Wild
T3	58362	58362	Wild
T3	53060	53060	Wild
T3	41098	41098	Wild
T3	71484	71484	Wild
T4 Base	T-456096	45064	Wild
T16	283600	45128	Wild 3rd Order/20 second
T16	259786	57160	Wild 3rd Order/20 second
T16	T16-82614		Wild scale reading w/ automatic vertical index
T16	T16-82739		Wild scale reading w/ automatic vertical index

T16	T16-82361		Wild scale reading w/ automatic vertical index
TM-20c	83040	36079	Lietz
TM-20c	88058	36080	Lietz

Verbier Theodolite	254855	31515	Dietzgen
Micrometered Theodolite	101321	6675	Dietzgen (broken)
Transit	531436	54563	K&E
Transit	531449	54564	K&E
Transit	531951	54565	K&E
Transit	531955	54566	K&E
Transit	9963	--	David White Co.
Transit 20 sec	TL3087	38977	Teledyne Gurley
Transit	43783	5897	Gurley
Transit	671278	22224	Gurley
Transit	TL3491	38973	Gurley
Transit	423026	7896	Gurley
Transit	36197	31627	K&E
Transit	7747	31530	David White Co.
Transit	90781	5863 box is 5871	David White Co.
Tape Survey Rule	N/A	N/A	8-6' wood, 2 small wood
Tape Survey Rule	N/A	N/A	6 metric pocket
Tape Survey Rule	N/A	N/A	2 pocket
Tape Survey Rule Holder	N/A	N/A	center back - 5 yellow
Tape 100' Steel	N/A	N/A	5 with 2 empty reels
Tape Puller	N/A	N/A	for steel tape
Time Cube	N/A	N/A	for atomic time for sun shot (missing)
Traverse Kit 1	N/A	N/A	Kit includes following Leica equipment: Case, 2 Carriers, 2 Tribrachs, 2 Prisms
Traverse Kit 2	N/A	N/A	Kit includes following Leica equipment: Case, 2 Carriers, 2 Tribrachs, 2 Prisms
Traverse Kit 3	N/A	N/A	Kit includes following Leica equipment: Case, 2 Carriers, 2 Tribrachs, 2 Prisms
Traverse Kit 4	N/A	N/A	Kit includes following Leica equipment: Case, 2 Carriers, 2 Tribrachs, 2 Prisms
Traverse Kit 5	N/A	N/A	Kit includes following Leica equipment: Case, 2 Carriers, 2 Tribrachs, 2 Prisms

Traverse Kit 6	N/A	N/A	Kit includes following Leica equipment: Case, 2 Carriers, 2 Tribrachs, 2 Prisms

Traverse Kit 7 not complete	N/A	N/A	Kit includes following Leica equipment: Case, 2 Tribrachs, 2 Prisms
Traverse Kit 8 not complete	N/A	N/A	Kit includes following Leica equipment: Case, , 2 Tribrachs, 1 Prism
Thedolite Digital	671342	671342	Carl Shangraw took to Grand Rapids for their classes
Thedolite Digital	671332	671332	Carl Shangraw took to Grand Rapids for their classes
Thedolite Digital	671344	671344	
Thedolite Digital	671270	671270	Carl Shangraw took to Grand Rapids for their classes
Thedolite Digital	671343	671343	Carl Shangraw took to Grand Rapids for their classes
Thedolite Digital	671349	671349	
Thedolite Digital	671351	671351	
Thedolite Digital	671347	671347	
Thedolite Digital	671338	671338	missing cap for knob
Thedolite Digital	671352	671352	
Total Station	421380	421380	TC1100 Leica
Total Station	421385	421385	TC1100 Leica
Total Station	421374	421374	TC1100 Leica
Total Station	421765	421765	TC1100 Leica

APPENDIX D - YEARLY ACADEMIC REVIEW

Administrative Program Review
Program: Surveying Engineering
Surveying Technology

Purpose of Administrative Program Review

1. to facilitate a process led by the deans and department heads/chairs to assess and evaluate programs under their supervision
2. to facilitate long term planning and recommendations to the VPAA
3. to collection and analyze information that will be useful in the University's accreditation efforts; Academic Program Review deliberation; and assessment.

Instructions: Please prepare a report following the outline below:

I. Summary of modifications since last report:

Please provide a brief summary of the changes that have taken place in the program since the last report.

Since the last Report the following curriculum changes have been made:

- BLAW 221 Business Law was dropped. Critical elements of this course were already being taught or were incorporated into SURE 365 Legal Aspects of Surveying I and SURE 420 Professional Practice of Surveying. This reduced the total number of required credit hours by three.

- CONM 220 Statics and Structures was dropped and then replaced by a new course, CENG 240 Engineering Statics. CENG 240 is calculus based whereas CONM 220 was not. The change was made to better align course content with an engineering curriculum. The number of credit hours was reduced from four to three.

- SURE 272 Programming Applications in Geomatics was reconfigured from three lecture hours per week to one lecture hour and three lab hours per week. Having lab hours with the instructor present was a direct result of comments made on student surveys. Course content was modified to use MATLAB rather than Visual Basic allowing a much more comprehensive experience in programming. The number of credit hours was reduced from three to two.

- The result of these revisions has been a more rigorous degree program with five fewer credit hours. The 137 credit hours formerly required to graduate have been reduced to 132.

In addition to the above mentioned adaptations, minor changes have been made to course designators and numbers without changing the content. This was done to better align the course designators with what content was actually being delivered.

Those courses renamed or renumbered to reflect a Geographic Information Systems (GIS) content are:

SURE 325, Principles of GIS, is now GISC 225, Principles of GIS
SURE 339, Remote Sensing, is now GISC 239, Remote Sensing

SURE 425, Technical Issues in GIS is now GISC 425, Technical Issues in GIS

Those courses renamed or renumbered to reflect Civil Engineering content are:

SURE 220, Engineering Surveying, is now CENG 220, Engineering Surveying
SURE 331, Hydraulics Engineering, is now CENG 321, Hydraulics Engineering
SURE 421, Soils Engineering, is now CENG 421, Soils Engineering
SURE 480, Sustainable Land Use is now CENG 485, Sustainable Land Use

The Capstone Course SURE 485 has been further changed this year to get the students more involved with what the industry is doing and increase the exposure of students to industry.

II. Program Assessment/Assessment of Student Learning

a. What is the program's learning outcomes?

The desired outcomes of the Surveying Engineering Program are:

1. A broad education and knowledge of contemporary issues necessary to understand the impact of surveying engineering solutions in a global, societal, and environmental context. (EAC/ABET Criteria 3d, c, h, j) (Program Educational Objectives B and C)
2. An ability to solve surveying engineering problems in practice by applying fundamental knowledge of mathematics, statistics, science, and by using modern surveying engineering techniques, skills, and tools. (EAC/ABET Criteria 3a, k) (Program Educational Objectives A and D)
3. An ability to identify, formulate, and solve surveying engineering problems, particularly the planning, design, establishing horizontal and vertical control, land use design, boundary determination, mapping and field layout of infrastructure that meet standards of accuracy and precision, keeping in mind cost, time, safety and quality needs, and objectives. (EAC/ABET Criteria 3c, e) (Program Educational Objectives A, B C, and D)
4. An ability to design and conduct experiments and to analyze and interpret data in engineering surveying, topographic surveying, geodetic surveying, and boundary surveying. (EAC/ABET Criteria 3b, j, k) (Program Educational Objectives A,C and D)
5. An ability to communicate technical material written papers/reports and oral presentations. (EAC/ABET Criterion 3g) (Program Educational Objective A)
6. An ability to function within multidisciplinary teams. (EAC/ABET Criterion 3d) (Program Educational Objective A & C)
7. An understanding of professional, societal, and ethical practice and responsibilities. (EAC/ABET Criterion 3f) (Program Educational Objectives B and C)
8. A recognition of the importance of professional licensure and a recognition of the need for, and an ability to engage in, life-long learning. (EAC/ABET Criterion 3i) (Program Educational Objectives A, C and D)

b. What assessment measures are used, both direct and indirect?
Assessment measures include: Employer surveys, Alumni surveys, Advisory Committee surveys, student surveys, faculty surveys, and performance in the national Professional Surveying examination.

c. What is the assessment cycle for the program?
Annual survey of students, faculty, current graduates, and Advisory Committee, semiannual surveys of alumni and employers

d. What assessment data were collected in the past year?
All of the above surveys were done last year.

e. How have assessment data been used for programmatic or curricular change?
The major curriculum revision done in 2007 was a direct result of the

feedback received from the program constituencies through the various surveys.

Course Outcomes Assessment

a. Do all multi-sectioned courses have common outcomes? *Yes,*

b. If not, how do you plan to address discrepancies?

c. How do individual course outcomes meet programmatic goals?

The outcomes of each course are tied to a set of ABET criteria known as “a through k criteria”.

III. Program Features

1. Advisory Board

a. Does the program have a board/committee? When did it last meet? When were new members last appointed? What is the composition of the committee (how many alumni, workplace representatives, academic representatives, etc.)

The Surveying Engineering Programs have a very active Advisory Committee. The Committee is made up of eight regular members and two ex-officio members representing two professional societies (The Michigan Society of Professional Surveyors, and Michigan Society of Professional Engineers). Three of the eleven members are program alumni, and two are from academia. The Committee membership represents private companies, county and state government agencies. The last meeting of the Committee was held on April 2012.

b. If no advisory board exists, please explain by what means faculty receive advice from employers and outside professionals to inform decisions within the program.

N/A

c. Has feedback from the Advisory Board affected programmatic or curricular change?

Yes, in fact, the last revision of the curriculum was reviewed by the Committee.

2. Internships/Cooperative or Experiential Learning

a. Is an internship required or recommended?
No, however, it is very rare to see a graduate who has not worked in surveying several summers prior to his/her graduation.

b. If the internship is only recommended, what percentage of majors elect the internship option? *N/A*

c. What challenges does the program face in regard to internships? What is being done to address these concerns? N/A

d. Do you seek feedback from internship supervisors? If so, does that feedback affect pedagogical or curricular change? *N/A*

3. Online Courses

a. Please list the web-based courses, both partial internet and fully online, offered last year.
The Surveying Department is offering a two-course certificate program in GIS on line. Some faculty in the department use WebCT to supplement course material including on-line quizzes and course grades.

b. What challenges and/or opportunities have web-based instructions created?
The challenges in web-based instruction include faculty commitment to the concept of web-based instruction and the time required to create a course to be delivered via web.

c. What faculty development opportunities have been encouraged/required in order to enhance web-based learning within the program?
We believe there are sufficient faculty development opportunities available for faculty through the faculty development center internally and funding opportunities through the COT faculty development fund, externally. Web-base instruction requires faculty interest and expertise including faculty release time.

d. How has student feedback been used to enhance course delivery?
In the online Certificate program in GIS student surveys have been used to revise course outlines and the delivery of instruction via the web.

E Is there any plan to offer this program online? If yes, what rationale is there to offer this program online? (emerging market opportunity? expand enrollment? demand for niche program offering? etc.

Not at this time Offering the surveying programs entirely on-line would be very challenging as there are several courses that have "hand-on" laboratory components.
It is, however, possible to offer some courses on-line particularly in the area of GIS. The program has excellent growth potentials in the areas of GIS as applied to homeland security if it partners with programs across

campus such as the Criminal Justice and Electrical and Electronics departments. We believe the Surveying Program has a lot to offer in this area provided a collaborative approach to homeland security is taken

4. Accreditation

a. Is the program accredited or certified?
Yes

b. By whom?
ABET

c. When is the next review?
The four year program was visited by ABET in September of this year. Next review will be determined by ABET based on this year's study . – 6 years maximum cycle.

d. When is the self-study due?
See note above

e. How has the most recent accreditation review affected the program?

The BS Surveying program was reviewed by ABET this past September. Aside form some concerns (See Areas of Concern under Section 6) the program received a very favorable preliminary report. Final ABET action regarding the accreditation visit will come in August of 2006.

5. Student/Faculty Recognition

a. Have students within the program received any special recognition or achievement?
Several students have been awarded national scholarship, a highly competitive process.
During the MSPS annual conventions three to four students are awarded $1,000 to $2,500 each.
The faculty award eight to ten additional scholarships valued from $500 to $2,500 each for a total of nearly $26,000 . For further details please visit the SURE website at http://www.ferris.edu/surveying/Scholarships/ScholarshipMain.cfm

b. Have faculty within the program received any special recognition or achievement?

Yes several as may be seen in Faculty Resumes.

6. Student Engagement

a. Is volunteerism and student engagement a structured part of the program?

No, however, the surveying engineering students have two very active student organizations (The Burt and Mullett Student Chapter of ACSM, and the Lambda Sigma Surveying Honor Society). The students through these two organizations have engaged and continue to engage in civic activities. The Program students routinely attend both state and national level conferences and have won several scholarships. As indicated in the body of the report, the program students have own nationwide competitions and own several first place awards in 2006, 2007, 2009 and second the third place in 2010 and 2008.

b. Does the program utilize service learning in the curriculum?
   No
c. Does the program participate in the American Democracy Project?

   Not directly, there is a member of the surveying faculty who serves on the ADP committee.

IV. Academic Program Review Recommendations

Please indicate the recommendations (enhancements or changes) made by APRC in the most recent review of the program by the APRC council. What actions have been taken in response to these recommendations?

Areas of strength:

The Surveying Programs have many strengths, chief among them are:

A very strong industry support – over a million dollars in annual consigned state-of-the-art equipment (hardware, software, training, etc.), establishment of the endowment for laboratory improvement such the John and Lynda Fenn Endowed Laboratory.

Nearly $26,000 in annual scholarships available for students.

Excellent job opportunities in the field or in the office -100% placement record for graduates every year.

Mostly dedicated faculty

Areas of concern (and proposed actions to address them):

The program enrollment as indicated in the body of the report has significantly declined. However, we admitted 350% more students this year than the last year. The program needs to concentrate more on student recruitment.

Future goals:

There is a possibility of collaboration with North Western Michigan College to work on Hydrographic Surveying Area.

There is a possibility of collaboration with the Construction program for the possibility of establishing a minor in Civil Engineering.

The program needs leadership. It would be a good idea to revert back to Department Chair format which will give the necessary exposure and credibility to the program and its supporters.

The 350% increase in enrollment of students this year vis-à-vis last year indicates that we need to replace the lost faculty positions as soon as the enrollment reaches close to 100 students.

FERRIS STATE UNIVERSITY

College of Engineering Technology

ABET
Self-Study Report

for the

Surveying Engineering Program

at

Ferris State University

Big Rapids, Michigan

July 2011

CONFIDENTIAL

BACKGROUND INFORMATION

A. Contact Information

List name, mailing address, telephone number, fax number, and e-mail address for the primary pre-visit contact person for the program.

<u>Primary Pre-Visit Contact Person:</u>

Deborah M. Dawson, PE
Director, School of Computer, Electrical,
Energy, Mechanical and Surveying Systems
Ferris State University
915 Campus Drive SWN 312
Big Rapids, Michigan 49307

Phone: 231-591-3204
Fax: 231-591-2082
e-mail: dawsond7@ferris.edu

<u>Alternate contact person</u>:

Sayed R. Hashimi, PS
Professor/Program Director
Ferris State University
915 Campus Drive SWN 314
Big Rapids, Michigan 49307

Phone: 231-591-2632
Fax: 231-591-2082
e-mail: hashimis@ferris.edu

B. Program History

Include the year implemented and the date of the last general review. Summarize major program changes with an emphasis on changes occurring since the last general review

The Bachelor of Science in Surveying Engineering Program began in 1972 in response to changes in Michigan law requiring such a degree for licensure as a professional surveyor. Prior to this, Ferris had a two-year associate's degree program. The first class to complete the baccalaureate degree graduated in 1974.

In 1976, rules promulgated by the State of Michigan Board of Licensing for Professional Surveyors caused the program to include one year of calculus, one year of engineering physics, one semester each of soils and hydraulics into the four-year degree program.

In 1982, the Surveying Engineering Program was accredited under the then Related Accreditation Commission (RAC) of ABET. Ferris was the first surveying program in the nation to receive such accreditation.

In 1994, after making appropriate curriculum revisions, the program received Surveying Engineering accreditation under the Engineering Accreditation Commission (EAC) of ABET.

Since the last ABET visit, the following curriculum changes have been made:

- BLAW 221 Business Law was dropped. Critical elements of this course were already being taught or were incorporated into SURE 365 Legal Aspects of Surveying I and SURE 420 Professional Practice of Surveying. This reduced the total number of required credit hours by three.

- CONM 220 Statics and Structures was dropped and then replaced by a new course, CENG 240 Engineering Statics. CENG 240 is calculus based whereas CONM 220 was not. The change was made to better align course content with an engineering curriculum. The number of credit hours was reduced from four to three.

- SURE 272 Programming Applications in Geomatics was reconfigured from three lecture hours per week to one lecture hour and three lab hours per week. Having lab hours with the instructor present was a direct result of comments made on student surveys. Course content was modified to use MATLAB rather than Visual Basic allowing a much more comprehensive experience in programming. The number of credit hours was reduced from three to two.

- The result of these revisions has been a more rigorous degree program with five fewer credit hours. The 137 credit hours formerly required to graduate have been reduced to 132.

In addition to the above mentioned adaptations, minor changes have been made to course designators and numbers without changing the content. This was done to better align the course designators with what content was actually being delivered.

Those courses renamed or renumbered to reflect a Geographic Information Systems (GIS) content are:

SURE 325, Principles of GIS, is now GISC 225, Principles of GIS
SURE 339, Remote Sensing, is now GISC 239, Remote Sensing
SURE 425, Technical Issues in GIS is now GISC 425, Technical Issues in GIS

Those courses renamed or renumbered to reflect Civil Engineering content are:

SURE 220, Engineering Surveying, is now CENG 220, Engineering Surveying
SURE 331, Hydraulics Engineering, is now CENG 321, Hydraulics Engineering
SURE 421, Soils Engineering, is now CENG 421, Soils Engineering
SURE 480, Sustainable Land Use is now CENG 485, Sustainable Land Use

C. Options

List and describe any options, tracks, concentrations, etc. included in the program.

Bachelor of Science Degree in Surveying Engineering

The ABET/EAC accredited baccalaureate degree program meets the formal educational requirements for licensure as a professional surveyor as established by the State of Michigan licensing board for professional surveyors. This degree also meets State of Michigan formal educational requirements for licensure as a professional engineer.

In addition to, but not a part of, the Bachelor of Science Degree Program are the following initiatives undertaken by the Surveying Engineering faculty to service those with an interest in surveying but not necessarily interested in the four-year degree.

Associate in Applied Science degree in Surveying Technology

The Surveying Technology program at Ferris is designed to provide students with the skills and knowledge necessary to function as effective members of surveying field crews. Graduates have the ability to perform basic surveying calculations and create maps using different computer-assisted mapping software. Technical courses taken in the associate's program transfer directly into the baccalaureate program.

Minor in Surveying and Mapping

The objective of the Minor in Surveying and Mapping is to give students majoring in other disciplines a general understanding of how surveying measurements are performed and to gain familiarity with the use the field surveying instruments. The knowledge gained through this Minor will enable the student who completes the program to function as a surveying technician within an organization.

Certificate in Surveying

The objective of the Certificate program in surveying is simply to give students a general exposure to the practice of surveying with the end result being an actual surveying credential.

Certificate in Geographic Information Systems

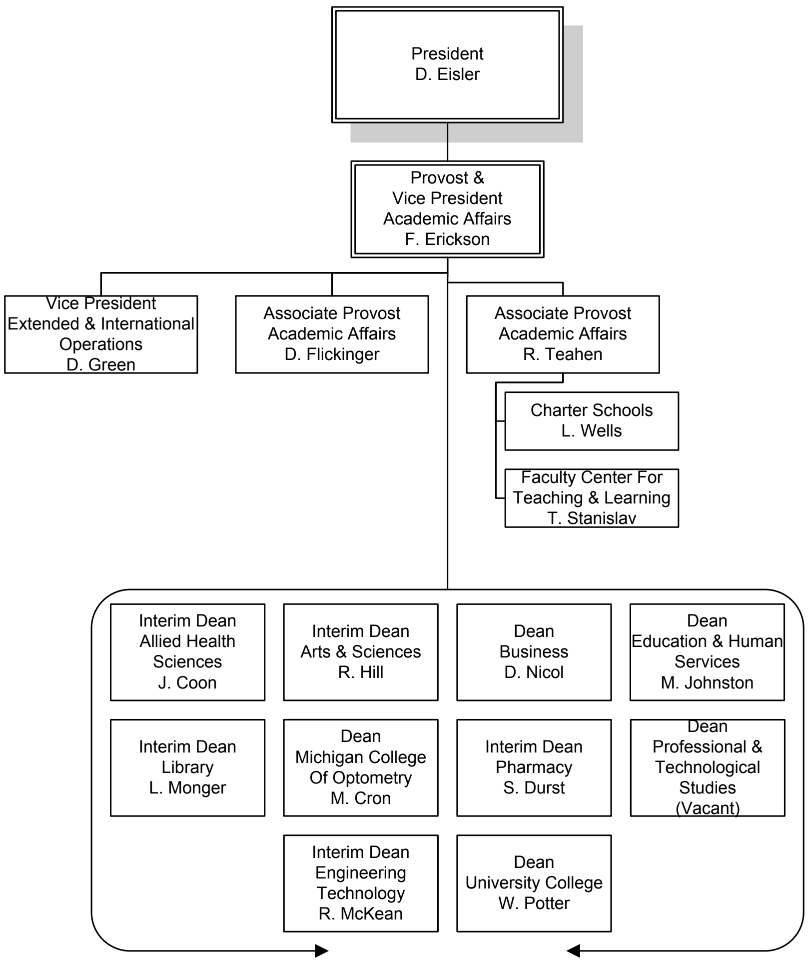
The GIS certificate is designed for individuals wishing to expand their knowledge and acquire cutting-edge skills in the emerging field of Geographic Information Systems. The certificate's three-course sequence combines practical exercises on popular GIS software with theoretical concepts of geospatial sciences.

D. Organizational Structure

Using text and/or organizational charts, describe the administrative structure of the program (from the program to the department, college, and upper administration of your institution, as appropriate).

FERRIS STATE UNIVERSITY

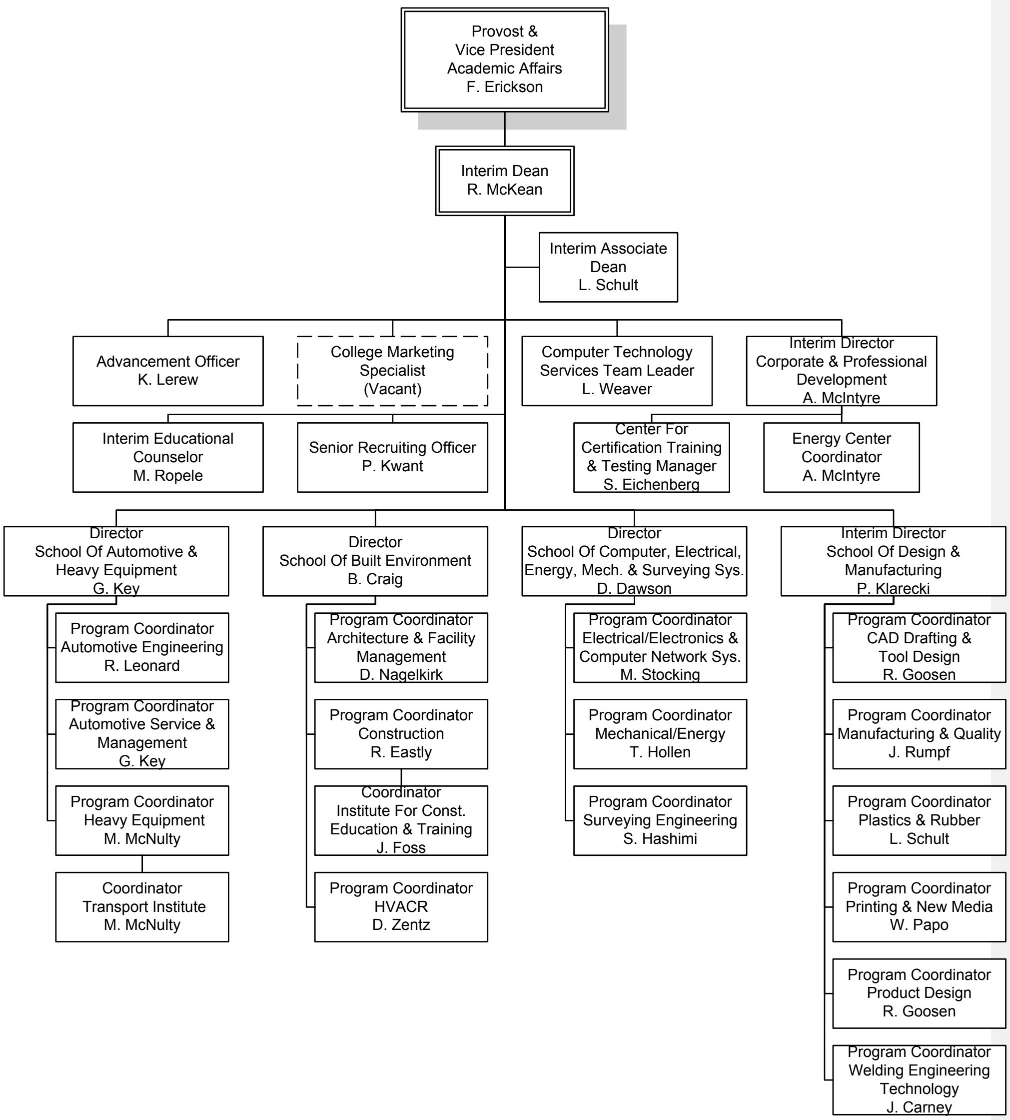
ACADEMIC AFFAIRS DIVISION



FERRIS STATE UNIVERSITY

ACADEMIC AFFAIRS DIVISION

COLLEGE OF ENGINEERING TECHNOLOGY



E. Program Delivery Modes

Describe the delivery modes used by this program, e.g., days, evenings, weekends, cooperative education, traditional lecture/laboratory, off-campus, distance education, web-based, etc.

Core courses are delivered on campus, during the day and on some evenings, using traditional lecture/laboratory methods. Certification courses are primarily offered on-line during all semesters.

F. Program Locations

Include all locations where the program or a portion of the program is regularly offered (this would also include dual degrees, international partnerships, etc.).

All classes are delivered on the Big Rapids campus of Ferris State University.

G. Deficiencies, Weaknesses or Concerns from Previous Evaluation(s) and the Actions Taken to Address Them

Summarize the Deficiencies, Weaknesses, or Concerns remaining from the most recent ABET Final Statement. Describe the actions taken to address them, including effective dates of actions, if applicable. If this is an initial accreditation, it should be so indicated.

The ABET Summary of Accreditation Actions for the 2005-2006 Accreditation Cycle listed zero deficiencies, zero weaknesses and two concerns. Summaries of the two concerns are:

1. Criterion 3(g) requires that students demonstrate the ability to communicate effectively. The accreditation team found a lack of consistency in grading written assignments for spelling and grammar between upper division courses where spelling and grammar were being corrected and lower division courses where spelling and grammar were not being corrected.

   Having been made aware of this situation, faculty members in lower division courses are making a concerted effort to be more consistent with those teaching upper division courses in checking spelling and grammar in written assignments.

2. Criterion 5 states that faculty must be of sufficient number and have the competencies to cover all of the curricular areas of the program. The accreditation team was concerned about a "full-time temporary" faculty member who for years had been teaching a virtual full load but was not available to offer the support and services to the student body expected and required of a regular faculty member. The report recommended that this position be converted to a full-time, tenure track position.

As a direct result of the 2005-2006 ABET Summary, a nationwide search was conducted to fill a newly created full time tenure track position in the Surveying Engineering Department. The search resulted in the hiring of Dr. Kurt Shinkle, bringing the number of full-time faculty members to six.

In the spring of 2010, Dr. Yaron Felus, Associate Professor, resigned due to family concerns. In August of 2010, Dr. Shinkle resigned for personal reasons, bringing the number of full time faculty to four. Of the two positions lost due to resignations, one has been authorized to be filled. A search to fill this position is currently underway and hopefully will be completed by the start of the 2011-2012 academic year.

While a challenge, working short staffed has at least temporarily had minimal impact on course delivery for the following reasons:

1. Program enrollment is lower due chiefly to the ability of students to afford a college education in these tough economic times and due to the fact that Michigan has lost population over the past decade shrinking the pool of available students. The recession has cost the state over 800,000 jobs chiefly in manufacturing, construction and housing, areas directly affecting surveying. While enrollment university wide is growing, growth is chiefly in the areas of health care and the social sciences. Student populations in technology are generally stagnant or falling. Courses such as SURE 110, SURE 115, SURE 272, CENG 220 and SURE 230 that were offered both semesters are now being offered during a single semester significantly decreasing faculty load.

2. For the past several years, Surveying Engineering program faculty have taught CONM 122 Construction Surveying. This course is offered by the Construction Management program. Generally, teaching the course requires two lecture hours per week along with three, three-hour lab sessions. This adds up to eleven contact hours or about two thirds of a full teaching load. CONM 122 is presently being taught by a licensed surveyor who is a member of the Construction Management Program faculty.

3. Reduced workloads have allowed current faculty to cover all courses without the use of adjuncts. Certain faculty members have been asked to and have willingly agreed to accept temporary overload assignments.

H. Joint Accreditation

Indicate whether the program is jointly accredited or is seeking joint accreditation by more than one commission.

This program is not jointly accredited.

GENERAL CRITERIA

CRITERION 1. STUDENTS

For the sections below, attach any written policies that apply.

A. Student Admissions

Summarize the requirements and process for accepting new students into the program.

From the Ferris State University Catalog for Surveying Engineering, entrance requirements into the program are: [http://catalog.ferris.edu/programs/291/]

> Admission to the College of Engineering Technology is open to high school graduates who demonstrate academic preparedness, maturity and seriousness of purpose with backgrounds appropriate to their chosen program of studies. Among first-time students in our technical programs, the average high school GPA is 2.8, and the average ACT composite score is 20.
>
> Students entering the Surveying Engineering program must have a high school diploma (or equivalent) with a minimum 2.5 GPA and a minimum ACT math subscore of 26. Transfer students must have a 2.0 GPA or better for previous college coursework. Minimum composite ACT of 17.

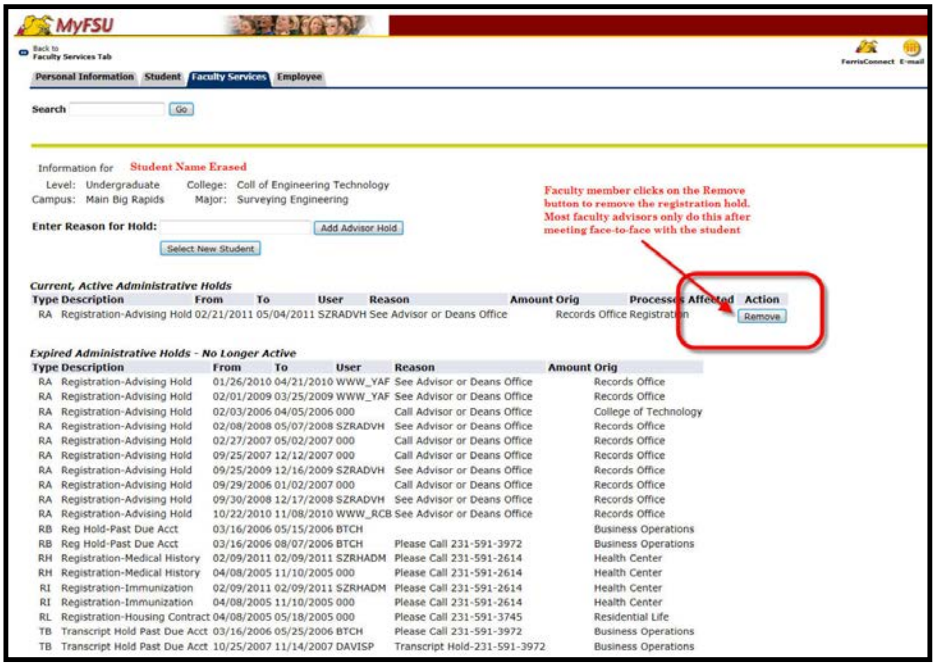
Application is made either on-line (free) or by using a paper application ($30 application fee). The student requests official transcripts from all other schools they have attended. If the student has fewer than 48 semester hours of transfer credit, they must also request official transcripts from their high school or a GED (General Education Development) Certificate. All transcripts must be mailed directly from the educational institution to the FSU Admissions and Records Office.

Once the application has been received, it is reviewed by an admissions counselor. If the applicant meets the minimum admissions criterion, they are then admitted into the Surveying Engineering program. Many students are found to be deficient of the criterion; in that case, the applicant is admitted into the Surveying Technology Associate degree program. In most instances, the deficiency is in mathematics in that the student is not able to enroll in Calculus I. Once the student has met the minimum criteria, they can then request a curriculum change into the Surveying Engineering program. For students who do not meet the minimum College of Engineering Technology criteria, they may be admitted to the University as a Pre-Tech student.

B. Evaluating Student Performance

Summarize the process by which student performance is evaluated and student progress is monitored. Include information on how the program ensures and documents that students are meeting prerequisites and how it handles the situation when a prerequisite has not been met.

Before a student can register for classes in any semester, he/she must have a registration hold cleared by his/her advisor (see following figure). This process allows each advisor to monitor the progress of the student and his/her performance in the previous semester.


MyFSU

Back to Faculty Services Tab

FerrisConnect E-mail

Personal Information | Student | Faculty Services | Employee

Search [ ] Go

Information for **Student Name Erased**

Level: Undergraduate College: Coll of Engineering Technology

Campus: Main Big Rapids Major: Surveying Engineering

Enter Reason for Hold: [ ] Add Advisor Hold

Select New Student

Faculty member clicks on the Remove button to remove the registration hold. Most faculty advisors only do this after meeting face-to-face with the student

Current, Active Administrative Holds

Type	Description	From	To	User	Reason	Amount Orig	Processes Affected	Action
RA	Registration-Advising Hold	02/21/2011	05/04/2011	SZRADVH	See Advisor or Deans Office	Records Office	Registration	Remove

Expired Administrative Holds - No Longer Active

Type	Description	From	To	User	Reason	Amount Orig
RA	Registration-Advising Hold	01/26/2010	04/21/2010	WWW_YAF	See Advisor or Deans Office	Records Office
RA	Registration-Advising Hold	02/01/2009	03/25/2009	WWW_YAF	See Advisor or Deans Office	Records Office
RA	Registration-Advising Hold	02/03/2006	04/05/2006	000	Call Advisor or Deans Office	College of Technology
RA	Registration-Advising Hold	02/08/2008	05/07/2008	SZRADVH	See Advisor or Deans Office	Records Office
RA	Registration-Advising Hold	02/27/2007	05/02/2007	000	Call Advisor or Deans Office	Records Office
RA	Registration-Advising Hold	09/25/2007	12/12/2007	000	Call Advisor or Deans Office	Records Office
RA	Registration-Advising Hold	09/25/2009	12/16/2009	SZRADVH	See Advisor or Deans Office	Records Office
RA	Registration-Advising Hold	09/29/2006	01/02/2007	000	Call Advisor or Deans Office	Records Office
RA	Registration-Advising Hold	09/30/2008	12/17/2008	SZRADVH	See Advisor or Deans Office	Records Office
RA	Registration-Advising Hold	10/22/2010	11/08/2010	WWW_RCB	See Advisor or Deans Office	Records Office
RB	Reg Hold-Past Due Acct	03/16/2006	05/15/2006	BTCH		Business Operations
RB	Reg Hold-Past Due Acct	03/16/2006	08/07/2006	BTCH	Please Call 231-591-3972	Business Operations
RH	Registration-Medical History	02/09/2011	02/09/2011	SZRHADM	Please Call 231-591-2614	Health Center
RH	Registration-Medical History	04/08/2005	11/10/2005	000	Please Call 231-591-2614	Health Center
RI	Registration-Immunization	02/09/2011	02/09/2011	SZRHADM	Please Call 231-591-2614	Health Center
RI	Registration-Immunization	04/08/2005	11/10/2005	000	Please Call 231-591-2614	Health Center
RL	Registration-Housing Contract	04/08/2005	05/18/2005	000	Please Call 231-591-3745	Residential Life
TB	Transcript Hold Past Due Acct	03/16/2006	05/25/2006	BTCH	Please Call 231-591-3972	Business Operations
TB	Transcript Hold Past Due Acct	10/25/2007	11/14/2007	DAVISP	Transcript Hold-231-591-3972	Business Operations

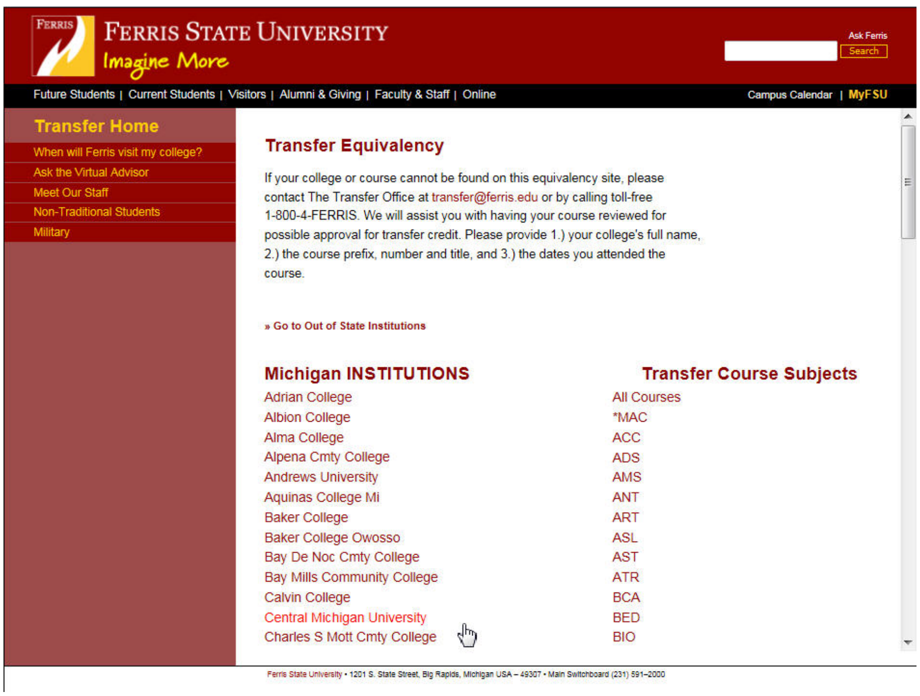
If, during the student visit, the advisor sees that a student is having difficulty, they may advise the student to take courses that will strengthen their educational base. On occasion, an advisor may ask the student to repeat a course. Students may not take more than 18 credits without the permission of the advisor. In addition, those students who are on academic probation (e.g. with GPA less than 2.00) must also have approval from the academic advisor before they are allowed to take more than 14 credit hours in a semester. A student may not drop a currently enrolled course without the approval of the academic advisor.

To ensure that students meet the proper pre-requisites, the registration software will not allow a student to register for a class unless all of the pre-requisites have been met. The criteria may be overridden by the School secretary upon written notice by the advisor and/or affected faculty member.

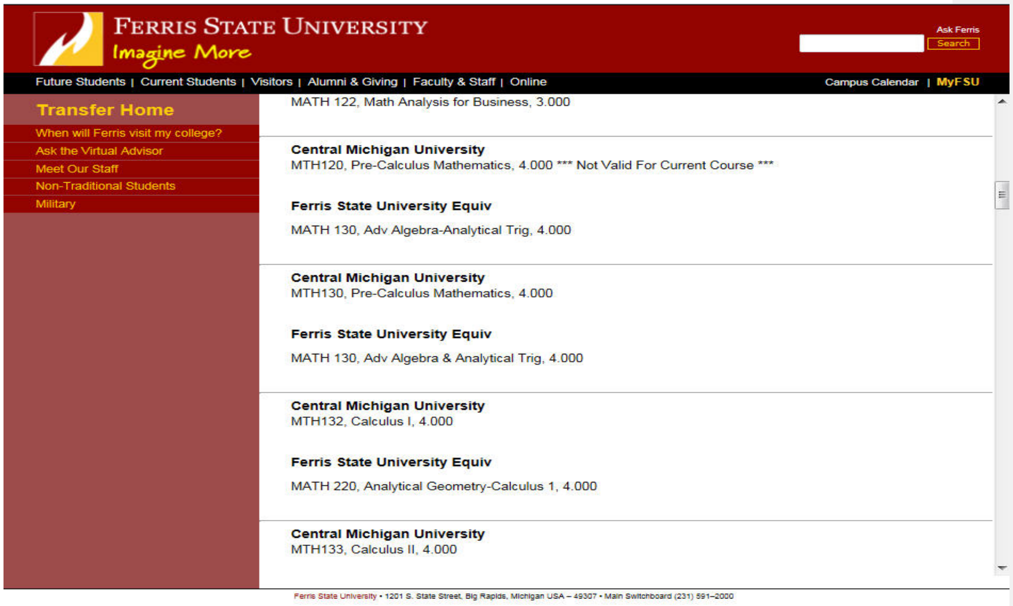
C. Transfer Students and Transfer Courses

Summarize the requirements and process for accepting transfer students and transfer credit. Include any state-mandated articulation requirements that impact the program.

Transfer students apply for admission in the same manner as described above. They are then required to have official transcripts mailed from the educational institution to the FSU Admissions and Registration Office. Once the transcripts have been received, the transcripts are evaluated. Ferris has a list of college equivalencies (see the following figure).



The Transfer Equivalency web page identifies the Michigan Institution (note that out-of-state institutions are also available). Click on the school and the transfer course subjects are listed. Clicking on a particular course prefix will identify the other institutions course and the Ferris equivalent. The following figure shows the results of a mathematics search.


FERRIS STATE UNIVERSITY
Imagine More
Ask Ferris
Search
Future Students | Current Students | Visitors | Alumni & Giving | Faculty & Staff | Online
Campus Calendar | MyFSU

Transfer Home
When will Ferris visit my college?
Ask the Virtual Advisor
Meet Our Staff
Non-Traditional Students
Military

MATH 122, Math Analysis for Business, 3.000

Central Michigan University
MTH120, Pre-Calculus Mathematics, 4.000 *** Not Valid For Current Course ***

Ferris State University Equiv
MATH 130, Adv Algebra-Analytical Trig, 4.000

Central Michigan University
MTH130, Pre-Calculus Mathematics, 4.000

Ferris State University Equiv
MATH 130, Adv Algebra & Analytical Trig, 4.000

Central Michigan University
MTH132, Calculus I, 4.000

Ferris State University Equiv
MATH 220, Analytical Geometry-Calculus 1, 4.000

Central Michigan University
MTH133, Calculus II, 4.000

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Students and faculty can also check the particular transfer equivalencies within the student's record using the MYFSU computer system. Following shows the transfer equivalencies for a student enrolled in the program.


MyFSU
Back to Faculty Services Tab
FerrisConnect E-mail OrgSync Calendar Groups Policies Logout Help

Student College 1: **Coll of Engineering Technology**
Major 1: **Surveying Engineering**
Minor 1:
Additional Minor:

Transfer Institution: Cmty College
Level: Undergraduate
Attendance Period: (1) 01/04-05/04

TRANSFER WORK IN HISTORY

Transfer Institution Courses							FSU Equivalent/Articulated Course(s)				
LEVEL	TERM	SUBJ	CRSE	TITLE	HOURS	GRADE	SUBJ	CRSE	TITLE	HOURS	ATTRIBUTE(S)
UG	200608	ENG	51A	Intro To Communication	0	C	ENGL	074	Intro Basic Collegiate Writing	0	

Transfer Institution Summary for this Attendance Period

LEVEL	ATTEMPTED	PASSED	EARNED	GPA HRS	QUAL PTS	GPA
UG	.00	.00	.00	.00	.00	.00

Transfer Institution: University
Level: Undergraduate
Attendance Period: (1) 05/06-05/08

TRANSFER WORK IN HISTORY

Transfer Institution Courses							FSU Equivalent/Articulated Course(s)				
LEVEL	TERM	SUBJ	CRSE	TITLE	HOURS	GRADE	SUBJ	CRSE	TITLE	HOURS	ATTRIBUTE(S)
UG	200605	CH	0011	Dev Of Chemical Skills	.67	NC					
UG	200605	CH	1000	Prep Chemistry Fundament	3	C	CHEM	---	Chem General Credit	3	
UG	200608	FW	2010	Vegetation Of North Amer	4	F					
UG	200608	FW	2051	Field Techniques	1	B-					
UG	200608	MA	0030	Team Approach for Coll Algebra	0	NC					
UG	200608	MA	1030	College Algebra I	3	NC					
UG	200608	UN	1000	Frameworks For Succ Coll	1	A	CRED	IT-	General Fsu Credit	1	
UG	200608	UN	1001	Perspectives On Inquiry	3	A	ENGL	---	Engl General Credit	3	
UG	200701	BL	2160	Botany	4	B-	BIOL	113	Basic Botany >	4	Scientific Understanding
											Scientific Understanding Lab
											Linked Course
											Scientific Understanding
											Scientific Understanding Lab
UG	200701	FW	1050	Natural Resources	1	A	BIOL	---	Biol General Credit	1	
UG	200701	HU	0122	World Cultures Study	.67	NC					
UG	200701	MA	0030	Team Approach for Coll Algebra	0	NC					
UG	200701	MA	1030	College Algebra I	3	A-	MATH	110	Fundamentals of Algebra	3	
UG	200701	UN	1002	World Cultures	4	C	HUMN	2CG	Humn Gen Crd 200 Level Cult/Gl	4	
UG	200701	UN	1010	Creating Your Own Succes	1	CR	CRED	IT-	General Fsu Credit	1	
UG	200705	GE	2000	Understanding The Earth	3	C	GEOL	121	Physical Geology >	4	Scientific Understanding
											Scientific Understanding Lab

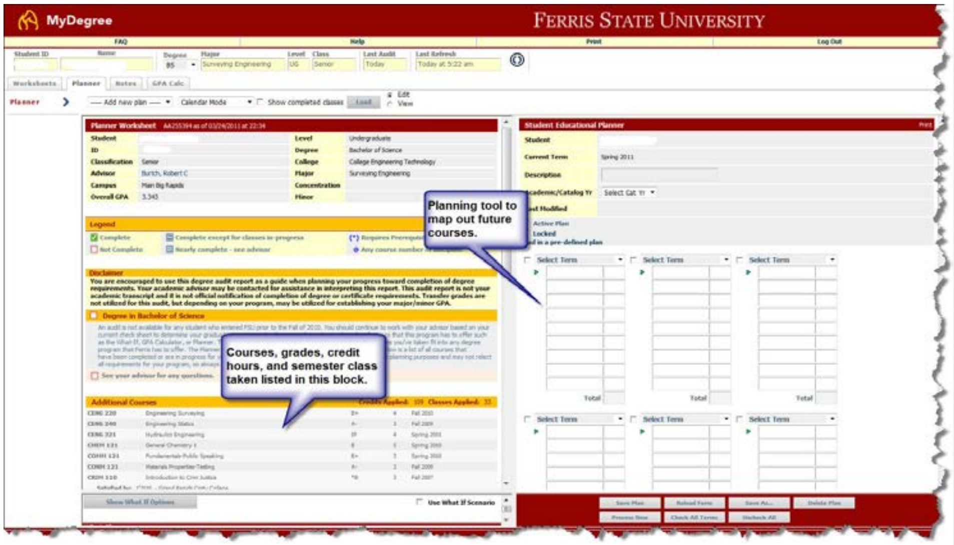
Students can also transfer their general education requirements if the school they attended prior to Ferris State University was a party to the Michigan Association of Collegiate Registrars and Admissions Officers (MACRAO) Transfer Agreement. A copy of the Academic Affaire Policy Letter on the MACRAO Transfer Policy dated 10/8/08 is attached to the end of this section of the report.
The Academic Affairs Policy Letter on Policy on Transfer Credits for Various Grades, Letter 01:7 dated December 11, 2001 is also attached to the end of this section of the report.

D. Advising and Career Guidance

Summarize the process for advising and providing career guidance to students. Include information on how often students are advised, who provides the advising (program faculty, departmental, college or university advisor).

All students at Ferris State University are assigned an academic advisor within a few weeks of their first semester on campus. In the College of Engineering Technology, each tenured and tenure-track faculty has advisees. New faculty members are not assigned advisees during their first year of employment to allow them time to learn and understand the curriculum. During this time, they are mentored in numerous areas including advising. In the Surveying Engineering program, faculty advise only those students who are enrolled in Surveying Engineering or Surveying Technology. Students are provided with the official curriculum and program check sheet prior to or at first enrollment in the program. They are expected to be aware of all published graduation requirements. The advisors are there to help students complete the requirements of the program. However, it is the responsibility of the students to ensure that they successfully complete all the requirements of the program. They will not be allowed to graduate unless they complete all the requirements of the program. They must also maintain a minimum cumulative grade point average (GPA) of 2.0. Any student falling below that threshold will not be permitted to graduate even though they have fulfilled all other university and program requirements.

Students and faculty can also track the student's progress through the program using a program called MyDegree. For new students the software also keeps track of the check sheet maintained by the program. The next figure shows a screen shot of the MyDegree page.



E. Work in Lieu of Courses

Summarize the requirements and process for awarding credit for work in lieu of courses. This could include such things as life experience, Advanced Placement, dual enrollment, test out, military experience, etc.

Within the Surveying Program, credit for life experience or military experience is not given per se. Students do have the opportunity to obtain credit by exam in two different ways. First, they can take a CLEP (College Credit-By-Exam Program) test, which evaluates a student's ability based on prior learning. There are 35 different exams (computer-based format) available in five different areas: Composition and Literature, Foreign Languages, Science and Mathematics, History and Social Sciences, and Business. The exams are administered by the Office of Institutional Research and Testing. A fee of $102 per test is assessed to the student and the candidate must score 50 or higher to obtain credit for that course.

The second avenue is to test a student's prior work experience. This is done at the department/program level. A student meets with their advisor or a representative from the program to determine if an exam exists or if a faculty member who teaches in that area would prepare a proficiency exam. The program has a policy that this must be done prior to the start of the semester. A $25/credit hour fee is assessed the student. If the student passes, they are given credit for that course. Unlike the CLEP test, there is no re-testing available for proficiency exams in the program area. See the Course Competency Assessment and Testing Policy, Academic Affairs Polity Letter of February 27, 2006 at the end of this Criterion 1 section.

Students can also gain credit for Advanced Placement (AP) courses. A 3 or higher is required for credit. The program area assigns the credit. For information about the Advanced Placement Program, see http://www.ferris.edu/admissions/testing/App.htm. Following is an image showing some of the courses with AP course credits and the minimum test score to obtain credit for a course.

Course Equivalents and Credits

Ferris State University grants college credit for AP scores of 3, 4, or 5.

Examination	Score	Credits	Course/s
Art, Studio Drawing	3,4,5	3	ARTS 101
Art, General	3,4,5	6	ARTS 101/102
Art, History	3,4,5	6	ARTH 110/111
Biology, General	3	4	BIOL 103
	4,5	8	BIOL 121/122
Chemistry, General	3	5	CHEM 121
	4,5	10	CHEM 121/122
Computer Science A	3,4,5	3	ISYS 110
English Language & Composition	3,4,5	3	ENGL 150
English Literature & Composition	3,4,5	3	LITR 150
Economics, Macro	3,4,5	3	ECON 221
Economics, Micro	3,4,5	3	ECON 222
Environmental Science	3,4,5	4	BIOL 111
French	3	8	FREN 101-2
	4,5	16	FREN 101-2, 201-2
German, Level 3	3,4,5	16	GERM 101-2, 201-2
Gov't and Politics – Comparative	3,4,5	4	PLSC Elective
Gov't and Politics – US	3,4,5	4	PLSC Foundation
History – European	3	3	HIST 151
	4,5	6	HIST 151/152
History – US	3	3	HIST 121
	4,5	6	HIST 121/122
History – World	3,4,5	3	HIST 200
Mathematics Calculus AB	3,4,5	5	MATH 220
Mathematics Calculus BC	4,5	10	MATH 220/230
Calc AB Subgrade	4,5	5	MATH 220
Physics B	3	4	PHYS General Credit
	4,5	8	PHYS 211/212
Physics C (Mechanics or E&M)	3,4,5	4	PHYS General Credit
Psychology	3,4,5	3	PSYC 150
Spanish, Level 3*	3	8	SPAN 101-2
	4	16	SPAN 101-2, 201-2
	5	24	SPAN 101-2, 201-2, 301-2
Statistics	3,4,5	3	STQM 260

Graduation Requirements

Summarize the graduation requirements for the program and the process for ensuring and documenting that each graduate completes all graduation requirements for the program. State the name of the degree awarded (Master of Science in Safety Sciences, Bachelor of Technology, Bachelor of Science in Computer Science, Bachelor of Science in Electrical Engineering, etc.)

The degree conferred upon graduates of the program is a Bachelor of Science in Surveying Engineering degree.

As indicated in sections C and D above, all students meet periodically with their advisor who monitors the student matriculation through the program. Both faculty and students have access to where the student is in the MyDegree student web page. This program was implemented in the fall 2010 and all new students' records as of that semester are complete. Students and faculty have the opportunity to create "what if" scenarios to map a student's progression through the program. Students who have been enrolled prior to the fall 2010 semester have reduced capabilities. They can still monitor their progress though. The reason older students do not have all the same capabilities is because when a student enrolls in a program, their course of study is the Course Sequence Guide (often called the Check Sheet) is the curriculum they need to complete. When the MyDegree web page was introduced, it only reflected the curriculum check sheets valid for the fall 2010 semester. Faculty also maintain hard copy files on all advisees and are responsible for making sure it is up to date and correct. It is incumbent upon the student to make sure their advisor is keeping them abreast of their progress and meeting program requirements for graduation.

The Surveying Engineering program requires the student to complete 133 semester hours to receive a bachelor's degree. The curriculum is discussed in more detail in subsequent sections of this report. The student must meet certain University General Education Requirements as well. To obtain a bachelor's degree from Ferris State University, the student must demonstrate competencies in communications, scientific understanding, quantitative skills, cultural enrichment, social awareness, global consciousness, and race/ethnicity/gender issues. The criteria are given as follows:

- The communications requirement involves completing 6 credit hours of English composition, 3 credits of Speech communication, and 3 additional credits selected from a cafeteria list of requirements. Within the Surveying Engineering program, this last criteria is met with having 3 of our courses designated at "Writing Intensive" (WIC) courses (SURE 365, SURE 420 and SURE 465).
- The scientific understanding requirement is 7 hours of course work, at least one course having a laboratory component. This criteria is met within the program with the following courses: PHYS 241, PHYS 242, CHEM 121 and, GEOL 131.
- Quantitative skill pertains to Mathematics skills. Again, there is a cafeteria list of requirements. Basically, students need to complete a course in Algebra. The program meets the criteria with MATH 220, MATH 230 and MATH 322.

- Graduates are required to complete 12 hours of cultural enrichment courses. One must be at the 200-level or higher. The SURE 331 had been designated as a cultural enrichment course.
- Surveying Engineering graduates are required to take 6 hours of social awareness courses. One must be a Foundations Course and one must be at the 200-level or higher.
- Finally, a graduate must complete one course that meets the global consciousness requirement and another course that meets the requirements for race/ethnicity/gender issued. These can be courses that also meet cultural enrichment, social awareness, or other curricular requirements.

The students must meet with their advisor and complete a graduation audit the semester before graduation. The advisor will make sure all the criteria will have been met before the expected date of graduation. They then attach the program check sheet to the graduation audit and the paperwork is submitted to the Dean's Office where the graduation audit officer checks to make sure all criteria have been met. A copy of the audit findings are then sent to both the student and the advisor.

The current program check sheet is shown on the next page.

F. Transcripts of Recent Graduates

The program will provide transcripts from some of the most recent graduates to the visiting team along with any needed explanation of how the transcripts are to be interpreted. These transcripts will be requested separately by the team chair. State how the program and any program options are designated on the transcript. (See 2011-2012 APPM, Section II.G.4.a.)

FERRIS STATE UNIVERSITY

ACADEMIC AFFAIRS POLICY LETTER

MACRAO Transfer Policy
General Education Courses
Approved by Academic Affairs 10/8/08
Effective Fall 2010

The Michigan Association of Collegiate Registrars and Admissions Officers (MACRAO) Transfer Agreement applies only to students entering bachelor degree programs at FSU, pertains solely to general education, and does not exempt students from meeting specific prerequisite and/or course requirements for their degrees. Only courses with a grade of "C" (2.0) or better will transfer.

Students transferring to Ferris State University with MACRAO will have met the lower-division general education communication competency; scientific understanding; cultural enrichment; social awareness; race, ethnicity, and gender; and global awareness requirements. In order to complete the general education requirements for a bachelor's degree, students with MACRAO must still complete math proficiency and upper-level communication competency requirements.

Many degrees require specific courses and prerequisite courses that also count for FSU's general education requirements. Because these specific courses are required for the degree, they must be taken even if a student has sufficient coursework to complete the MACRAO agreement.

FERRIS STATE UNIVERSITY

ACADEMIC AFFAIRS POLICY LETTER

December 11, 2001 01:7

POLICY ON TRANSFER CREDITS FOR VARIOUS GRADES

Admissions Policy: Transfer Students

Students transferring to Ferris State University (FSU) from other institutions of higher education may be granted transfer credit. Transfer credit is subject to the following criteria:

General Considerations

1. If FSU has an institutional articulation agreement with the student's prior institution, that agreement governs the student's transfer determination if covered by the articulation agreement. Otherwise, the student's transfer determination is governed by individual course equivalency evaluations and FSU's transfer policies or as determined by FSU in its sole discretion.

2. Institutional articulation agreements will focus on conditions for accepting students (with specific degrees and GPA's) and transferring them into FSU's programs, not determining course-by-course equivalencies.

3. Credits are considered for transfer upon presentation of official evidence of completion (i.e. official transcripts, DD214, etc.).

4. College-level coursework taken at a regionally accredited institution is transferable to FSU. An applicant with a cumulative GPA of 2.0 or higher is admissible. An applicant with a cumulative GPA of less than a 2.0 may be admitted at the sole discretion of Ferris.

5. Ferris accepts transfer courses in which the student earned a grade of "C" (2.0) or better. Consistent with program progression policies, coursework taken at other institutions and not accepted for credit at FSU may need to be repeated. All references to a 2.0 GPA are on a 4.0 scale.

6. Additional information concerning the transferability of college credit is included in the University catalog, which describes the degree programs offered through a specific Ferris college. Under special circumstances, after twelve semester credits of work at Ferris have been successfully completed, the appropriate college dean's office may accept coursework from institutions which are not regionally accredited, according to the guidelines of this policy.

7. Credit may be granted for military training courses, group study, or correspondence work if the course(s) or other work is recommended for credit by the American Council on Education or approved through an appropriate Ferris competency assessment process.

8. Credits from transferred coursework are recorded on the FSU transcript, but do not count toward the FSU cumulative GPA or academic honors computations.

Transfer Students: Course and Transcript Evaluation

1. Transcripts of transfer students are evaluated by the dean's office of the college in which the student enrolls.

2. Transfer course equivalency evaluations are determined by the FSU department with comparable coursework as indicated by the Ferris course designator. These evaluations represent an institutional determination and will not be independently renegotiated by each FSU college. That is, if a transfer student enters Ferris and then changes program and college, the initial transfer course equivalent determination is not changed unless a determination that an error in the evaluation has occurred, or prerequisite validation occurs per #4 of this section. This determination is at the sole discretion of Ferris State University.

FERRIS STATE UNIVERSITY

ACADEMIC AFFAIRS POLICY LETTER

February 27, 2006

Course Competency Assessment and Testing Policy

Competency Competency Assessment is one of the credit-by-examination options offered to students who wish to demonstrate proficiency in courses offered through the University. It can be comprised of a single or multiple instruments including classroom proficiency examinations, portfolios, or performance assessments/ projects. Faculty in the appropriate course, program, or department determines the method of assessing courses eligible for competency assessment.

Those students completing Course Competency Assessment and meeting the standards required for a grade of "C" or higher will earn credit for the course. Credit granted on the basis of a course competency assessment is entered on a student's record without a grade and is not included in the computation of the Ferris grade point average (GPA) or graduation honors.

A student may take a Course Competency Assessment for any course a maximum of two times.

Prerequisites must be met before Course Competency Assessment may be considered for any course.

Credit normally will not be awarded for any course for which the student has already earned credit or for courses below the level of a course for which the student already has credit.

Courses such as lab science courses, workshops, special topics, seminars and directed or independent studies are excluded from Course Competency Assessment.

Academic departments may exclude certain courses from Course Competency Assessment.

FERRIS STATE UNIVERSITY
Imagine More

Bachelor of Science Degree

Surveying Engineering

Accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (EAC/ABET).

Course Sequence Guide

Student:			
Email:		ID:	
Advisor:		Ph:	

YEAR 1 - FALL SEMESTER			Crs	Gr
SURE	110	Fundamentals of Surveying (MATH 120 co-req.)	4	
SURE	115	Intro to Computer Mapping	1	
ENGL	150	English 1	3	
MATH	220	Analytical Geometry & Calculus 1 (MATH 130 or 126)	5	
		Cultural Enrichment Elective	3	
FSUS	100	FSU Seminar	1	
		Total	17	

YEAR 1 - SPRING SEMESTER			Crs	Gr
CENG	220	Engineering Surveying * (SURE 110)	4	
CONM	121	Materials Properties & Testing ** (MATH 116)	3	
ENGL	250	English 2 (ENGL150)	3	
MATH	230	Analytical Geometry & Calculus 2 (MATH 220)	5	
		Total	15	

YEAR 2 - FALL SEMESTER			Crs	Gr
CENG	240	Engineering Statics (MATH 230,co-req PHYS 241)	3	
SURE	215	Surveying Computations ** (SURE 110)	3	
CHEM	121	General Chemistry 1 (CHEM 103, MATH 115)	5	
PHYS	241	General Physics 1 (C- in MATH 220)	5	
		Total	16	

YEAR 2 - SPRING SEMESTER			Crs	Gr
SURE	230	Advanced Surveying * (SURE 110, 115)	4	
SURE	272	Programming Appl. In Geomatics (SURE 215, MATH 130)	2	
MATH	322	Linear Algebra (MATH 220)	3	
PHYS	242	General Physics 2 (C- in MATH 230, PHYS 241)	5	
SURE	331	Ethics/Profess. In Engineering & Technology (ENGL 150)	3	
		Total	17	

YEAR 3 - FALL SEMESTER			Crs	Gr
GISC	239	Remote Sensing	3	
SURE	365	Legal Aspects of Surveying 1 *** (SURE 215 co-req, ENGL 250)	3	
SURE	372	Adjustment Computations 1 (SURE 230,272; MATH 230,322)	3	
COMM	121	Fundamentals of Public Speaking	3	
GEOL	131	Geology and Land-Use Mgmt.	3	
		Social Awareness Elective	3	
		Total	18	

YEAR 3 - SPRING SEMESTER			Crs	Gr
GISC	225	Principles of GIS	3	
SURE	340	Photogrammetry (SURE 110)	3	
SURE	373	Adjustment Computations 2 (SURE 372)	3	
SURE	420	Prof. Practice of Surveying *** (SURE 365, ENGL 250)	3	
SURE	452	Geodesy 1 (SURE 230, 372)	4	
		Total	16	

Submit Application for Graduation.

YEAR 4 - FALL SEMESTER			Crs	Gr
GISC	425	Tech. Issues in GIS & Cartography (SURE 272, GISC 225)	3	
SURE	366	Evid. & Procedure for Boundary Locations (SURE 365)	3	
SURE	440	Advanced Photogrammetry (SURE 340, 373)	3	
SURE	453	Geodesy 2 (SURE 373, 452)	4	
		Cultural Enrichment Elective	3	
		Total	16	

YEAR 4 - SPRING SEMESTER			Crs	Gr
CENG	321	Hydraulics Engineering (PHYS 242, MATH 230)	4	
CENG	421	Soils Engineering (CONM 121, MATH 220)	4	
CENG	485	Sustainable Land Use (Senior Status)	4	
SURE	465	Lgl. Aspts. of Survey. 2 *** (SURE 365, ENGL 250, Sr. Status)	3	
		Social Awareness Elective (200 level or above)	3	
		Total	18	

* CENG 220- Engineering Surveying and SURE 230 - Advanced Surveying may be taken in either semester.
** CONM 121 - Materials Properties and Testing and SURE 215 Surveying Computations may be taken in either semester.
*** Writing Intensive Courses.

Course Prefixes: SURE: Surveying Engineering GISC: Geographic Information Sciences CENG: Civil Engineering

CRITERION 2. PROGRAM EDUCATIONAL OBJECTIVES

A. Mission Statement:
Provide the institutional mission statement.

Ferris State University prepares students for successful careers, responsible citizenship, and lifelong learning. Through its many partnerships and its career-oriented, broad-based education, Ferris serves our rapidly changing global economy and society.

Vision Statement:

Ferris State University will be:
The recognized leader in integrative education, where theory meets practice throughout the curriculum, and where multi-disciplinary skills important in a global economy are developed with the result that Ferris State University will also be:

- The preferred choice for students who seek specialized, innovative, career- and life-enhancing education
- The premier educational partner for government, communities, agencies, businesses, and industries through applied research and joint ventures
- A stimulating, student-centered academic environment that fosters life-long engagement, leadership, citizenship, and continuing intellectual development
- A university that aligns its practices and resources in support of its core values of collaboration, diversity, ethical community, excellence, learning, and opportunity

B. Program Educational Objectives
List the program educational objectives and state where these can be found by the general public.

The Bachelor of Science Program in Surveying Engineering is designed to meet the needs of all students in the program. The Program Educational Objectives associated with this program are as follows:

1. Graduates will be able to analyze and solve surveying engineering problems by applying basic principles of mathematics, science, and engineering. Graduates will be able to use modern surveying engineering techniques, skills, and tools to identify, formulate, and solve surveying engineering problems.
2. Graduates will be able to apply the knowledge and skills from a broad education in order to understand the impact of surveying engineering solutions in a global, societal, and environmental context consistent with the principles of sustainable development.
3. Graduates will be prepared for professional practice in surveying engineering. Graduates will demonstrate an understanding of ethical, societal, and professional responsibilities; will recognize the limits of their knowledge and initiate self-directed learning opportunities; and will be able to function and communicate effectively individually and within multidisciplinary teams.

4. Provide the education needed for the graduates to become qualified as licensed professional surveyors.

The objectives of the program are published in the program brochure and are also available in the Program website http://www.ferris.edu/surveying/.

C. Consistency of the Program Educational Objectives with the Mission of the Institution
Describe how the program educational objectives are consistent with the mission of the institution.

The key words in the mission statement of Ferris State University are: successful careers, responsible citizenship, lifelong learning, career-oriented, broad-based education, and to serve our rapidly changing global economy and society.

The Surveying Engineering Program has four objectives and each of them is directly related to the key words contained in the Mission Statement of the University. The vision statement of the University is also included to further cement the fact that the program objectives have a direct relevance to both the mission and vision of the University. The following statements verify as to how the Program Educational Objectives are consistent with the mission of the University:

1. Objective A refers to the ability of graduates who can use the knowledge of science and mathematics to solve problems related to their surveying engineering problems. This is relevant to their being career oriented and also on being responsible and successful citizens.

2. Objective B refers to the broad-based education so that they are able to solve global, societal, and environmental problems related to the discipline in accordance with the principles of sustainable development.

3. Objective C refers to the fact that the graduates need to be responsible citizens to serve our rapidly changing global economy and society with a commitment for self-directed life-long learning by being able to understand ethical, societal, and professional responsibilities; and recognize the limits of their knowledge.

4. Objective D refers to the fact that some graduates may have to be licensed in order to be successful in their careers. The rigorous academic program at Ferris is part of the process in the licensure process.

Each objective is either directly or indirectly related to the key words of the mission of the University.

D. Program Constituencies

List the program constituencies. Describe how the program educational objectives meet the needs of these constituencies.

The Surveying Engineering Program has identified the following constituencies:

1. Students
2. Alumni
3. Employers
4. Advisory Committee
5. Faculty

First of all, it is obvious to state that the program exists to educate the students so that they become competent to enter the professional workforce. Therefore, it is important to incorporate students' input to develop the objectives keeping in mind that they have limited knowledge of the profession.

Ferris State University has a long history of providing Surveying and Surveying Engineering education to students not only from Michigan but also from other parts of the USA and many countries in the world. Our alumni understand what it takes to improve the program. They have been out in the industry and the profession. Therefore, it is important that their input is appropriately incorporated for the continual success of the program.

Because of the strength and the reputation of the program, just like the students and alumni, employers of our graduates are scattered throughout the world. Often times, they may have differing and even conflicting views; nevertheless, their input is important so as to keep the program relevant to the employers.

The program has very active advisory committee members. Some are also the employers of the graduates of the program and some are alumni. The members of the committee are selected to represent a broad-based group which includes academicians from other institutions. Some have donated a substantial amount of money to the program. The advisory committee meets twice a year. Their input is critical for the success of the program. The program educational objectives are developed in consultation with the committee members and are approved by them.

Many of the faculty members have been with the program for a long time. Each of them has a stake in the success of the program and they are totally committed to the success of the program. They are also very active professionally. Some of them have also established scholarships just like some of the advisory committee members. Therefore, feedback from faculty is critical for the continual improvement of the program. They are also directly responsible to upgrade not only the objectives and outcomes but the whole program curriculum so that the program incorporates new knowledge and delete material that is no longer relevant to the profession.

The program educational objectives were developed in consultation with the constituencies and they definitely meet their needs.

E. Process for Revision of the Program Educational Objectives

Describe the process that periodically reviews and revises, as necessary, the program educational objectives including how the program's various constituencies are involved in this process. Include the results of this process and provide a description of any changes that were made to the program educational objectives and the timeline associated with those changes since the last general review.

The involvement of the various constituencies is not the same because of their knowledge, experience, proximity, and availability. The program seeks input from the advisory committee members at least twice a year. The input from faculty is continual. The faculty group meets at least once a week. The relevancy and importance of the program and how the program may be improved is discussed whenever there is a new development in the profession. Formal and informal input from students as they take various courses is taken into account. However, the input from the employers and alumni is sought through the surveys the program conducts. The faculty and students also meet the employers and alumni annually at the Michigan Society of Professional Surveyors conference held in different parts of Michigan. The faculty also attend the national level conferences as well several state level conferences where input from alumni and employers is sought informally.

Two years ago, as a result of the formal as well as the informal input from the constituencies, both program educational objectives and the program outcomes were completely revised. They were changed to take into account the feedback from the constituencies.

The program has adopted a process whereby we seek input via formal surveys and informal input; when there is sufficient input; then new objectives are developed. These are first discussed by the faculty group. Once the faculty group approves them, they are taken to the advisory committee meetings to examine and discuss each objective and how it is relevant to the program. The program objectives are changed upon approval of the advisory committee.

The step-by-step process for upgrading the Program Educational Objectives is as follows:

1. Seek input from the constituencies (refer to Table 2.1 for the kind of input and frequency of input); the level of involvement of each constituency and their responsibilities varies according to their role and importance. Obviously, faculty and the advisory committee will have a greater role than students.
2. The faculty in the program analyze and debate each suggestion and its relevance to the program educational objectives keeping in mind the requirements imposed by the state licensing board, general education requirements of the university, the ABET requirements, plus the developments in new technologies.
3. Once the faculty feel that the changes are required as a result of the input from the constituencies or changes from the licensing board or ABET, the required changes are

made by the program faculty. These are then discussed and debated in the advisory committee meeting.

4. If the advisory committee approves the changes, the educational objectives are published in the Program website which is given below:
5. http://www.ferris.edu/ surveying/
6. It is a continual and cyclical process and does not really end as indicated in Figure 2.1
7. If the faculty decide to change the courses or curriculum as a result of the input from the constituencies, then the proposed changes as shown in figure 2.1 are made by the faculty group. These changes are then taken to the advisory committee meeting. The changes are adopted upon approval by the advisory committee.

Evaluating Achievement of Program Objectives

Figure 2.1: Program Educational Objectives Change Cycle

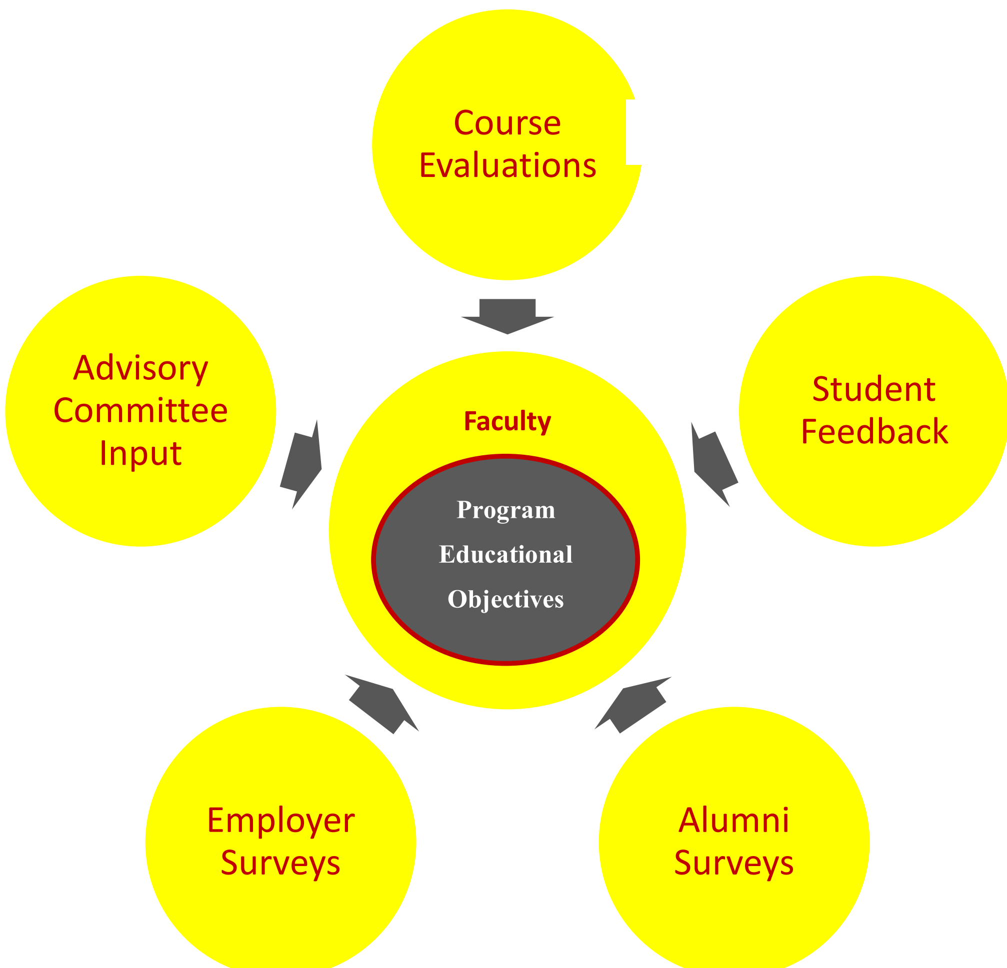


Table 2.1 Frequency of Constituency Surveys

Constituency	Indicator	Frequency
Students	Class discussion and student surveys	Periodically
	Student assessment of instruction	Each semester
	Student transcripts	Each semester
Faculty	Weekly meetings	Each week
	Meeting with administration	Periodically
	Faculty Survey	Periodically
Advisory Committee	Formal input during Fall and Spring Semester meetings	Biannual
	Informal input	Continual
	Advisory Committee surveys	Periodically
Alumni	Informal input	Continual
	Alumni Survey	Periodically
Employers	Employer Survey	Periodically
	Informal input	Continual

Substantial changes to the program were made two years ago. For now, it has not been observed that there is any reason to believe that the program educational objectives will be changed soon. However, the program is now (spring 2011) conducting a survey of all the constituencies and after analyzing the input from all the groups, it may be necessary to change parts or all of the objectives.

CRITERION 3. STUDENT OUTCOMES

A. Student Outcomes

List the student outcomes for the program and indicate where the student outcomes are documented. If the student outcomes are stated differently than those listed in Criterion 3, provide a mapping to the (a) through (k) Student Outcomes.

Student Outcomes for the B.S. degree in Surveying Engineering as related to the Program Educational Objectives are listed below. Further, the relationships to the Program Educational Objectives and the EAC/ABET Criterion 3 (a-k) outcomes are also identified.

1. A broad education and knowledge of contemporary issues necessary to understand the impact of surveying engineering solutions in a global, societal, and environmental context. (EAC/ABET Criteria 3; c, d, h, j) (Program Educational Objectives B and C)
2. An ability to solve surveying engineering problems in practice by applying fundamental knowledge of mathematics, statistics, science, and by using modern surveying engineering techniques, skills, and tools. (EAC/ABET Criteria 3; a, k) (Program Educational Objectives A and D)
3. An ability to identify, formulate, and solve surveying engineering problems, particularly the planning, design, establishing horizontal and vertical control, land use design, boundary determination, mapping and field layout of infrastructure that meet standards of accuracy and precision, keeping in mind cost, time, safety and quality needs, and objectives. (EAC/ABET Criteria 3; c, e) (Program Educational Objectives A, B and D)
4. An ability to design and conduct experiments and to analyze and interpret data in engineering surveying, topographic surveying, geodetic surveying, and boundary surveying. (EAC/ABET Criteria 3; b, j, k) (Program Educational Objectives A and D)
5. An ability to communicate technical material written papers/reports and oral presentations. (EAC/ABET Criterion 3; g) (Program Educational Objective C)
6. An ability to function within multidisciplinary teams. (EAC/ABET Criterion 3; d) (Program Educational Objective C)
7. An understanding of professional, societal, and ethical practice and responsibilities. (EAC/ABET Criterion 3f) (Program Educational Objectives B and C)
8. A recognition of the importance of professional licensure and a recognition of the need for, and an ability to engage in, life-long learning. (EAC/ABET Criterion 3; i) (Program Educational Objectives C and D)

Student outcomes appear on the Surveying Engineering Program's web site, on all promotional brochures and on course outlines and syllabi.

A graphic representation between ABET/EAC Criteria 3 (a-k) and Student Outcomes may be found on Chart 3-1.

Chart 3-1: Relationship Between ABET/EAC Criteria 3: (a-k) with Student Outcomes

Mapping ABET/EAC Criteria 3: (a-k) with Student Outcomes											
ABET/EAC Criteria 3:	a	b	c	d	e	f	g	h	i	j	k
Student Outcomes											
1			X	X				X		X	
2	X										X
3			X		X						
4		X								X	X
5							X				
6				X							
7						X					
8									X		

B. Relationship of Student Outcomes to Program Educational Objectives
Describe how the student outcomes prepare graduates to attain the program educational objectives.

The B.S. Program in Surveying Engineering is designed to meet the needs of all students in the program. The Program Educational Objectives associated with this program are as follows:

A. "Graduates will be able to analyze and solve surveying engineering problems by applying basic principles of mathematics, science, and engineering. Graduates will be able to use modern surveying engineering techniques, skills, and tools to identify, formulate, and solve surveying engineering problems."

   Student Outcomes 2, 3 and 4 prepare students to attain Program Educational Objective "A". Student Outcome 2 requires knowledge of the fundamentals using modern techniques, skills and tools, Student Outcome 3 an ability to identify, formulate and solve surveying engineering problems and Student Outcome 4 an ability to design and conduct experiments and to analyze and interpret data.

B. "Graduates will be able to apply the knowledge and skills from a broad education in order to understand the impact of surveying engineering solutions in a global, societal, and environmental context consistent with the principles of sustainable development."

   Student Outcomes 1 and 7 prepare students to attain Program Educational Objective "B". Student Outcome 1 requires a broad education and knowledge of contemporary issues necessary to understand the impact of surveying engineering solutions and Student Outcome 7 an understanding of professional, societal and ethical responsibilities.

C. "Graduates will be prepared for professional practice in surveying engineering. Graduates will demonstrate an understanding of ethical, societal, and professional responsibilities; will recognize the limits of their knowledge and initiate self-directed learning opportunities; and will be able to function and communicate effectively individually and within multidisciplinary teams."

   Student Outcomes 1, 5 and 6 prepare students to attain Program Educational Objective "C". Student Outcome 1 addresses the impact of surveying solutions in a global, societal and environmental context; Student Outcome 5 the ability to communicate written material and Student Outcome 6, the ability to function in multidisciplinary teams.

D. "Provide the education needed for the graduates to become qualified as licensed professional surveyors."

   Student Outcomes 7 and 8 prepare students to attain Program Educational Objective "D". Student Outcome 7 addresses and understanding of the professional, societal and ethical practice and responsibilities while Student Outcome 8 the recognition of the importance of professional licensure and a recognition of the need for, and the ability to engage in, lifelong learning.

A graphic representation between Student Outcomes and Program Educational Objectives may be found on Chart 3-2.

Chart 3-2: Relationship Between Student Outcomes and Program Objectives

Mapping Relationship of Student Outcomes with Program Educational Objectives								
Student Outcomes	1	2	3	4	5	6	7	8
Program Objectives								
A		X	X	X				
B	X						X	
C	X				X	X		
D							X	X

CRITERION 4. CONTINUOUS IMPROVEMENT

This section of your self-study report should document your processes for regularly assessing and evaluating the extent to which the program educational objectives and student outcomes are being attained. It should also describe how the results of these processes are being utilized to effect continuous improvement of the program.

Assessment is defined as one or more processes that identify, collect, and prepare the data necessary for evaluation. Evaluation is defined as one or more processes for interpreting the data acquired though the assessment processes in order to determine how well the program educational objectives and student outcomes are being attained.

Although the program can report its processes as it chooses, the following is presented as a guide to help you organize your self-study report. It is also recommended that you report the information concerning your program educational objectives separately from the information concerning your student outcomes.

A. Program Educational Objectives

It is recommended that this section include (a table may be used to present this information):

1. *A listing and description of the assessment processes used to gather the data upon which the evaluation of each the program educational objective is based. Examples of data collection processes may include, but are not limited to, employer surveys, graduate surveys, focus groups, industrial advisory committee meetings, or other processes that are relevant and appropriate to the program.*
2. *The frequency with which these assessment processes are carried out*
3. *The expected level of attainment for each of the program educational objectives*
4. *Summaries of the results of the evaluation processes and an analysis illustrating the extent to which each of the program educational objectives is being attained*
5. *How the results are documented and maintained*

In order to assess the effectiveness, usefulness, and acceptability of the program educational objectives, the constituency surveys as portrayed in table 4.1 are conducted at various time periods and frequency depending on their level of contribution. Not all constituencies have the same level of interaction and stake in the program. The faculty and students have by far the highest interest and stake in the program followed by advisory committee members, alumni and employers. Therefore, the level and frequency of interaction and their contribution is not the same. The assessment tools and indicators used for students are: Class discussion and student surveys, Student end of semester surveys, and Student transcripts. These are conducted each semester except for student surveys which are conducted at least every three years. The faculty in the program by far have the highest level of interest and stake in the program. Moreover, they also have the responsibility to periodically update both program educational objectives and the student outcomes so that they satisfy the needs of the constituencies and updates in terms of the inclusion of the latest developments in the discipline of surveying engineering.

Table 4.1 Frequency of Constituency Surveys

Constituency	Indicator	Frequency
Students	Class discussion and student surveys Student assessment of instruction Student surveys to evaluate program objectives Student transcripts	Periodically Each semester Each semester
Faculty	Weekly meetings Meeting with administration Faculty Survey	Each week Periodically Periodically
Advisory Committee	Formal input during Fall and Spring Semester meetings Informal input Advisory Committee surveys	Biannual Continual Periodically
Alumni	Informal input Alumni Survey	Continual Periodically
Employers	Employer Survey Informal input	Periodically Continual

In order to ensure that the program instruction is going smoothly and also to monitor the program in terms of satisfying the needs of the constituencies, the program faculty group meets weekly. In addition, the faculty also meets periodically with the administration. In addition, the faculty input survey is conducted to ensure that all parts of program educational objectives as well as student outcomes and other issues related to the program are addressed.

The Surveying Engineering program at Ferris State University has a long history of having an advisory committee. It is a matter of pride for the program to note that several of our current and past advisory members have established scholarships for the students in the program. One member donated large sums of money to maintain the GIS and Photogrammetry lab and continues to donate funds every year in terms of challenge funds.

The advisory committee meets twice a year - once in the fall semester and again in the spring semester. In addition, we also conduct advisory surveys. Moreover, the students, faculty, and advisory committee members are in continual contacts with entities such as in Michigan Society of Professional Surveyors (MSPS) annual meetings and various other MSPS Chapter level meetings. These informal meetings and interactions provide a valuable input for the continual development of the program.

The Surveying Program at Ferris was established in 1957 and has over 600 alumni. Our alumni are very active in both state and national level professional organizations. This provides our students, faculty, and advisory committee members an opportunity to interact informally on several occasions. In addition, the alumni surveys are conducted periodically.

The alumni of the program have found employment all over the world. They are working at different levels of government including the Federal government. In addition, they are also employed by private companies both large and small. The input from the employers is important to ensure that the program is keeping up with ever-changing technology and the changing nature of the responsibilities of the professionals involved with the spatial information systems. The employer surveys are conducted periodically and their input is incorporated in the objectives and the outcomes. These, in turn, guide us with upgrading the curriculum.

The flow chart shown in figure 4.1 shows how the program uses input from the constituencies to monitor and upgrade the program educational objectives. Please note that upgrading and changing of the program educational objectives does result in changing the program which requires addition/deletion of courses and changing the contents of the courses. Two years ago, the curriculum was changed as a result of the constituency surveys. The contents of some courses such as SURE115 were reduced to one credit. In some areas, such as in Legal Aspects of Surveying, a new course (SURE 366) was added as a result of the demands from students, alumni, and employers.

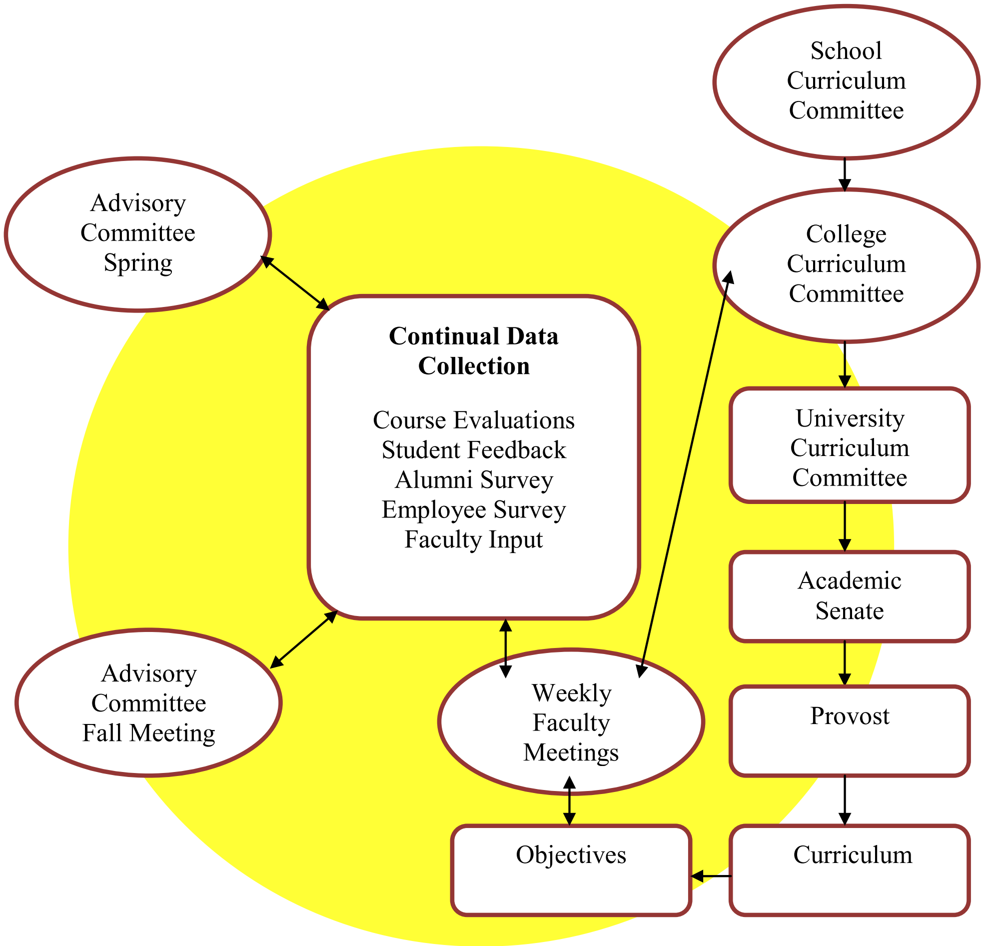


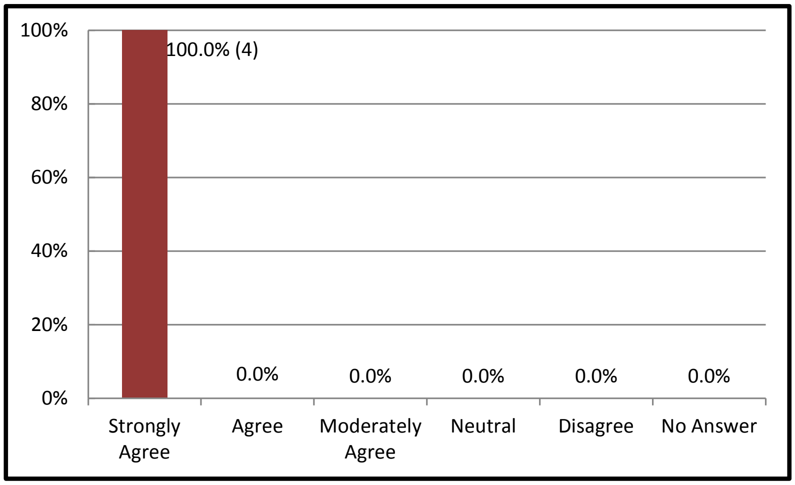
Figure 4.1: Flow chart for assessment of Program Educational Objectives

Please also note that the change in curriculum requires us to pass through various committees and administrative levels within the university. As indicated in the flow chart in Figure 4.1, the changes in the curriculum are forwarded to the College of Engineering Technology Curriculum Committee. If it finds that there are some issues that they question, they send it back to the program to be addressed and resubmitted to the CET Curriculum Committee. The CET Committee will then forward the proposal to the University Curriculum Committee. Once it is approved there, the proposal is sent to the Academic Senate. Upon their approval, the proposal is forwarded to the Provost's Office which has the official power to change the curriculum. The faculty continually monitor the curriculum and the program educational objectives. Any changes made have to go through the process as shown in the flow chart in Figure 4.1.

The results of the constituencies surveys conducted recently are given below:

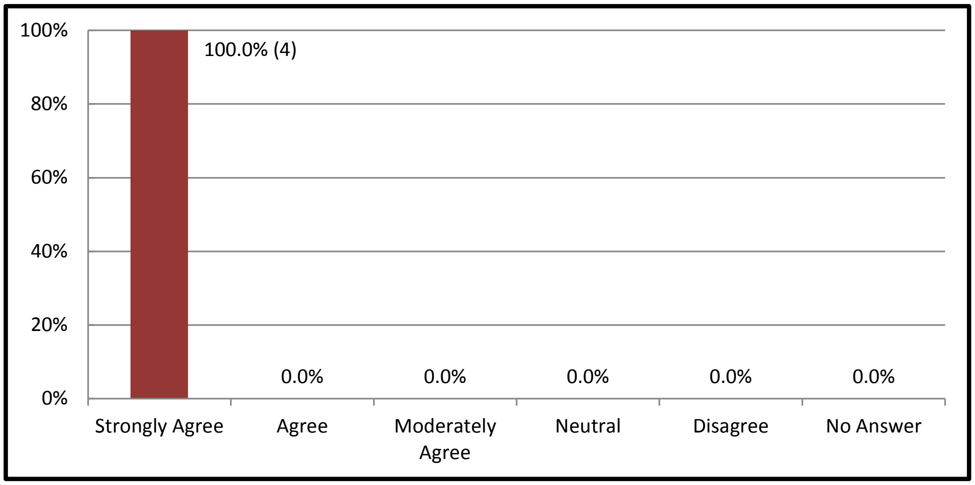
Results of the Faculty Surveys

Figure 4.2 Faculty survey for evaluation of objective one



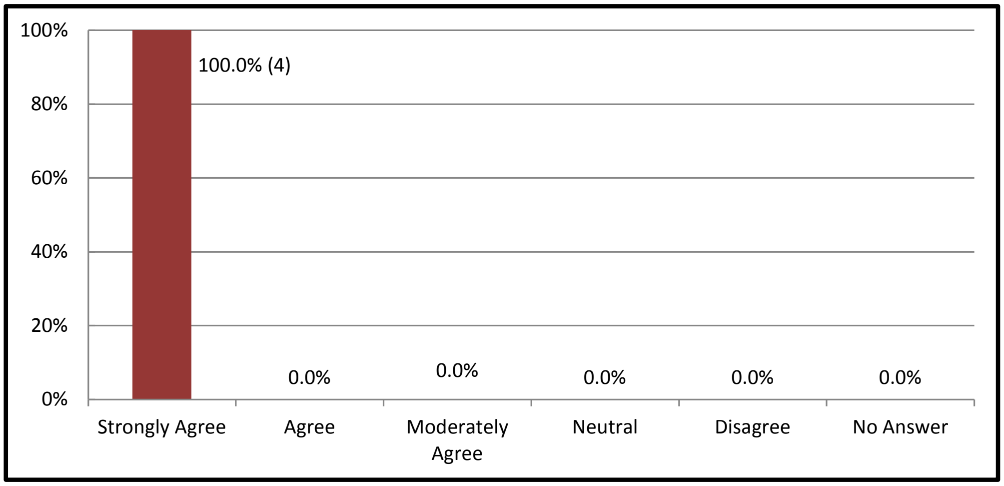
Program Objective 1: Graduates will be able to analyze and solve surveying engineering problems by applying basic principles of mathematics, science, and engineering. Graduates will be able to use modern surveying engineering techniques, skills, and tools to identify, formulate, and solve surveying engineering problems.

Figure 4.3 Faculty survey for evaluation of objective two



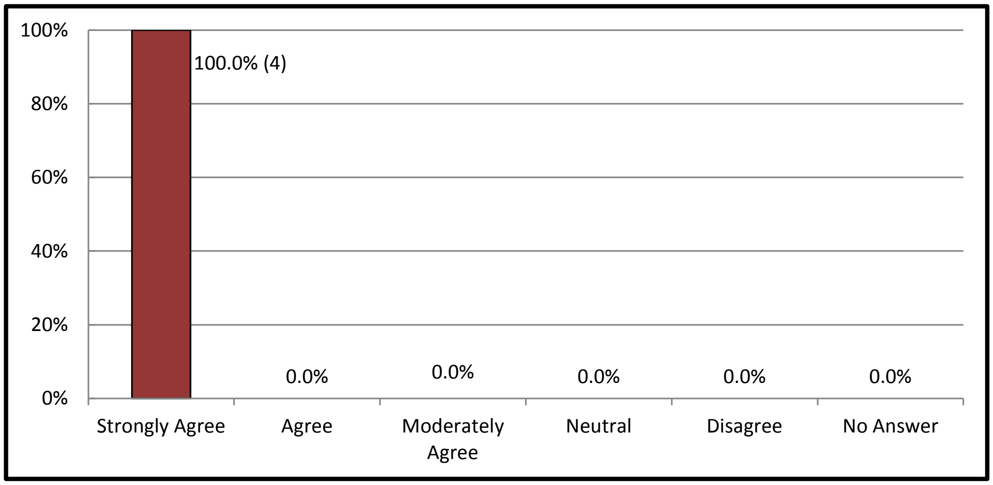
Program Objective 2: Graduates will be able to apply knowledge and skills from a broad education in order to understand the impact of surveying engineering solutions in a global, societal, and environmental context consistent with the principles of sustainable development.

Figure 4.4 Faculty survey for evaluation of objective three



Program Objective 3: Graduates will be prepared for professional practice in surveying engineering. Graduates will demonstrate an understanding of ethical, societal, and professional responsibilities; will recognize the limits of their knowledge and initiate self-directed and life-long learning opportunities; and will be able to function and communicate effectively individually and within multidisciplinary teams.

Figure 4.5 Faculty survey for evaluation of objective Four

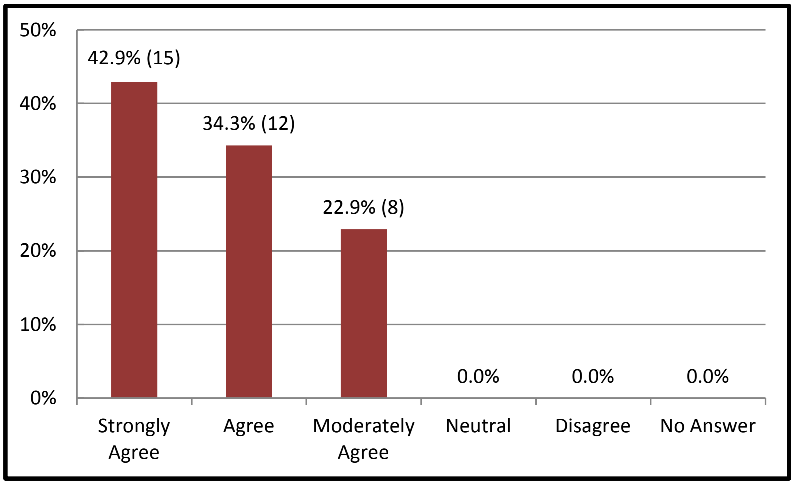


Program Objective 4: Provide the education needed for the graduates to become qualified as licensed professional surveyors.

An analysis of the charts is given above for all four educational objectives of the program. It is clear that 100% of the faculty fully support the program educational objectives. This is no surprise since the program educational objectives were written by the faculty and approved by the advisory committee.

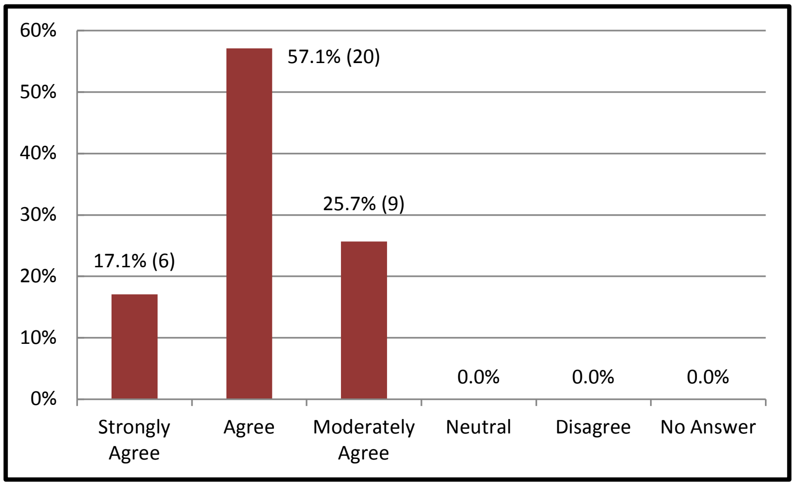
Results of the Student Surveys:

Figure 4.6 Student survey for evaluation of objective #one



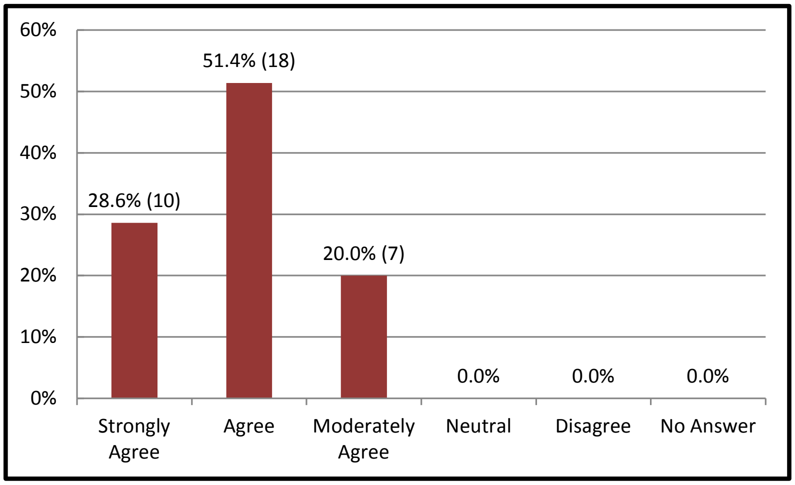
Program Objective 1: Graduates will be able to analyze and solve surveying engineering problems by applying basic principles of mathematics, science, and engineering. Graduates will be able to use modern surveying engineering techniques, skills, and tools to identify, formulate, and solve surveying engineering problems.

Figure 4.7 Student survey for evaluation of objective # 2



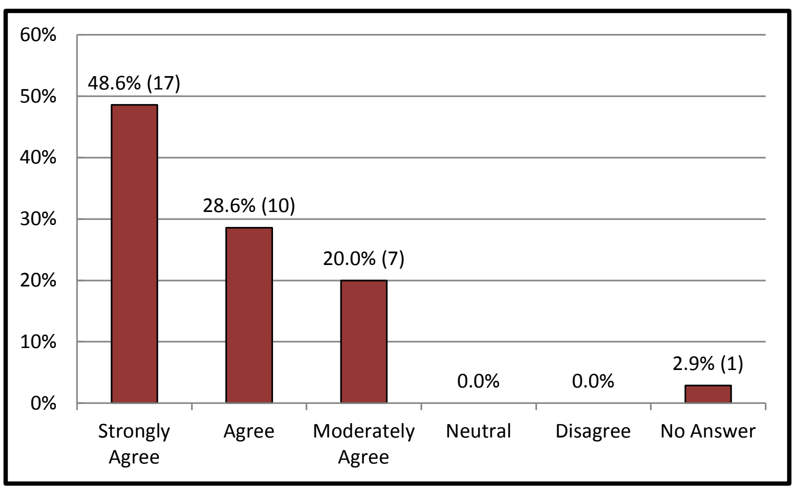
Program Objective 2: Graduates will be able to apply knowledge and skills from a broad education in order to understand the impact of surveying engineering solutions in a global, societal, and environmental context consistent with the principles of sustainable development.

Figure 4.8 Student survey for evaluation of objective #: 3



Program Objective 3: Graduates will be prepared for professional practice in surveying engineering. Graduates will demonstrate an understanding of ethical, societal, and professional responsibilities; will recognize the limits of their knowledge and initiate self-directed and life-long learning opportunities; and will be able to function and communicate effectively individually and within multidisciplinary teams.

Figure 4.9 Student survey for evaluation of objective # 4



Program Objective 4: Provide the education needed for the graduates to become qualified as licensed professional surveyors.

An analysis of the charts is given above for all four educational objectives of the program. It is clear that 100% of the majority of students support the program educational objectives. For objectives "#1" 43%, 34%, and 23% of the students surveyed strongly agreed, agreed or moderately agreed. It is interesting to note that none of the students disagreed or even stay neutral.

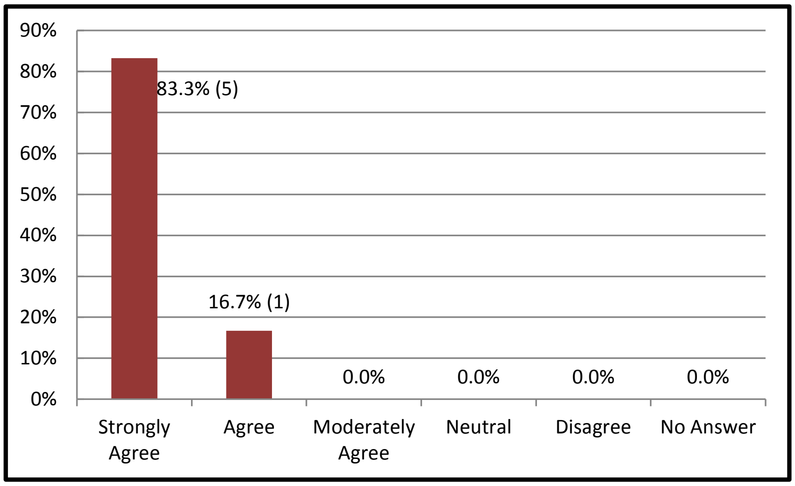
Similarly for objectives #2, all respondents either strongly agreed, or agreed or moderately agreed with the objectives. There were 49%, 28%, 20%, and 3% strongly agreed, agreed, moderately agreed.

For objectives #3, all respondents either strongly agreed, or agreed or moderately agreed with the objectives. There were 29%, 51%, and 20% strongly agreed, agreed, and moderately agreed with this objective.

Furthermore, for objectives #4, almost all respondents either strongly agreed, or agreed or moderately agreed with the objectives. There were 17%, 57%, and 26% strongly agreed, agreed, and moderately agreed with this objective. Only 3% refused (one student) to answer the question. It is believed that the student in question must be a foreign student who is not interested in getting a license.

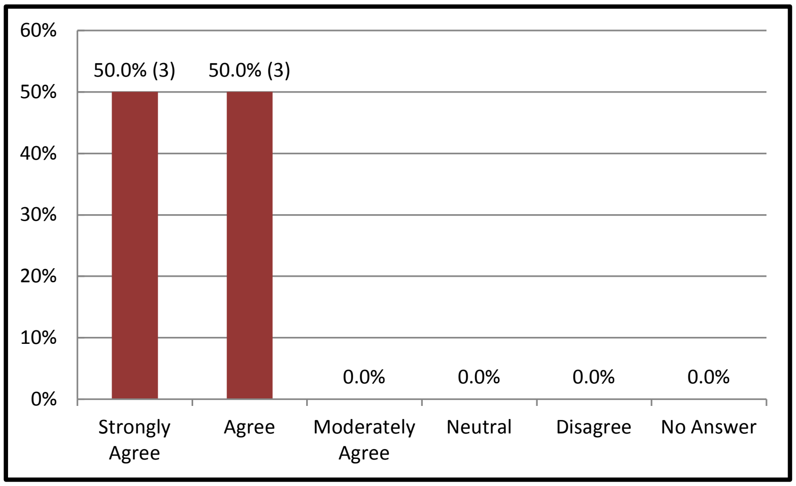
Results of the Advisory Committee Surveys

Figure 4.10: Advisory Committee Survey to Evaluate objective # 1



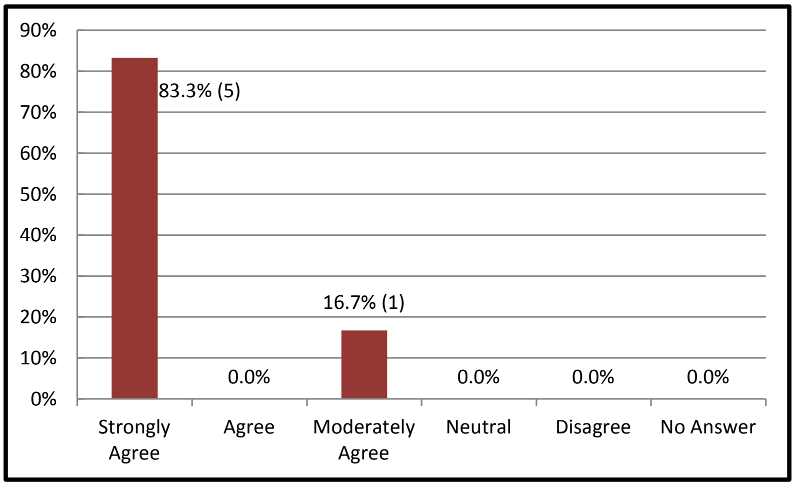
Program Objective 1: Graduates will be able to analyze and solve surveying engineering problems by applying basic principles of mathematics, science, and engineering. Graduates will be able to use modern surveying engineering techniques, skills, and tools to identify, formulate, and solve surveying engineering problems.

Figure 4.11: Advisory Committee Survey to Evaluate objective # 2



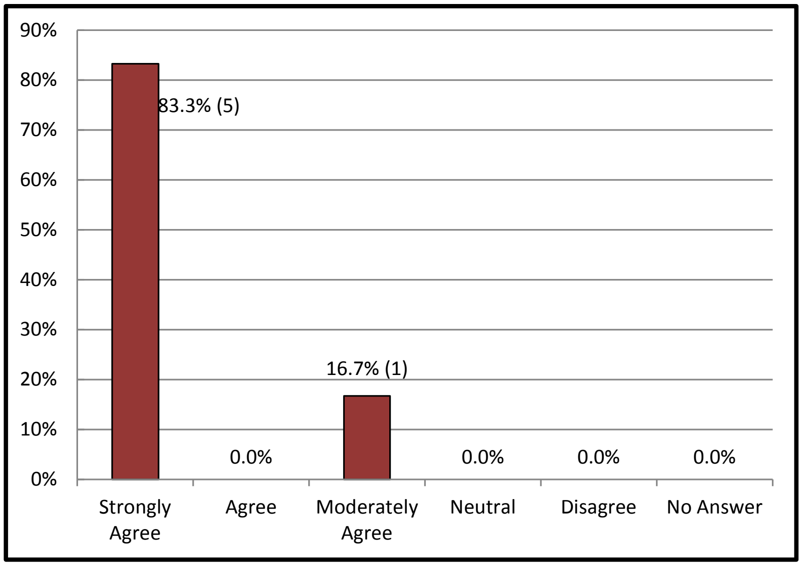
Program Objective 2: Graduates will be able to apply knowledge and skills from a broad education in order to understand the impact of surveying engineering solutions in a global, societal, and environmental context consistent with the principles of sustainable development.

Figure 4.11: Advisory Committee Survey to Evaluate objective # 3



Program Objective 3: Graduates will be prepared for professional practice in surveying engineering. Graduates will demonstrate an understanding of ethical, societal, and professional responsibilities; will recognize the limits of their knowledge and initiate self-directed and life-long learning opportunities; and will be able to function and communicate effectively individually and within multidisciplinary teams.

Figure 4.13: Advisory Committee Survey to Evaluate objective # 4

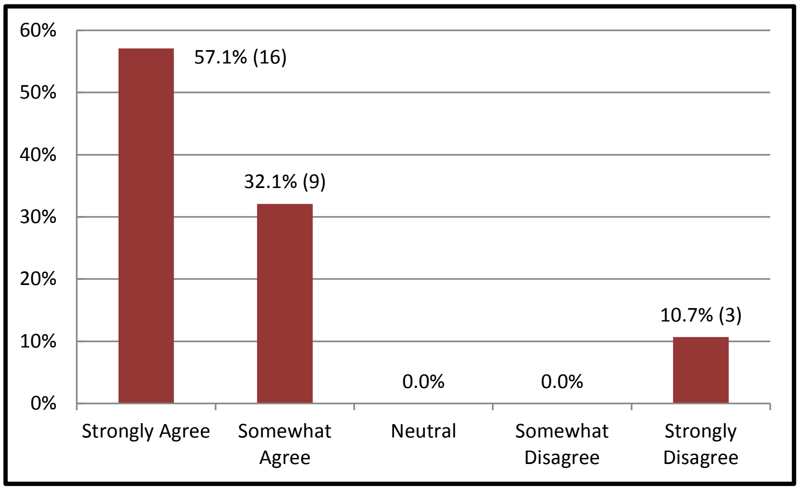


Program Objective 4: Provide the education needed for the graduates to become qualified as licensed professional surveyors.

The results of the advisory committee surveys are given in figure 4.10 to figure 4.13. Please note that these objectives were approved by the advisory committee. When one examines these charts, it is clear that 100% of the advisory members agreed with the objectives of the program. For objective #1, 83% strongly agreed while 17% agreed. For objective #2, 50% strongly agreed and another 50% agreed. Similarly, for objective #3, 83% strongly agreed and another 17% moderately agreed. For the objective #4, 83% strongly agreed and 17% moderately agreed. This shows that there is strong support for the objectives of the program and what the program has achieved over the years.

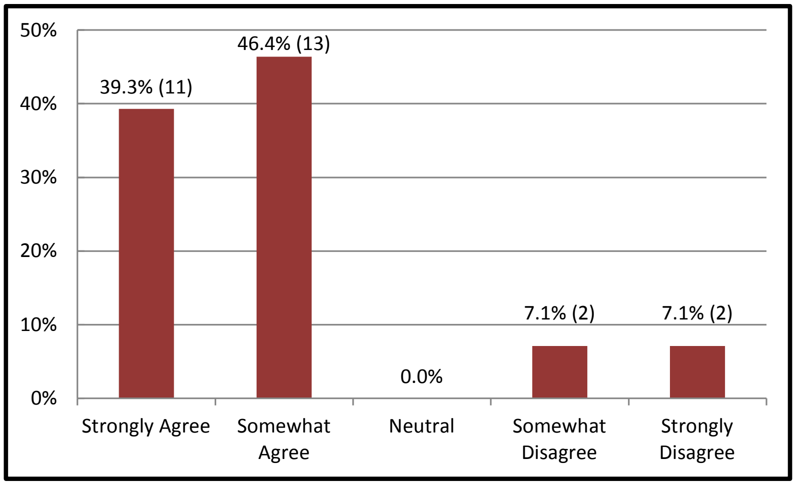
Results of the Alumni Surveys

Figure 4.14: Alumni Survey to Evaluate objective # 1



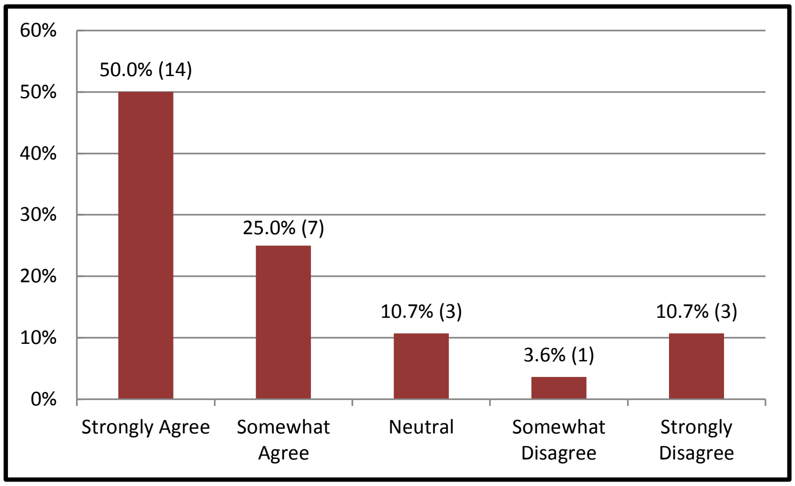
Program Objective 1: Graduates will be able to analyze and solve surveying engineering problems by applying basic principles of mathematics, science, and engineering. Graduates will be able to use modern surveying engineering techniques, skills, and tools to identify, formulate, and solve surveying engineering problems.

Figure 4.15: Alumni Survey to Evaluate objective # 2



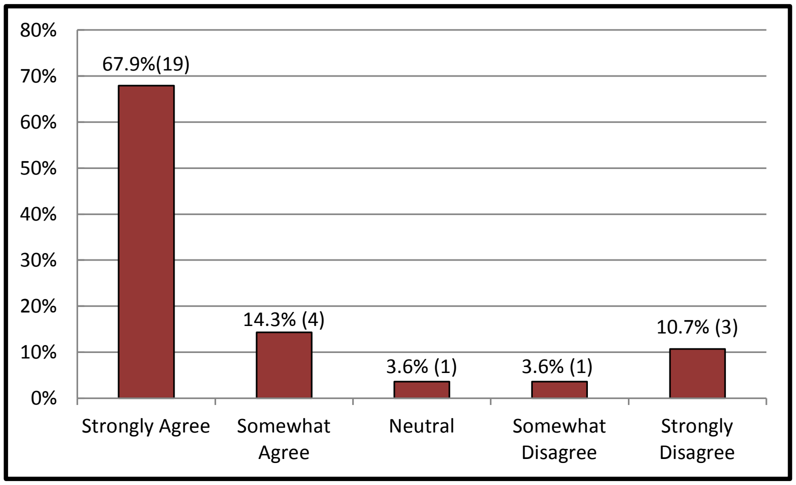
Program Objective 2: Graduates will be able to apply knowledge and skills from a broad education in order to understand the impact of surveying engineering solutions in a global, societal, and environmental context consistent with the principles of sustainable development

Figure 4.16: Alumni Survey to Evaluate objective # 3



Program Objective 3: Graduates will be prepared for professional practice in surveying engineering. Graduates will demonstrate an understanding of ethical, societal, and professional responsibilities; will recognize the limits of their knowledge and initiate self-directed and life-long learning opportunities; and will be able to function and communicate effectively individually and within multidisciplinary team

Figure 4.17: Alumni Survey to Evaluate objective # 4

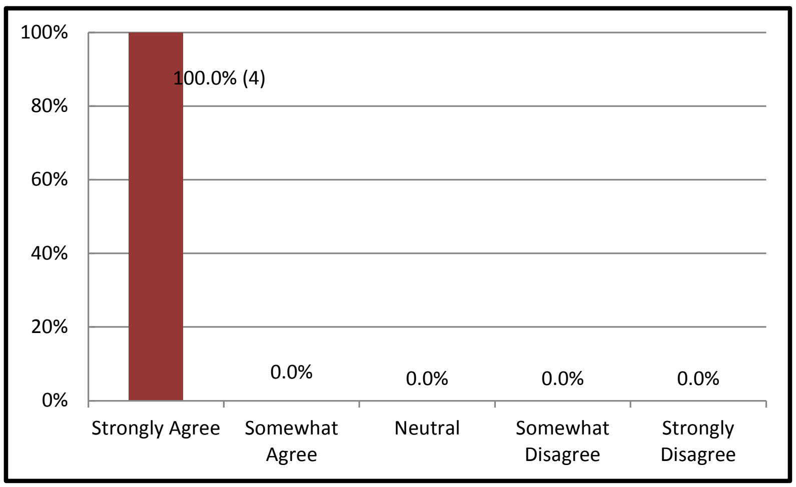


Program Objective 4: Provide the education needed for the graduates to become qualified as licensed professional surveyors.

When one examines the results of the alumni surveys figures 4.14 to 4.17, it is clear that the vast majority of the respondents (over 75%-90%) either strongly agree or agree that the program objectives are relevant and valid for the program.

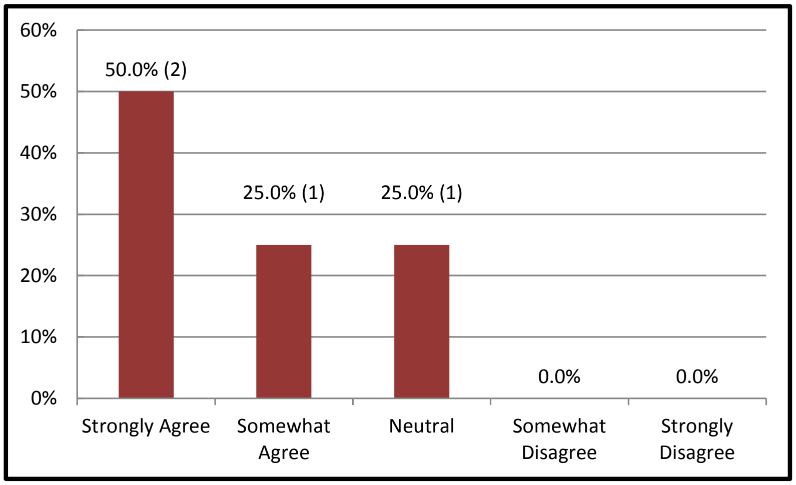
Results of the Employer Surveys

Figure 4.18: Employer Survey to Evaluate objective # 1



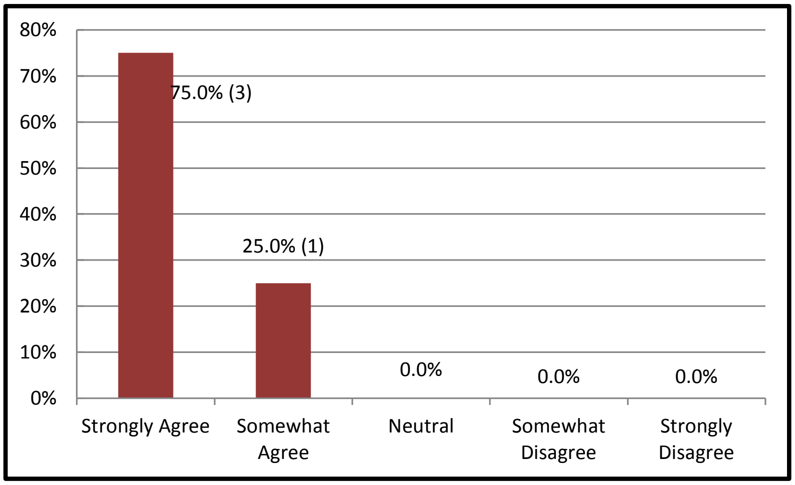
Program Objective 1: Graduates will be able to analyze and solve surveying engineering problems by applying basic principles of mathematics, science, and engineering. Graduates will be able to use modern surveying engineering techniques, skills, and tools to identify, formulate, and solve surveying engineering problems.

Figure 4.19: Employer Survey to Evaluate objective # 2



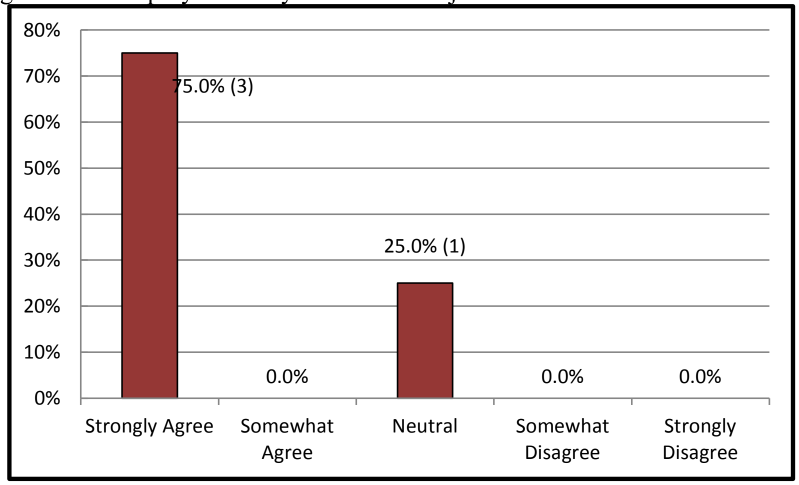
Program Objective 2: Graduates will be able to apply knowledge and skills from a broad education in order to understand the impact of surveying engineering solutions in a global, societal, and environmental context consistent with the principles of sustainable development. Figure 4.20: Employer Survey to Evaluate objective # 3

Figure 4.20: Employer Survey to Evaluate objective # 3



Program Objective 3: Graduates will be prepared for professional practice in surveying engineering. Graduates will demonstrate an understanding of ethical, societal, and professional responsibilities; will recognize the limits of their knowledge and initiate self-directed and life-long learning opportunities; and will be able to function and communicate effectively individually and within multidisciplinary team

Figure 4.21: Employer Survey to Evaluate objective # 4



Program Objective 4: Provide the education needed for the graduates to become qualified as licensed professional surveyors.

An examination of the employer surveys figures 4.17 to 4.21 reveals that between 75% to 100% employers believe that the program objectives of the Surveying Engineering Program are very relevant to the industry. It also implies that the employers believe in the kind of educational objectives the program has and it obviously reflects on the high technical, ethical, life-long learning and self learning attitudes our graduates have displayed.

4. *The expected level of attainment for each of the program educational objectives*
6. *Summaries of the results of the evaluation processes and an analysis illustrating the extent to which each of the program educational objectives is being attained*
7. *How the results are documented and maintained*

The expected level of attainment of the objectives is 70%. As indicated in all of the constituencies' surveys as summarized above, it is clear that all of the program objectives have exceeded our expectations.

In all the above surveys, it is clear that there is a high level of support for the program and its objectives from the constituencies that were surveyed. The results of the survey of the constituents were either strongly agreed, or agreed or moderately agreed. However, the student input for objectives need monitoring. If these show any weakness in subsequent surveys and is also corroborated by other constituencies, then they may need to be changed.

The results have been summarized and graphically portrayed using histograms as illustrated in the figures 4.2 to 4.21. These are all documented and saved in the program office.

B. Student Outcomes

It is recommended that this section include (a table may be used to present this information):

1. *A listing and description of the assessment processes used to gather the data upon which the evaluation of each student outcome is based. Examples of data collection processes may include, but are not limited to, specific exam questions, student portfolios, internally developed assessment exams, senior project presentations, nationally-normed exams, oral exams, focus groups, industrial advisory committee meetings, or other processes that are relevant and appropriate to the program.*
2. *The frequency with which these assessment processes are carried out*
3. *The expected level of attainment for each of the student outcomes*
4. *Summaries of the results of the evaluation process and an analysis illustrating the extent to which each of the student outcomes is being attained*
5. *How the results are documented and maintained*

The surveying engineering program at Ferris State University is a very well known program throughout the United States and in several foreign countries. It took a long time for this program to evolve to be what it is today. The program has produced high-quality graduates who have held several government positions. This has been a result of a very comprehensive curriculum comprising all aspects of surveying engineering. In addition, the program uses extensive methods of student assessment. The assessment tools that are used to monitor and assess students' performance are given in the following section.

Assessment Tools Used

1. Exams: short answer questions, numerical problems, multiple-choice questions, True/False questions (calculation and knowledge based)
2. Quizzes - short-answer questions, numerical problems
3. Homework assignments
4. Laboratory assignments
5. Oral Presentations
6. FS. Fundamentals of surveying a nationally normed test

Assessment Tools	Frequency of Use	Minimum Expected level of Achievement In percentage	Results
U	Variable depending on the course	70	
V	Variable depending on the course	70	
W	Variable depending on the course	70	
X	Variable depending on the course	70	
Y	Once a semester for a select course	70	
FS	Every year for seniors	75	

The above tools are used for each course taught in the program; however, other departments use some of the same tools. These tools are then used to assess each course and a table is produced for each course each semester. An example of the table is given for SURE 111: Fundamentals of Surveying is given below:

Table 4.2: Assessment Plan for SURE 110 Fundamentals of Surveying

Semester:		Instructor:											
Course Outcomes	Program Outcome and ABET Criteria	Instructor Evaluation						(number)					
		Assessment Tool 1	Score (%)	Assessment Tool 2	Score (%)	Assessment Tool 3	Score (%)	E (5 pt)	G (4 pt)	A (3 pt)	N (2 pt)	NC (1 pt)	Composite %
1. an awareness of units of measurements and the accuracy of the surveying instruments and the errors associated with them	1 a	U,X	93	V	87	W	98						93
2. the ability to use various surveying instruments	3 a, k	U,X	97	V	84	W	91						91
3. the ability to perform computations using data taken from field notes	2, 3 a, k	U,X	89	V	84	W	87						87
4. the ability to draw maps & write report from the field and computed data.	4,5 a, e	U,X	87	V	82	W	86						85
Instructor Comments													

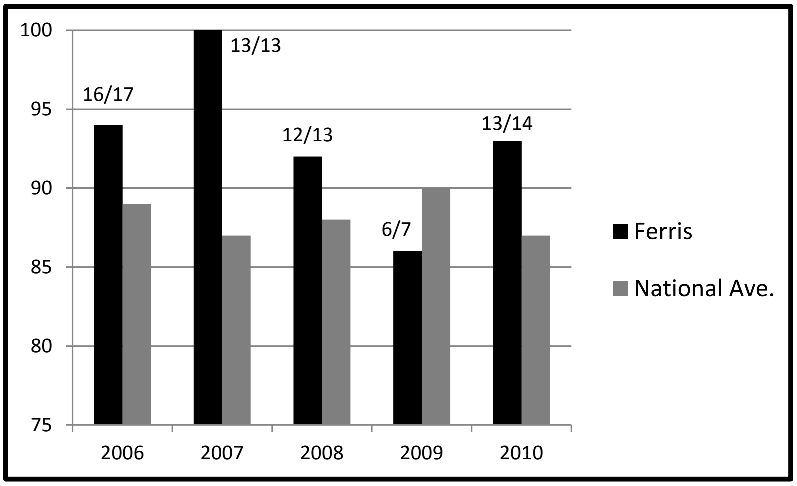
Assessment legend:

U. Exams: short answer questions, numerical problems, multiple-choice questions, True/False questions (calculation and knowledge based)
V. Quizzes - short-answer questions, numerical problems
W. Homework assignments
X. Laboratory assignments
Y. Oral Presentations

Results of the Nationally-Normed Fundamentals of Surveying Test

The majority of our students would like to be licensed professional surveyors. The Fundamentals of Surveying Test is taken about a semester prior to graduation or in the semester of graduation. The following figure 4.22 portrays the results of the performance of our students and the comparison with the national average.

Figure 4.22: NCEES FS Exam - Passing Rate Comparison



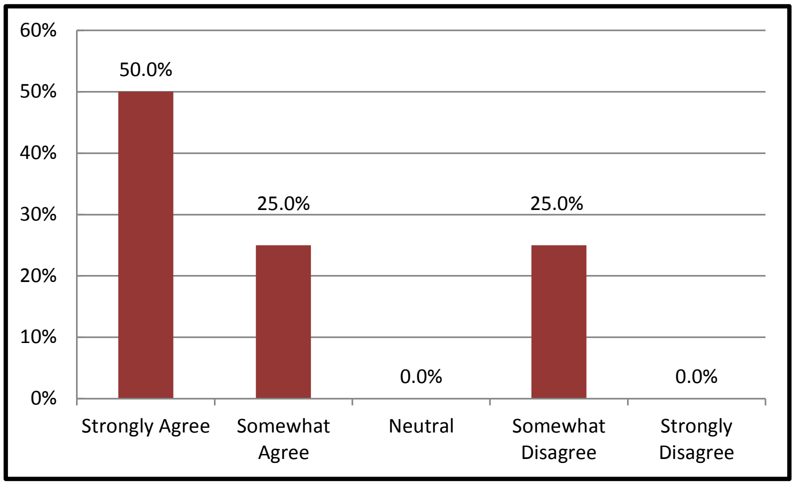
From figure 4.22, it is clear that the program graduates consistently outperformed the national average level except in 2009 when we only had seven students take the test and unfortunately, one of them failed. Please note that our lowest performance passing rate was 86% in 2009. Other than that, the passing rate of the program graduates has been higher than 90% and it was 100% in 2007.

Extensive surveys of the constituencies – alumni, employer, advisory committee, faculty and students – were carried out. The results were summarized and histograms were plotted just like the ones done for the program objectives. The results strongly indicate that the student outcomes the program has now are very well supported by all the constituencies.

Sample Results for the Student Outcomes Survey

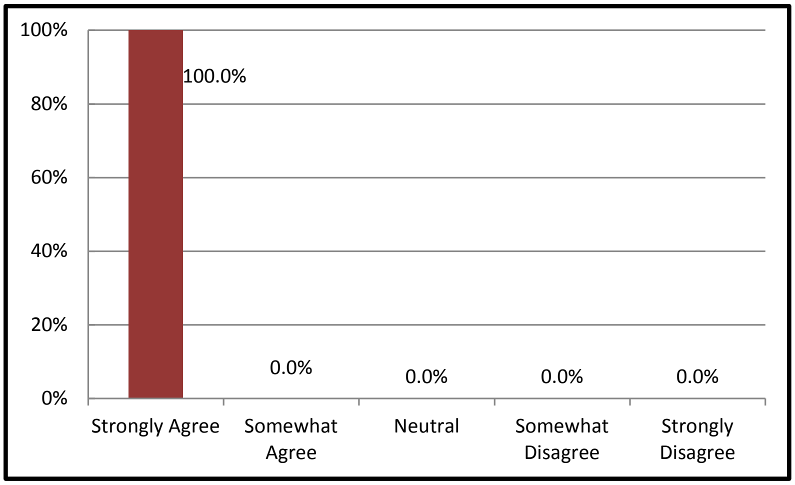
Please note that student outcomes surveys were carried out for each constituency. It is felt that it would be unnecessary to include all the results here. The results will be available to the visiting team if they would like to see them. Only the employer survey of the student outcomes is included here.

Figure 4.22: Employer Survey to Evaluate student outcome # 1



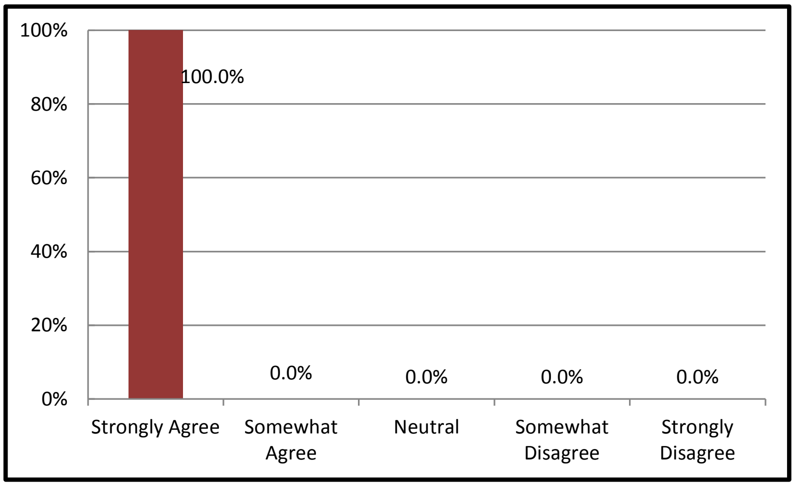
Student Outcome 1: A broad education and knowledge of contemporary issues necessary to understand the impact of surveying engineering solutions in a global, societal, and environmental context.

Figure 4.23: Employer Survey to evaluate student outcome # 2



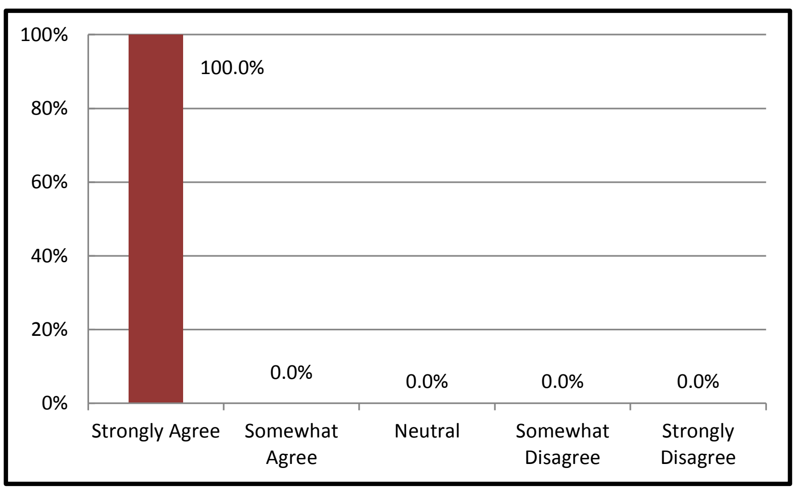
Student Outcome 2: An ability to solve surveying engineering problems in practice by applying fundamental knowledge of mathematics, statistics, science, and by using modern surveying engineering techniques, skills, and tools.

Figure 4.24: Employer Survey to evaluate student outcome # 3



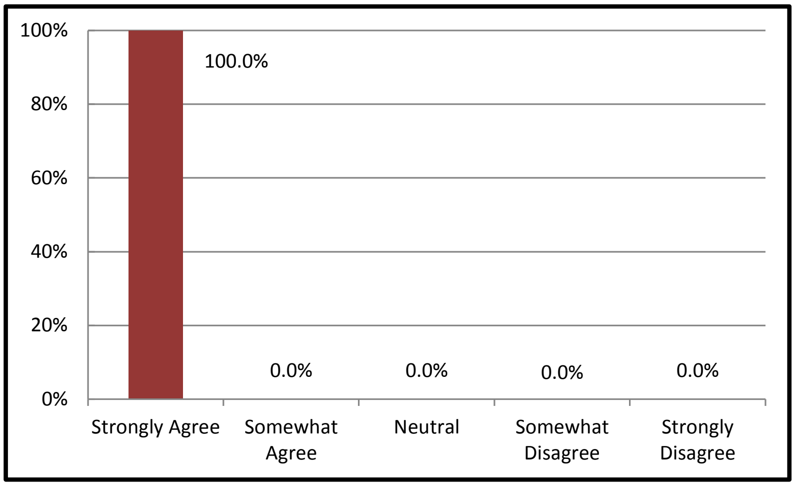
Student Outcome 3: An ability to identify, formulate, and solve surveying engineering problems, particularly the planning, design, establishing horizontal and vertical control, land use design, boundary determination, mapping and field layout of infrastructure that meet standards of accuracy and precision, keeping in mind cost, time, safety and quality needs, and objectives.

Figure 4.25: Employer Survey to evaluate student outcome # 4



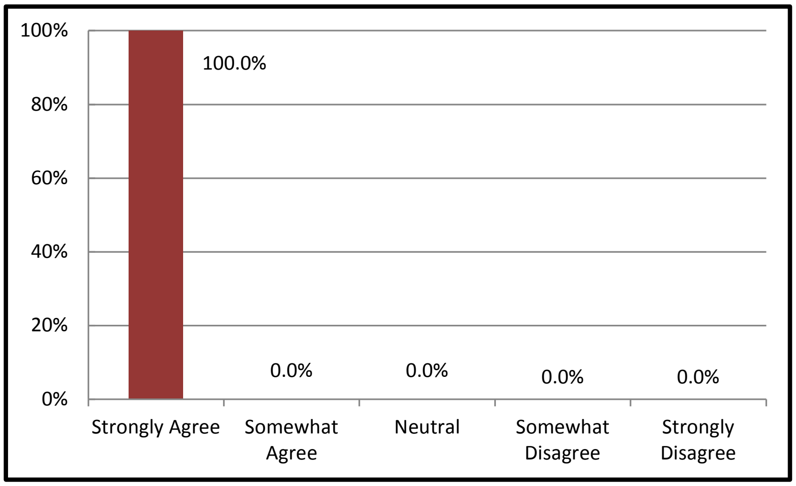
Student Outcome 4: An ability to design and conduct experiments and to analyze and interpret data in engineering surveying, topographic surveying, geodetic surveying, and boundary surveying.

Figure 4.26: Employer Survey to evaluate student outcome # 5



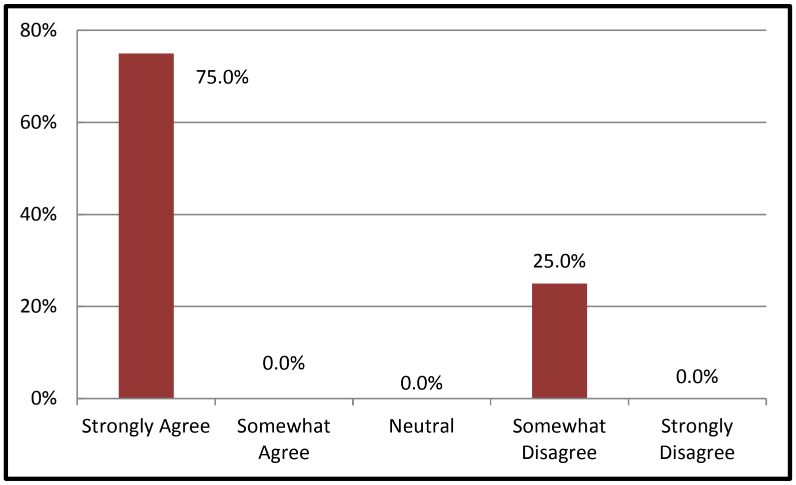
Student Outcome 5: An ability to communicate technical material written papers/reports and oral presentations.

Figure 4.27: Employer Survey to evaluate student outcome # 6



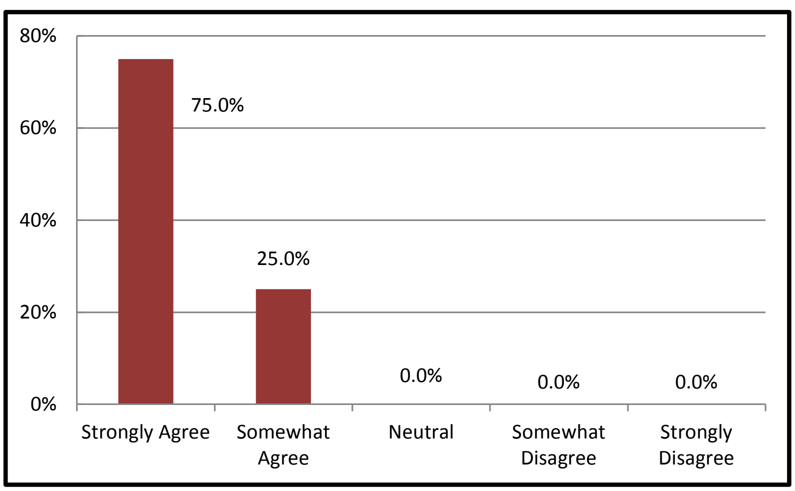
Student Outcome 6: An ability to function within multidisciplinary teams.

Figure 4.28: Employer Survey to evaluate student outcome # 7



Student Outcome 7: An understanding of professional, societal, and ethical practice and responsibilities.

Figure 4.29: Employer Survey to evaluate student outcome # 8



Student Outcome 8: A recognition of the importance of professional licensure and a recognition of the need for, and an ability to engage in, life-long learning.

Since the input from the various constituencies have been very supportive of both the program educational objectives and student outcomes, the program has no plan to change the courses or the level of concentrations in the different aspects of the curriculum at this time. It should be noted that the curriculum, as well as program objectives and student outcomes, were changed only about two years ago. If the program input from the constituencies clearly indicates that something must be changed, then the curriculum change process as outlined in Figure 4.1 must be followed.

C. Continuous Improvement

Describe how the results of evaluation processes for the program educational objectives and the student outcomes and any other available information have been used as input in the continuous improvement of the program. Indicate any significant future program improvement plans based upon recent evaluations. Provide a brief rationale for each of these planned changes.

In order to keep the program current and relevant, the program seeks continual input from its constituencies - alumni, employer, advisory committee, faculty and students. The frequency and the level of interaction are given in Table 4.1. Obviously, as stated in the above sections, all constituencies do not have the same level of input and interaction. For example, faculty members have a greater role than students or advisory committee members. In addition, it is not as easy to seek input from the employers and the alumni.

The curriculum changes that were made about three years ago were an example of how the input from the constituencies affected the program. The alumni, students, employers, and advisory committee members wanted an increase in the coverage in the legal aspects of the curriculum. Consequently, SURE 366 which is a three-credit legal aspects course was added to the curriculum. SURE 329, a cartography course was deleted and some of its contents were added to GISC 425 which is a second GIS course.

Please also note that the change in curriculum requires the program to pass through various committees and administrative levels within the university. As indicated in the flow chart in Figure 4.1, the changes in the curriculum are forwarded to the College of Engineering Technology Curriculum Committee. If it finds that there are some issues that they disagree then they send it back to the program and the faculty has to address them. Once approved by the College Curriculum Committee, the proposal is then forwarded to the University Curriculum Committee. Upon approval there, the proposal is sent to the Academic Senate. Once it is approved by the Senate, the proposal is forwarded to the Provost Office which has the official power to change the curriculum. The faculty continually monitors the curriculum and the program educational objectives. Any changes made have to go through the process as shown in the flow chart in Figure 4.1.

Since the results of the constituencies surveys have been very supportive of the current program educational objectives and the student outcomes, at the moment we do not have any plans to change the curriculum.

D. Additional Information

Copies of any of the assessment instruments or materials referenced in 4.A, 4.B, or 4.C must be available for review at the time of the visit. Other information such as minutes from meetings where the assessment results were evaluated and where recommendations for action were made could also be included.

The results of the surveys both included in the self-study report and other relevant information will be available to the visiting team from ABET.

CRITERION 5. CURRICULUM

A. Program Curriculum

1. *Complete Table 5-1 that describes the plan of study for students in this program including information on course offerings in the form of a recommended schedule by year and term along with average section enrollments for all courses in the program over the two years immediately preceding the visit. State whether you are on quarters or semesters and complete a separate table for each option in the program.*

   See next pages for Table 5-1

Table 5-1 Curriculum

Program Name: *Surveying Engineering*
The University academic calendar is in **semesters**
No other options within the program

Course (Department, Number, Title) List all courses in the program by term starting with first term of first year and ending with the last term of the final year.	Indicate Whether Course is Required, Elective or a Selected Elective by an R, an E or an SE.[2]	*Curricular Area (Credit Hours)* Math & Basic Sciences	Engineering Topics Check if Contains Significant Design (√)	General Education	Other	Last Two Terms the Course was Offered: Year and, Semester, or Quarter	Average Section Enrollment for the Last Two Terms the Course was Offered[1]
First Semester – Fall							
SURE 110 – Fundamentals of Surveying (MATH 120-co-req.)	R		4 (√)			F09, F10	15
SURE 115 – Intro. To Computer Mapping	R				1	S10, F10	10
ENGL 150 – English I	R			3		F10, S11	23
MATH 220 – Calculus & Analytic Geometry I (MATH 130 or 126)	R	5				F10, S11	28
FSUS 100 – Freshmen Seminar	R				1	F09, F10	10
Cultural Enrichment Elective	SE			3			
Second Semester – Spring							
CENG 220 – Engineering Surveying (SURE 110)	R		4 (√)			S10, F10	12
CONM 121 – Materials Properties and Testing (MATH 120)	R		3			F10, S11	10
ENGL 250 – English II (ENGL150)	R			3		F10, S11	23
MATH 230 – Calculus & Analytic Geometry II (MATH 220)	R	5				F10, S11	28

Third Semester – Fall							
SURE 215 – Surveying Computations (SURE 110)	R		3			F10, S11	9
CENG 240 – Engineering Statics (MATH 230, co-req. PHYS 241)	R		3			F09, F10	18
CHEM 121 – General Chemistry I (CHEM 103, MATH 115)	R	5				F10, S11	23
PHYS 241 – General Physics I (C- or higher in MATH 220)	R	5				F09, F10	17
Forth Semester – Spring							
SURE 230 – Advanced Surveying (SURE 110)	R		4			S10, S11	14
SURE 272 – Programming Applications in Geomatics (SURE 215, MATH 130)	R		1 (√)		1	S10, S11	16
SURE 331 – Ethics in Engineering and Technology (ENGL 150)	R			3		F10, S11	29
MATH 322 – Linear Algebra (MATH 220)	R	3				S10, S11	35
PHYS 242 – General Physics II (C- or higher in MATH 230, PHYS 241)	R	5				S10, S11	17
Fifth Semester – Fall							
GISC 239- Remote Sensing	R		3			S10, F10	14
SURE 365 – Legal Aspects of Surveying* (SURE 215, ENGL 250)	R		3			F09, F10	23
SURE 372- Adjustment Computations I (SURE 230, 272, MATH 230, 322)	R	3				F09, F10	21
COMM 121- Fundamentals of Public Speaking	R			3		F10, S11	28
GEOL 131- Geology and Land Use Management	R	3				F09, F10	23
Social Awareness Elective	SE		3				
Sixth Semester – Spring							
GISC 225 – Principles of GIS	R		3			F10, S11	15
SURE 340 – Photogrammetry (SURE 110)	R		3			F10, S11	14
SURE 373 – Adjustment Computations II (SURE 372)	R	1	2 (√)			S10, S11	24
SURE 420 – Professional Practice of Surveying* (SURE 365, ENGL 250)	R		3			S10, S11	26
SURE 452 – Geodesy I (SURE 230, 372)	R		4(√)			S10, S11	14

Seventh Semester – Fall							
GISC 425 – Technical Issues in GIS (SURE 272, GISC 225)	R		3			F09, F10	12
SURE 366 – Evidence and Procedure for Boundary Locations (SURE 365)	R		3			F09, F10	17
SURE 440 – Advanced Photogrammetry (SURE 373, SURE 340)	R		3(√)			F09, F10	14
SURE 453 – Geodesy II (SURE 373, 452)	R		4(√)			F09, F10	14
Cultural Enrichment Elective	SE			3			
Eighth Semester – Spring							
CENG 321 – Hydraulics Engineering (PHYS 242, MATH 230)	R		4			S10, S11	25
CENG 421 – Soils Engineering (CONM 121, MATH 230)	R		4			S10, S11	20
CENG 485 – Sustainable Land Use (Senior Status)	R		4(√)			S10, S11	15
SURE 465 – Legal Aspects of Surveying II* (SURE 365, ENGL 250, Senior Status)	R		3			S10, S11	21
Social Awareness Elective	SE			3			
Course Abbreviations, and Symbol Description: SURE- Surveying Engineering CENG – Civil Engineering GISC - Geographic Information Sciences CONM – Construction Management * Writing Intensive							
TOTALS-ABET BASIC-LEVEL REQUIREMENTS		35 Hours	74 Hours	21 Hours	3 Hours		
OVERALL TOTAL CREDIT HOURS FOR THE DEGREE	133 Hours						
PERCENT OF TOTAL		26%	56%	16%	2%		
Total must satisfy either credit hours or percentage	*Minimum Semester Credit Hours*	*32 Hours*	*48 Hours*				
	Minimum Percentage	*25%*	*37.5 %*				

1. *For courses that include multiple elements (lecture, laboratory, recitation, etc.), indicate the average enrollment in each element.*
2. *Required courses are required of all students in the program, elective courses are optional for students, and selected electives are courses where students must take one or more courses from a specified group.*

Instructional materials and student work verifying compliance with ABET criteria for the categories indicated above will be required during the campus visit.

2. *Describe how the curriculum aligns with the program educational objectives.*

The Program Educational Objectives are shown in **boldface** as follows:

A. **Graduates will be able to analyze and solve surveying engineering problems by applying basic principles of mathematics, science, and engineering. Graduates will be able to use modern surveying engineering techniques, skills, and tools to identify, formulate, and solve surveying engineering problems.**

The Surveying Engineering Program is designed on the foundation of mathematics and physical sciences (see Table 5-1) that develop students' abilities to perform critical thinking and problem solving. The engineering science courses draw on the mathematics and sciences foundation to build the students engineering knowledge and problem solving skills.

In SURE 215, students apply mathematical concepts and use modern tools such as MathCAD spreadsheets in solving surveying engineering problems. In GISC 225, GISC 239, and GISC 425, students learn to use modern GIS software such as ESRI's ArcInfo 10.0, and Image processing software in the laboratories for problem solving and analysis. In SURE 373 –Adjustment Computations II, students learn advanced problem solving and analysis techniques using MATLAB and MathCAD as programming and problem solving tools. In CENG 220, SURE 230, SURE 452, and SURE 453, students use modern field surveying instruments such as GPS receivers, Total Stations and the associated processing software such as Leica GeoOffice, Trimble software, and Carlson Civil Engineering Suite to conduct laboratory projects. These are but only some examples of how problem solving and use of modern surveying engineering techniques are integrated into the program. In CENG 485, students will draw upon their accumulated knowledge base to create a subdivision plat over a predetermined area. They will need to understand how to use CAD software and engineering design to effectively create a plat that will meet the needs of the community.

B. Graduates will be able to apply the knowledge and skills from a broad education in order to understand the impact of surveying engineering solutions in a global, societal, and environmental context consistent with the principles of sustainable development.

The Surveying Engineering Program provides students a broad base spectrum of surveying engineering topics beyond the fundamentals. This includes areas of studies such as geodesy, digital photogrammetry, cartography, remotes sensing, geographic information science (GIS), Global Navigation Satellite Systems (GNSS), and computer programming. Approximately 10% of the graduates pursue graduate work and the remaining find employment with diverse surveying engineering employers such as conventional surveying organizations, State Departments of Transportation, Bureau of Land Management, National Geospatial Intelligence Agency (NGA), offshore oil exploration companies just to name a few. The graduates' diverse field of employment is a significant indicator of the programs' global, societal, and environmental outreach.

In CENG 485, students are required to look at land development from a sustainability point of view. Besides a core knowledge of subdivision principles, zoning, transportation design, and hydrology, students are provided with articles from trade magazines, newspapers and other sources that describe how other factors influence land development issues. These topics include aging infrastructure, census results, state redevelopment funding, use of unique engineering materials like porous concrete, and a host of other issues. The purpose is to make the student aware that land development does not occur within a vacuum and that many other societal and environmental issues may have a greater impact upon land use.

C. Graduates will be prepared for professional practice in surveying engineering. Graduates will demonstrate an understanding of ethical, societal, and professional responsibilities; will recognize the limits of their knowledge and initiate self-directed and lifelong learning opportunities; and will be able to function and communicate effectively individually and within multidisciplinary teams.

The professional practice of surveying requires the graduates to take the licensure examination. Over 90% of the graduates opt to take the Fundamentals of Surveying (FS) examination given by the National Council of Examiners for Engineering and Surveying (NCEES). As an external performance indicator, since April of 2006 to October of 2010, 88 graduates have taken the FS examination and of those, 83 (94%) have passed the examination. This is based on the NCEES confidential report provided to the institution. The FS examination can only be taken by students who graduate within six months of the examination date. Most Ferris students take it while still at school either in April or in October. Only a small percentage of the graduates do not opt to take the FS examination. They include international students and some of those who pursue graduate work or work for governmental agencies that do not require licensure.

Engineering ethics and professionalism concepts are reinforced in several courses within the program, more specifically, the program includes a required three-credit course (SURE 331 – Ethics and Professionalism in Engineering and Technology). Similarly, the professional practice of surveying engineering is covered in a three-credit course on Professional Practice of Surveying - SURE 420.

Since its inception in 1972, the Surveying Engineering Program has graduated in excess of 650 students. They make up a significant population of the practicing professional surveyors in the State of Michigan. The fact that the number of outstanding complaints filed against licensed professional surveyors in the State is less than two percent of the total number of licensed professional surveyors per year (source: Michigan Department of Licensing and Regulations) is a strong indication that the program graduates practice ethically and within the bounds of their knowledge and abilities.

D. Provide the education needed for the graduates to become qualified as licensed professional surveyors.

As demonstrated in Table 5-1, the Surveying Engineering Program includes 74 semester hours of engineering topics. It satisfies not only ABET's general engineering and program specific criteria, but the requirements of the Michigan Board of Licensing for Professional Surveyors. The program graduates are eligible for licensure as a Professional Surveyor in all 50 states. Section 5.C above amplifies the graduates' success in the Fundamentals of Surveying (FS) examination.

3. *Describe how the curriculum and its associated prerequisite structure support the attainment of the student outcomes.*

Table 5-1 shows the courses required within the program for each semester. Each course name is followed by the prerequisite(s) inside a parenthesis. For example, **First Semester – Fall**, SURE 110- Fundamentals (MATH 120 co-req.) indicates that MATH 120 is a co-requisite for SURE 110.

Student Outcome 1

A broad education and knowledge of contemporary issues necessary to understand the impact of surveying engineering solutions in a global, societal, and environmental context. (EAC/ABET Criteria 3d, c, h, j) (Program Educational Objectives B and C)

The program requires 17 credit hours of mathematics; 13 credit hours of which (MATH 220, 230, and 322) are taught by the Mathematics Department of the College of Arts and Sciences and four credit hours (SURE 372, and part of SURE 373) are taught by the Surveying Engineering Program faculty. MATH 220, 230, and 322 are pre-requisites to SURE 372, and SURE 372 is a prerequisite to SURE 373. The basic sciences component of the program consists of 18 credit hours of physics, chemistry and geology. Collectively, the mathematics and basic sciences make up a total of 35 credit hours (26%) while ABET requirements are of 32 (25%).

The Program's general education component consists of three semester hours of directed elective (SURE 331 – Ethics and Professionalism in Engineering and Technology) and 12 semester hours of free electives. Of the free electives, at least one course must be designated as **Global Consciousness**, and one must be designated as **Race/Ethnicity and/or Gender**. Their requirements are defined as follows:

Global Consciousness

In an increasingly interdependent world and global economy, graduates should be able to demonstrate a working knowledge of the world, its diverse cultures, and the geographic, economic, cultural and historical relationships among nations and peoples.

The Student Outcomes Criteria for Global Consciousness are:

- identify various regions, features or countries other than North America;
- describe distinctive geographic, economic, cultural, linguistic, or historical features of a region, culture, or society other than North America;
- articulate geographic, economic, cultural, linguistic and/or historical relationships among diverse nations and peoples;
- comment accurately about current events in at least one country or region other than North America;
- describe a method for developing an understanding of geographic, economic, cultural, linguistic, and/or historical contexts of a country or region anywhere in the world;
- Ferris graduates should develop a more positive perspective and understanding of the importance of global consciousness.

The Global Consciousness course must meet the following criteria:

1. At least 50 percent of the course content must address one or more of the following areas of study concerning a region(s) or country(s) outside North America (United States and Canada): Geography, Economics, Language(s), Culture(s), History.
2. The course must provide the students with an understanding of the cultural context of the region(s) and area(s) of study. The course must provide the students with an understanding of contemporary cultures outside the United States and Canada.

Race/Ethnicity and/or Gender

In a society and work environment where issues of diversity are recognized as important towards social awareness and working conditions, graduates should be able to demonstrate working knowledge and understanding of issues surrounding race/ethnicity and/or gender.

The Student Outcomes Criteria for Race/Ethnicity and/or Gender are:

Ferris graduates should have increased their ability or capacity to:

- Articulate the ways in which existing issues surrounding race/ethnicity and/or gender impact the construction of identity, stereotypes, prejudice, discrimination, and privilege, especially within the United States.
- Comment accurately about current events and issues in the United States and throughout the world as they directly relate to race/ethnicity and/or gender. Ideally, this would include an awareness of the interconnectedness of these events and issues from the perspective of different disciplines.
- Describe distinct attributes (geographic, scientific, economic, cultural, linguistic and/or historical) of race/ethnicity and/or gender. This would also include discussion of how these attributes have impacted the social construction of race/ethnicity and/or gender or how race/ethnicity and/or gender, especially within the United States, have themselves affected these attributes.
- Identify the meaning and influence of the categories known as race/ethnicity and/or gender has had on the production of social knowledge and individual responses to that social knowledge.
- Ferris graduates should develop a more positive perspective and consciousness of the significance of race/ethnicity and/or gender, both in terms of how these concepts have shaped their own world view as well as enhancing their understanding of social relations.

The Race/Ethnicity and/or Gender course criteria are:

1. Course must approach the subject of race/ethnicity and/or gender from an identifiable theoretical framework
2. Course must address race/ethnicity and/or gender issues appropriate to the course discipline. Courses can narrowly address a single category (race, or ethnicity, or gender), or any combination of two categories (race and gender, or race and ethnicity, or gender or ethnicity), or all three categories combined. No matter how the course is configured, at least 75% of the course content must be based on issues clearly identified as race/ethnicity and/or gender.
3. Course materials must demonstrate clear evidence that the significant focus of the course is concerned with race/ethnicity and/or gender. Such evidence will be included in:
    a. the course description.
    b. the title(s) or chapter heading of reading assignments.
    c. the lecture topics specified in each course syllabus.
    d. the graded assignment and examination materials in each course section.

The measurable outcomes are at the course level. The fact that a student successfully completes the elective general education courses is indicative of satisfying **Student Outcome 1.**

The Bachelor of Science Degree in Surveying Engineering is designed to incorporate Professional Surveyor licensing requirements of the State of Michigan, Professional Engineering and design requirements of the Accreditation Board of Engineering and Technology (ABET) and the general education requirements of Ferris State University. Key to successful integration is a focus on balance: balance of the theoretical with the practical, balance of the science with the arts, balance of the individual with the whole. Graduation from this program requires 133 semester hours with a minimum 2.0/4.0 grade point average. The course of study is long, rigorous and challenging and gives graduates a sense of pride and accomplishment along with the confidence and self assurance that they will make their marks on the world.

Student Outcome 2

An ability to solve surveying engineering problems in practice by applying fundamental knowledge of mathematics, statistics, science, and by using modern surveying engineering techniques, skills, and tools. (EAC/ABET Criteria 3a, k) (Program Educational Objectives A and D)

Problem solving is an integral component of the program. The solutions to close form problems are taught in Fundamentals of Surveying – SURE 110 Engineering Surveying – CENG 220 Control Surveying – SURE 230 Surveying Computations – SURE 215 Engineering Statics – CENG 240 Programming Applications in Geomatics – SURE 272 Photogrammetry – SURE 340 Evidence and Procedures for Boundary Locations – SURE 366 Advanced Photogrammetry – SURE 440 Geodesy I – SURE 452 and Geodesy II – SURE 453. Adjustment Computations II – SURE 373 utilizes advanced mathematical concepts in error propagation and least squares adjustment applications. Seventeen of the 24 (70+%) technical courses within the program contain a significant laboratory component where students use state-of-the-art laboratory equipment and software.

The Surveying Engineering laboratory is equipped with Leica and Trimble hardware and software in excess of $1.1 million dollars on a yearly consignment. In addition, the Environmental Systems Research Institute (ESRI) GIS software site license, and the Carlson Civil Engineering Suite, Leica Photogrammetry and Image Processing Software are among many other software systems available and used in the program.

An internal measure of success of **Student Outcome 2** is students' successful completion of the courses listed above. This will be demonstrated by graded student work samples during the team's visit.

Student Outcome 3

An ability to identify, formulate, and solve surveying engineering problems, particularly the planning, design, establishing horizontal and vertical control, land use design, boundary determination, mapping and field layout of infrastructure that meet standards of accuracy and precision, keeping in mind cost, time, safety and quality needs, and objectives. (EAC/ABET Criteria 3c, e) (Program Educational Objectives A, B and D)

During the first two years of the program, the students focus on learning the concepts of spatial measurement, and computations. These courses include SURE 110, SURE 115, SURE 215, and SURE 272. The concepts of horizontal and vertical control are reinforced and expanded in Control Surveying – SURE 230, Geodesy I – SURE 452. The concepts of accuracy, precision, horizontal and vertical network design are integral parts of Adjustment Computations I – SURE 372, and Adjustment Computations II – SURE 373, and Geodesy II – SURE 453. In SURE 453, students design control networks consistent with the Federal Geodetic Control Subcommittee (FGCS) accuracy guidelines. Calculus 2 - MATH 230, Linear Algebra – MATH 322, and Programming Applications in Geomatics – SURE 272 are required prerequisites to SURE 372 and SURE 373. Boundary determination and legal principles are taught in a three-course sequence; Legal Aspects of Surveying I – SURE 365, Evidence and Procedure for Boundary Determination – SURE 366, and Legal Aspects of Surveying II – SURE 465. As a minimum, the three courses require Surveying Computations – SURE 215 as a prerequisite. Furthermore, SURE 365 and 465 along with Professional Practice of Surveying - SURE 420 are identified as "Writing Intensive" courses. "Writing Intensive" courses require English II – ENGL 250 as a prerequisite.

Safety is a paramount consideration on all surveying engineering sites. The faculty members have taken safety issues very seriously in laboratory projects and in teaching OSHA safety rules as they apply to surveying engineering project sites. Surveying engineering students are required to purchase their own safety vests and wear them when outside. Additionally, students are not allowed to be on county road and state highway right of ways. In a consistent manner, job safety is at the introduction of all courses with field laboratory components such as SURE 110, CENG 220, SURE 230, SURE 452, and SURE 453. A block of instructional material in Professional Practice of Surveying – SURE 420 is included to address safety issues in surveying engineering projects.

The internal measure of success of Student Outcome 3 is students' successful completion of the courses listed above. This will be demonstrated by graded student work samples during the team's visit.

Student Outcome 4

An ability to design and conduct experiments and to analyze and interpret data in engineering surveying, topographic surveying, geodetic surveying, and boundary surveying. (EAC/ABET Criteria 3b, j, k) (Program Educational Objectives A and D)

Preliminary design concepts are introduced in Fundamentals of Surveying – SURE 110 where the students are taught the basic elements of field traverse design and calculations. Intermediate design concepts are introduced in Engineering Surveying – CENG 220 and Control Surveying – SURE 230. In CENG 220, students design and layout horizontal and vertical alignment of roads and highways with super-elevation. In SURE 230, topographic surveying principles and applications using modern surveying instrumentation and technologies such as GPS and total stations make a significant component of the course. Advanced design concepts are undertaken in Adjustment Computations II, Advanced Photogrammetry, Geodesy II, and the Sustainable Land Use (the cap-stone course).

The internal measure of success of **Student Outcome 4** is students' successful completion of the courses listed above. This will be demonstrated by graded student work samples during the team's visit.

Student Outcome 5

An ability to communicate technical material written papers/reports and oral presentations. (EAC/ABET Criterion 3g) (Program Educational Objective C)

The program requires two sequential courses in college writing, English I- ENGL 150 and English II – ENGL 250. In support of written communication, three of the technical courses within the program are approved as "writing intensive" courses by the University Curriculum Committee (UCC). The "writing intensive" courses are: Legal Aspects of Surveying I – SURE 365, Professional Practice of Surveying – SURE 420, and Legal Aspects of Surveying II – SURE 465. SURE 365 and SURE 465 both include writing fully documented essays about current legal topics relating to surveying focusing upon substance, organization, style and correctness. Students prepare a number of legal property descriptions in various formats. SURE 465 includes six legal case studies. SURE 420 requires essays on topics relating to the professional practice of surveying as well as the preparation of "point papers" where students are required to take a stand and defend a position. SURE 465 and SURE 420 require project reports. All three courses require extensive use of memoranda and formal business letters. There are several courses in the program where students write term papers such as Geodesy II- SURE 453, Advanced Photogrammetry – SURE 440, and Ethics and Professionals in Engineering and Technology – SURE 331.

Fundamentals of Public Speaking – COMM 121 is a required communication and oral presentation course that forms the foundation for public speaking. In this course, the students learn how to develop and deliver informative and persuasive speeches. They also learn characteristics of a speech, components of a speech, use of visual aids, speech topics and audience, research skills, selection and organization of topics for persuading the audience. Within the program, oral presentations are required in the Geodesy, Photogrammetry, Ethics and Professionalism, Professional Practice of Surveying, and GIS courses.

The internal measure of success of **Student Outcome 5** is students' successful completion of the courses listed above. This will be demonstrated by graded student work samples during the team's visit.

Student Outcome 6

An ability to function within multidisciplinary teams. (EAC/ABET Criterion 3d) (Program Educational Objective C)

The practice of surveying engineering by its very nature involves interacting with professionals from other disciplines such as civil engineers, architects, land developers, state and local governmental engineering entities. Understanding the roles and responsibilities of other professionals involved in surveying projects is very crucial in the successful completion of the projects. To this end, the program promotes and fosters multidisciplinary approach in the delivery of the instructions. For examples, several courses within the program are taught by professors/professional engineers from the Construction Management area. They include Hydraulics Engineering – CENG 321, Soils Engineering – CENG 421, Materials Properties and Testing – CONM 121, and Engineering Statics – CENG 240. On the application side, outside speakers are brought to campus on a weekly basis to connect the practice of surveying engineering to real world type applications.

In Ethics and Professionalism in Engineering and Technology – SURE 331, surveying engineering students often work as team members with students from other program areas such as automotive, electrical and electronics, heavy equipment, etc. Projects in this class include research, analysis and presentation of ethical issue in engineering and technology.

We are currently in the process of negotiating a joint cooperative working relationship with the faculty of Northwestern Michigan College's (NMC) Freshwater Studies Program to develop a hydrographic surveying experience for our students and surveying experience for their students. The faculty and student interaction between the two schools offers significant collaborative opportunities for promoting interdisciplinary outreaches.

On a faculty level, we teach a GIS course for the College of Business' Information Security and Intelligence (ISI), Environmental Biology, and Public Administration programs. The faculty knowledge of GIS application to the ISI program brings an added dimension and prospective of how spatial data are utilized by other disciplines.

Student Outcome 7

An understanding of professional, societal, and ethical practice and responsibilities. (EAC/ABET Criterion 3f) (Program Educational Objectives B and C)

Honesty, loyalty and integrity are hallmarks of the Professional Surveyor and, therefore, these traits are expected of all students and faculty members in all aspects of the educational experience. Ethics and Professionalism in Engineering and Technology - SURE 331 deals specifically with codes of ethics adopted by surveying and engineering societies; explains the meaning and attributes of professionalism along with the ethical, moral and social responsibilities of engineers; discusses standards, law, safety, risks, professional obligations, loyalty, client relationships, global awareness and intellectual property. Legal Aspects of Surveying I - SURE 365, Evidence and Procedures for Boundary Location **-** SURE 366, and, Legal Aspects of Surveying II - SURE 465 define the quasi-judicial role of the professional surveyor in society. The Professional Practice of Surveying - SURE 420 stresses the legal obligation to comply with contractual and statutory requirements along with the moral obligation to provide decent standards of living for the professional's family and employees.

Membership and active participation in professional societies is encouraged. The Surveying Engineering Program provides students opportunities to become involved in student professional and honor society memberships. The Burt and Mullett student chapter affiliated with both the Michigan Society of Professional Surveyors (MSPS) and the American Congress on Surveying and Mapping (ACSM) and the Mary Feindt chapter of Lambda Sigma are two such organizations designed to foster professional and ethical responsibilities. The Surveying Engineering students have been active participants at the annual MSPS conference since 1975.

For each of the past 12 years, there has been Ferris student representation at the annual ACSM conference. Since 2006, the Ferris team received first place in the student competition three times, second place once, and third place once. Furthermore, annually Ferris students have received two or more scholarship awards at the ACSM conference. At the conferences sponsored by both ACSM and MSPS surveying engineering students have manned booths and assisted with presentations.

Student Outcome 8

A recognition of the importance of professional licensure and a recognition of the need for, and an ability to engage in, life-long learning. (EAC/ABET Criterion 3i) (Program Educational Objectives C and D)

One of the primary reasons for the existence of the surveying engineering program is the need to fulfill the Michigan Board of Licensing's educational requirements for a professional surveyor. The following page is an excerpt from **Rule 201 of the Administrative Rules** for licensure as a professional surveyor in the State of Michigan.

The volume of writing and research requirements force students to look outside of class notes and textbooks in seeking answers to complex questions as will be required of them as practicing professionals.

Students are strongly encouraged to find employment with surveying/engineering companies during vacation periods and summers to meld theory with practice. Rapid technological change coupled with the increased size and scope of projects being undertaken by the private sector bring home the need for constant continual upgrading of knowledge and skills to remain competitive.

Through active participation in professional societies, students learn the importance that practicing professionals put on continuing competence.

Every semester a number of professionals present seminars to the students on most Tuesdays. This activity is arranged by the Burt and Mullett Student Chapter of ACSM. Students have also arranged for outside speakers, for example, Mr. Dave Doyle of National Geodetic Survey (NGS) for one-day seminars.

The program focuses on providing sufficient skills for entry level employment, graduate studies and continued professional competence.

On average, 10-15% of the graduates have earned post graduate degrees in geodesy, photogrammetry, business, and law. Program graduates are University professors, division chiefs with the Bureau of Land Management (BLM), and Departments of Transportation. As lifelong learners, the program graduates have served as professional society boards of directors and presidents. For example, the last three presidents of MSPS are Ferris surveying engineering alumni.

Excerpts From Rule 201 of the Administrative Rule for Licensing as a Professional Surveyor in Michigan

Rule 201. (1) A baccalaureate degree shall be deemed to be acceptable if the candidate holding the degree has achieved all of the credits in college level courses in accordance with the following table:

General Title	Representative Courses Which May Be Included	Semester Hours.	Quarter Hours
Mathematics	analytic geometry, calculus, statistics	12	18
Humanities and Communications	English, speech, government, history, literature, philosophy, sociology	10	15
Law and Business	legal principles, Michigan surveying law, accounting, economics, business administration	10	15
Basic Science	physics, chemistry, geology, Astronomy, biology, dendrology	18	27
Further Development	computer science, remote sensing graphics, linear analysis	6	9
Engineering Science	statics, fluid mechanics, properties and mechanics of materials	8	12
Engineering	construction materials transportation, soils, hydraulics hydrology	13	20
Surveying	mensuration, operation of Instruments, practical astronomy, geodesy, topographic surveying, route surveying, boundary surveying, photogrammetry cartography, planning and design of land divisions, construction layout	30	45

4. Attach a flowchart or worksheet that illustrates the prerequisite structure of the program's required courses.

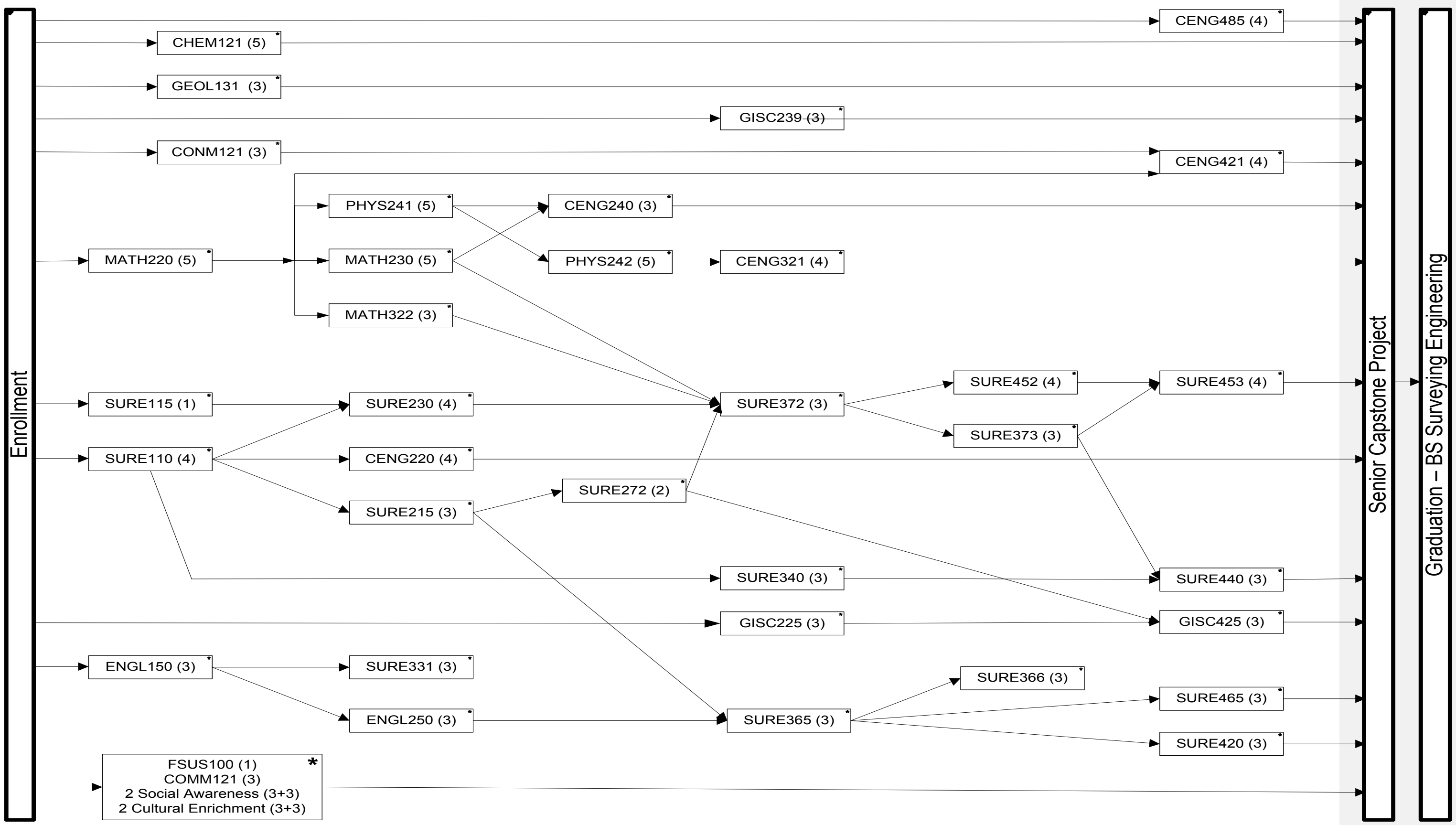


Table 5.2 – Relationship Among Courses

5. *For each curricular area specifically addressed by either the general criteria or the program criteria as shown in Table 5-1, describe how your program meets the specific requirements for this program area in terms of hours and depth of study.*

   At the present time, the Surveying engineering program does not have any other options.

   The program fulfills all the requirements of the EAC general criteria as per Table 5-1, as well as the program criteria set forth by the American Congress on Surveying and Mapping (ACSM) and the American Society of Civil Engineers (ASCE).

   The criteria specified in Table 5-1 requires 32 semester hours (25%) in Mathematics and Basic Sciences. The program actually has 35 semester hours which constitutes 26% of the total credits.

   The criteria specified in Table 5-1 requires 48 semester hours (37.5%) in Engineering Topics. The program actually has 74 semester hours which constitutes 56% of the total credits.

   The criteria specified in Table 5-1 does not specify a certain number of semester hours in General Education nor in the "Other" categories. The program actually has 21 semester hours (16%) in General Education and three semester hours (2%) in "Other" category.

6. *Describe the major design experience that prepares students for engineering practice. Describe how this experience is based upon the knowledge and skills acquired in earlier coursework and incorporates appropriate engineering standards and multiple design constraints.*

   The program of instruction culminates with **Sustainable Land Use - CENG 485**. This is the Capstone course resulting in the design of a detailed land use plan integrating the principles of engineering design, environmental concerns, social and psychological aspects within a framework of sustainable development. Within this course, students are required to prepare, in part, a preliminary and final subdivision plat and associated construction drawings. These latter drawings are generally profiles of the terrain and road network, drainage, and sanitary sewer facilities. Moreover, students are required to prepare a certified survey drawing. The course also explores the different modes of development. For example, through outside readings and research and through lecture, students are introduced to issues such as sustainable building design, LEED principles, traditional neighborhood design, avignation easements, right to farm legislation, Brownfield development and superfund site remediation, PUDs and other cluster type development patterns, inclusionary zoning, antiquated/premature subdivision, road diets, as well as a host of other issues affecting land development. The goal of the course is to draw upon the student's background in surveying, law and engineering principles and to see how this affects the development of a land parcel.

Design of safe, cost-effective processes that will support predetermined survey standards and specifications is the core of the field course sequence of SURE 110, CENG 220, SURE 230, SURE 452, and SURE 453. SURE 272 introduces students to computer program design using an object oriented programming language and graphics user interface (GUI). Students are expected to produce executable routines capable of solving the more common surveying engineering problems.

CENG 321, Hydraulics Engineering, combines hydrology and hydraulics and includes gravity drainage and pressure water supply system design. CENG 421, Soils Engineering, explores soil classification systems, weight-volume relationships, permeability, flow nets, dams, lateral earth pressures, shear stresses, loads on buried conduits, slope stability and foundation project designs.

GISC225 and GISC 425 explore the fundamental principles of Geographic Information Systems and focus upon system design. The Photogrammetry course sequence of SURE 340 and SURE 440, coupled with GISC 239 Remote Sensing, combine theory and practice to the design of different kinds of maps and mapping systems.

SURE 373, SURE 452 and SURE 453 introduce students to Geodesy and Geodetic network design. Topics include determining the size and shape of the earth, exploration of dynamic physical forces such as gravity and orbital mechanics, establishment of datums, map projections and coordinate systems, satellite geodesy, and extensive use of the Global Positioning System, control network design analysis and adjustments.

SURE 366 and SURE 465 combine the design engineering aspects of surveying with the legal aspects to determine the location of boundaries.

7. *If your program allows cooperative education to satisfy curricular requirements specifically addressed by either the general or program criteria, describe the academic component of this experience and how it is evaluated by the faculty.*

   The program does not have any cooperative education option.

8. *Describe the materials (course syllabi, textbooks, sample student work, etc.), that will be available for review during the visit to demonstrate achievement related to this criterion. (See the 2011-2012 APPM Section II.G.6.b.(2) regarding display materials.)*

   The course syllabi, textbooks and samples of student work such as graded homework, tests, and projects will be available for the team at the time of the visit per 2011-2012 APPM Section II.G.6.b.(2).

B. Course Syllabi

In Appendix A, include a syllabus for each course used to satisfy the mathematics, science, and discipline-specific requirements required by Criterion 5 or any applicable program criteria. For required courses with multiple sections that do not use a common syllabus, please include a syllabus for each of the different sections.

CRITERION 6. FACULTY

A. Faculty Qualifications

Describe the qualifications of the faculty and how they are adequate to cover all the curricular areas of the program. This description should include the composition, size, credentials, and experience of the faculty. Complete Table 6-1. Include faculty resumes in Appendix B.

The program faculty members are dedicated and are highly qualified to teach the courses in the curriculum. To date there are four full-time, tenure-track faculty (the Department Coordinator is given a 75% teaching load). Three Surveying Engineering program courses (CENG 240, CENG 321 and CENG 421) are taught by highly qualified Construction Technology and Management faculty who are Professional Engineers.

All of the full-time faculty members have at least a Master's degree in the surveying engineering area. Three of the four faculty members are licensed as Professional Surveyors. The faculty resumes demonstrate that the faculty members are professionally involved at the state and national level activities.

Table 6-1. Faculty Qualifications
Surveying Engineering Program

Faculty Name	Highest Degree Earned- Field and Year	Rank [1]	Type of Academic Appointment[2] T, TT, NTT	FT or PT[4]	Years of Experience			Professional Registration/ Certification	Level of Activity H, M, or L		
					Govt./Ind. Practice	Teaching	This Institution		Professional Organizations	Professional Development	Consulting/summer work in industry
Burtch, Robert	MS	P	T	FT	13	30	30	MICHIGAN	HIGH	HIGH	NONE
Hashimi, Sayed	MS	P	T	FT	12	33	33	MICHIGAN	MED	LOW	MED
Shangraw, Carl	MS	P	T	FT	27	17	17	MICHIGAN WISCONSIN	HIGH	HIGH	MED
Thapa, Khagendra	PHD	P	T	FT	37	16	16	UK LIST	HIGH	MEDIUM	MED

Instructions: Complete table for each member of the faculty in the program. Add additional rows or use additional sheets if necessary. Updated information is to be provided at the time of the visit.

1. Code: P = Professor ASC = Associate Professor AST = Assistant Professor I = Instructor A = Adjunct O = Other

2. Code: TT = Tenure Track T = Tenured NTT = Non Tenure Track

3. The level of activity, high, medium or low, should reflect an average over the year prior to the visit plus the two previous years.

4. At the institution

B. Faculty Workload

Complete Table 6-2, Faculty Workload Summary, and describe this information in terms of workload expectations or requirements.

Table 6-2. Faculty Workload Summary

SURVEYING ENGINEERING PROGRAM
2006-2011

Faculty Member (name)	PT or FT[1]	Classes Taught (Course No./Credit Hrs.) Term and Year[2]	Program Activity Distribution[3]			% of Time Devoted to the Program[5]
			Teaching	Research or Scholarship	Other[4]	
BURTCH, ROBERT	FT	Fall 2006: SURE 110, SURE 339 Spring 2007: SURE 110, SURE 339, SURE 340 Summer 2007: SURE 382 Fall 2007: SURE 340, SURE 425, SURE 440 Spring 2008: CENG 485, SURE 215, SURE 340 Summer 2008: GISC 225 Fall 2008: GISC 425, SURE 340, SURE 440 Spring 2009: SURE 340 Summer 2009: GISC 225-co-taught with K. Thapa Fall 2009:GISC 239, GISC 425, SURE 440	100			100

Comment [O1]: Need this column filled in

		Spring 2010: CENG 485, SURE 340, Fall 2010: GISC 239, GISC 425, SURE 340, SURE 440 Spring 2011: CENG 485, GISC 225, SURE 340				
HASHIMI, SAYED	FT	Fall 2006: SURE 215-co-taught with K. Thapa, SURE 272 Spring 2007: SURE SURE 373 Fall 2007: SURE 272 Spring 2008: SURE 272, SURE 373 Fall 2008: SURE 215, SURE 272 Spring 2009: SURE 272, SURE 373 Fall 2009: SURE 215, SURE 272 Spring 2010: SURE 215, SURE 272, SURE 373 Fall 2010: CENG 240, SURE 110, SURE 215 Spring 2011: SURE 215, SURE 272, SURE 373	75		25	100
SHANGRAW, CARL	FT	Spring 2007: SURE 215, SURE 366, SURE 465 Fall 2007:SURE 215, SURE 230, SURE 365, SURE 420 Spring 2008: SURE 230, SURE 366, SURE 465 Fall 2008: SURE 230,SURE 365, SURE 366 Spring 2009: SURE 215, SURE 230,SURE 452, SURE 465 Fall 2009: SURE 230, SURE 365 SURE 366 Spring 2010: SURE 115, SURE 230, SURE 420, SURE 465 Fall 2010: CENG 220, SURE 115, SURE 365SURE 366 Spring 2011: SURE 230, SURE 420, SURE 465	100			100

THAPA, KHAGENDRA	FT	Fall 2006: SURE 215-co-taught with S. Hashimi, SURE 215, SURE 372, SURE 453 Spring 2007: SURE 331, SURE 452 Summer 2007: SURE 282 Fall 2007: SURE 115, SURE 372, SURE 453 Spring 2008: SURE 331, SURE 452 Fall 2008: SURE 115,SURE 331, SURE 372, SURE 453 Spring 2009: SURE 115, SURE 331, SURE 452 Summer 2009: GISC 225-co-taught with R. Burtch, GISC 382 Fall 2009: SURE 115, SURE 331, SURE 372, SURE 453 Spring 2010: GISC 282, SURE 331, SURE 452 Summer 2010: GISC 225 Fall 2010: GISC 225, SURE 331 Spring 2011: GISC 225, GISC 282, SURE 331, SURE 452 Summer 2011: GISC 225, GISC 282, GISC 382, SURE 372, SURE 453	100			100

1. FT = Full Time Faculty or PT = Part Time Faculty, at the institution
2. For the academic year for which the self-study is being prepared.
3. Program activity distribution should be in percent of effort in the program and should total 100%.
4. Indicate sabbatical leave, etc., under "Other."
5. Out of the total time employed at the institution.

A full-time load is considered 12 credit hours or 18 contract hours per semester (24 credits or 36 contact hours per academic year). The faculty workload is determined by the Vice President of Academic Affairs policy letter below.

ANNUALIZED WORKLOAD
FOR INSTRUCTIONAL FACULTY:
July 25, 2007

98:1 REVISED

1. All examples will be based on a standard workload of 24 semester hours per academic year, excluding summer (recognizing the differences between colleges and between departments within colleges, 24 hours shall neither be a minimum nor a maximum).
2. No more than two-thirds (2/3) of an annual workload will be assigned in any one semester unless the member agrees. On a semester hour basis, where 24 hours is the standard workload, sixteen (16) semester hours would be two-thirds (2/3 of an annualized load.
3. A member with a full workload, including released time, may teach a maximum of five (5) overload credit hours per semester under this policy.
4. If the department head/chair can document to the dean that a faculty member in his or her college will be assigned and has agreed to teach an overload in the fall semester and will have a full load or an overload in the spring semester, the fall overload will be paid during the fall semester.

C. Faculty Size

Discuss the adequacy of the size of the faculty and describe the extent and quality of faculty involvement in interactions with students, student advising and counseling, university service activities, professional development, and interactions with industrial and professional practitioners including employers of students.

The Surveying Engineering program has four full-time faculty members. It also has the advantage of using the Construction Technology &Management Program faculty. This gives the program a broader view and also adds to the varying different professional and degree backgrounds. All advising and counseling takes place through our faculty. The SURE Faculty have students assigned to them as their advisees. The students must see the advisor in order to be cleared for registration every semester. The faculty teaching load is 12 credit hours or 18 contacts plus four office hours for advising students. The faculty schedule and individual instructor office hours are posted on the wall outside the faculty offices to ensure students' access to their advisers. The faculty are also required to enter their office hours in MYFSU so all faculty, staff, and students have access to this information.

The Surveying Engineering faculty are involved on a number of college-wide and university-wide activities. They include: The University Arts and Lecture Committee, Academic Senate, Steering Committee on American Democracy Project, College of Technology

Promotions Committee, College of Technology Sabbatical Leave Committee, University-wide Judicial Services Committee, and Reserve Officers Training Program (ROTC).

These activities include serving as members and officers of the Michigan State Board of Licensing for Surveyors, committee members and president of the Michigan Society of Professional Surveyors, ABET evaluator, NCEES Examination Committee, ACSM Scholarship Committee, ASPRS Certification Committee, ASCE Publications Committee, and NSF evaluator. More details about faculty can be found in Appendix B Faculty Resumes.

D. Professional Development

Describe the professional development activities that are available to faculty members.

The Faculty Center for Teaching and Learning provides faculty with opportunities to explore new knowledge about teaching and learning, as well as to implement new teaching and assessment methods. Through this program faculty are invited to engage in important discussions, and to develop and use innovative and creative teaching content and methods. Information about specific projects and other opportunities for faculty is listed below.

<u>The Faculty Center for Teaching and Learning</u>

Mission statement

The mission of the Faculty Center for Teaching and Learning is to support Ferris faculty and the greater educational community in their efforts to affect deep and positive learning.

Vision Statement

The Faculty Center for Teaching and Learning is a collaborative and welcoming learning community which aims to influence measurable effectiveness in teaching, advance scholarly activities, and promote innovation in teaching and learning.

Values

FCTL values:

- The University's core values of collaboration, diversity, ethical community, excellence, learning, and opportunity
- Teaching that is grounded in substantiated research of how people learn and other research on teaching and learning (e.g., learner-centered teaching, active learning)
- Being a safe and supportive environment for Ferris faculty to seek assistance, learn, and work in creative and diverse ways
- The autonomy of individuals, while also recognizing the shared responsibility of the University community to advance the mission, vision, and goals of Ferris State University
- Making public our policies, processes, and the outcomes of our work without infringing upon the privacy of others
- Involving faculty members in determining FCTL's practices, policies, and programmatic priorities
- Having respectful and open- and service-minded relationships with the entire University community

The College of Engineering Technology Dean's Office encourages and supports faculty in development activities. Potential activities are selected by an individual faculty member; an application is completed by the faculty member, supported by the Department Chair, and submitted to the College of Engineering Technology Associate Dean. Upon receipt, the Associate Dean will evaluate the faculty application and respond directly to the faculty member, providing them a personal approval letter in support of their activity. Approved professional development activities are supported financially for various aspects of the project including travel, lodging, conference fees, support materials, meals, etc. Upon completion of the event, the faculty member is required to submit a project summary report detailing the experience and how this obtained knowledge will support classroom activities. They also share their newly acquired knowledge with faculty peers of their department. Upon review of this report by the Associate Dean, reimbursement funds are then transferred to the department.

E. Authority and Responsibility of Faculty

Describe the role played by the faculty with respect to their guidance of the program, and in the development and implementation of the processes for the evaluation, assessment, and continuing improvement of the program, including its program educational objectives and student outcomes. Describe the roles of others on campus, e.g., dean or provost, with respect to these areas.

The Faculty basically start all curriculum initiatives. The proposed curriculum change summary and routing sheet, "Form A," indicates that program development is initiated by the program faculty. From there the change request is sent to the school curriculum committee for a vote. The director of the school gets to vote on it at this point. From there, it moves forward to the college-wide curriculum committee. They discuss the proposal and the changes based on the input from the advisory committees and the accreditation committees. From there, the change request is forwarded to the Dean of the College of Engineering Technology who approves or disapproves the curriculum change. From there, it goes to the University Curriculum committee which is a sub-committee of the Academic Senate at the University level. From there, the Senate moves it forward to the Vice President for Academic Affairs. All initiation and control of rewriting the objectives and the processes are initiated by the Faculty.

The process used to ensure consistency and quality of the courses taught is defined by the outlines for every course. Each course has a specific outline which includes hours spent on specific topics and each course also has a syllabus that must be followed by every instructor. Therefore, all of the courses taught by all the different instructors have the exact same content and time on the content. That then goes through what we call our Program Review cycle and our evaluation instruments that records performance. Basically we have records and grades, project presentations, portfolios, industrial internship experience, capstone course and then we also have faculty input, student assessment of instruction of each class, the graduate surveys, alumni surveys, employer surveys, and the advisory committee input. We also have the full process of Academic Program Review, Post-Tenure Faculty Review, and ABET Accreditation Review that monitors these courses so they all mandate the same instruction.

CRITERION 7. FACILITIES

A. Offices, Classrooms and Laboratories

Summarize each of the program's facilities in terms of their ability to support the attainment of the program educational objectives and student outcomes and to provide an atmosphere conducive to learning.

Classrooms, laboratories, equipment and infrastructure are up-to-date and provide excellent support to accomplish program objectives. Survey instruments such as GNSS, receivers, electronic total stations, digital levels and software available to the faculty and students are both modern and representative of the surveying and mapping industry.

1. *Offices (such as administrative, faculty, clerical, and teaching assistants) and any associated equipment that is typically available there.*

   The School of CEEMS (Computer Networks and Systems, Electrical/Electronic Engineering Technology, Energy Systems Engineering, Mechanical Engineering Technology, and Surveying Engineering) Administrative and Clerical Support offices are located in SWN 312, 314, and 405. The shared technician office is located in SWN 412. Each of these areas is equipped with computers and network access to printers. Computers are updated on a rotational basis. Each computer is equipped with the Microsoft Office Suite products. The clerical offices also have copier/fax machines.

   Faculty are located in Johnson Hall as to be readily available for students during office hours. These offices are also equipped with computers and network access to printers.

   a) Administrative Offices: School and Surveying Engineering SWN 312A/314 – 783 square feet with office computers for administrators.
   b) Clerical Offices: Shared resource with Electrical and Computer Engineering SWN 312/405 – 1162 square feet with office computers for clerical and student support. Copier/fax machines for program are also located within this space.
   c) Technician Office: SWN 412 – 767 square feet with office computer for technician.
   d) Faculty Offices: JOH 304/411/422 – 597 square feet with office computers for faculty.

2. *Classrooms and associated equipment that is typically available where the program courses are taught.*

   Swan 211 and Swan 207 classrooms serve the Surveying Engineering program for teaching and other related activities. They are located close to the surveying instrument room and are convenient for teaching courses which require actual equipment demonstration. The classroom furnishings and space are more than adequate:

   a) Surveying Engineering Classroom Swan 211 - 930 Sq. ft; with a large screen, projector, and computer available to facilitate computer instruction.
   b) Surveying Engineering Classroom Swan 207 - 1100 Sq. ft, a large screen, projector, and computer available to facilitate computer instruction.

3. *Laboratory facilities including those containing computers (describe available hardware and software) and the associated tools and equipment that support instruction. Include those facilities used by students in the program even if they are not dedicated to the program and state the times they are available to students. Complete Appendix C containing a listing the major pieces of equipment used by the program in support of instruction.*

   University funding, industrial consignment, and other donations have enabled the department to acquire many sophisticated surveying instruments, computers, and software. As a result, the program has maintained modern and advanced surveying and mapping laboratories. All the computers are networked by a NOVELL Local Area Network.

Key Surveying Instruments:

Instrument	Manufacturer	Condition	Method of acquiring
6 GPS system 1200. (with RTK ability) and with SKI-Pro software	Leica Geosystems	New	Provided on a consignment basis annually
6 GPS 5800 RTK Surveying System	Trimble	New	Provided on a consignment basis annually
6 new robotic total stations, TCR 1250	Leica Geosystems	New	Provided on a consignment basis annually
Six digital levels (DNA10)	Leica Geosystems	New	Provided on a consignment basis annually
25 tripods	Leica Geosystems	New	Bought after a money raising campaign from the surveying engineering community.
Laser Scanner with Cyclone software	Cyra	New	Provided on a consignment basis annually
10 digital theodolites	Leica Geosystems	5 years old	University funding
Several levels and conventional theodolites.	Various	Good Useable Condition	University funding

A complete list of equipment inventory is provided in Appendix C. All the surveying equipment is maintained at a surveying engineering equipment room by the surveying clerk.

Telecomm Closet

The telecommunication server closet next to Swan 106 contains a dedicated network server for the Surveying department. Purchased in 2004, the server is a Dell PowerEdge PE2650 containing a Xeon 3.0GHz processor, 1Gb of RAM and a 120Gb hard drive. The system utilizes Microsoft Windows Server 2003. providing Net Licensing for our Leica software as well as provide web authoring for Surveying's student web pages.

Fenn's Digital Photogrammetry and GIS Lab, Swan 201- 1980 sq. ft.

Swan 201 is a computer lab containing 21 workstations, one instructor station, and a presenter. The workstations contain 3.4GHz processors, 4Gb RAM, and a 150Gb hard drive. There is an HP Laserjet 4350tn printer, Canon iPF655 imagePROGRAF plotter, and a HP DesignJet 450C plotter in the room. The lab is currently running Microsoft Windows XP and hosts the following software: (Total 22 Computers)

Office	Microsoft	2007
Visual Studio	Microsoft	2005
ArcGIS	ESRIInc.	10
Auto CAD	AutoDesk	2009
DWG TrueView	AutoDesk	2011
ERDAS	Leica	2010
Irian View	irian skiljan	4.27
iWitness	iWitness	2009
Matlab	The MathWorks	2010a
MathCAD	PTC	14.0

Surveying Engineering Computer Lab SWAN 204/206- 1000 sq. ft

Swan 206/204 is a computer lab containing 19 workstations, one instructor station, and a presenter. The workstations contain 3.4GHz processors, 4Gb RAM, and a 150Gb hard drive. There is a HP Laserjet 4350tn printer, and a HP DesignJet 800 plotter in the room. The lab is currently running Microsoft Windows XP and hosts the following software: (total 20 computers)

Office	Microsoft	2007
Visual Studio	Microsoft	2005
AutoCAD	AutoDesk	2009
AutoCAD Civil 3D	Autodesk	2009
AutoCAD Civil 3D LDC	Autodesk	2009
AutoCAD Map 3D	Autodesk	2009
DWG TrueView	Aurodesk	2009
Civil Suite	Carlson	2009
ArcGIS	ESRI Inc.	10
Autometric	Kork Digital Mapping	13
Corpscon	US Government Title	5.11
ERDAS	Leica	2010
GeoOffice	Leica	7.0
Cyclone	Leica	6.0
GPS1200 Simulation	Leica	6.0
TPS1200 Simulation	Leica	6.0
Trimble Office	Trimble	1.63
Irian View	Irian Skiljan	4.23
Math CAD	PTC	14.0
Matlab	The MathWorks	2010a
iWitness	iWitness	2009

Since the construction of the new Granger Building for Construction and HVAC, the Surveying Engineering Program benefits from the following laboratories:

<u>The Soils Laboratory</u> is fully equipped for testing the fundamental properties of soils relevant to engineering design and construction. The laboratory includes

approximately 1000 square feet of space with four large work stations and other storage cabinetry. Equipment is available to test soil gradation, Atterberg limits, specific gravity, compaction, permeability, and shear strength. Specialized equipment in the laboratory include two direct/residual shear machines, two unconfined compression machines, three drying ovens, two electronic balances, mechanical sieve shaker, and Lancaster mixer.

<u>The Materials Laboratory</u> is fully equipped for preparing and testing the fundamental properties of construction materials including aggregate, Portland cement concrete, hot mix asphalt, and mortar. The laboratory includes approximately 1000 square feet of space with four large work stations and other storage cabinetry, as well as an adjoining work area of 500 square feet housing testing equipment and aggregate storage. Equipment is available for testing the following: gradation, specific gravity, and toughness of aggregate; slump, air content, and strength of Portland cement concrete; specific gravity, compaction, density, and asphalt content of hot mix asphalt; and flow and strength of mortar. Specialized equipment in the laboratory and storage area include a Versa tester machine, concrete compressive strength machine, concrete mixer, three mechanical sieve shakers, L.A. Abrasion machine, gyratory compactor, NCAT asphalt content over, six centrifuges, flow table, large capacity oven along with six smaller ovens, and eight electronic balances.

B. Computing Resources

Describe any computing resources (workstations, servers, storage, networks including software) in addition to those described in the laboratories in Part A, which are used by the students in the program. Include a discussion of the accessibility of university-wide computing resources available to all students via various locations such as student housing, library, student union, off-campus, etc. State the hours the various computing facilities are open to students. Assess the adequacy of these facilities to support the scholarly and professional activities of the students and faculty in the program.

A high-speed, wide-area network provides broad campus access to academic resources, the Internet, and other computing resources such as FLITE library. Each of the 3,000 residence hall rooms and University apartments has network connections. Every residence hall is equipped with a computer lab. In addition, there are large computing laboratories available to students in various locations on the Ferris State University campus. Brophy/McNerney, Merrill/Travis, Taggart and Bond have 24-hour computer labs. All students living in the residence halls can print to a laser printer at their hall front desk from their laptops and desktops in their rooms.

Student Technology Services provides installation of network cards and computer support to students for a fee. Copies of the Microsoft software Office 2010, Mac Office 2011, Windows 7, and Windows XP Professional are available for a $30.00 per copy of the software.

The University operates a Nortel Private Branch Exchange for voice services. Remote data access to the Internet and campus facilities is available for all faculty, staff, and students. Fiber optic, broadband, twisted pair, and wireless networks are utilized to provide services for voice, data, and video. Imail electronic mail is offered to students on and off campus. The Ferris Web site (http://www.ferris.edu) provides information about the University and is used to support student Web services. The University portal, My FSU, links products such as Student, Faculty, and Employee Web Services with capabilities of the Internet to create a customized campus experience.

C. Guidance

Describe how students in the program are provided appropriate guidance regarding the use of the tools, equipment, computing resources, and laboratories.

Instruction for all Surveying Engineering labs is provided by well trained faculty members – not teaching assistants. All faculty members in the College of Engineering Technology are required to have teaching experience as well as industrial experience before they can be hired. As can be seen by the faculty's résumés, they have many years of industrial experience and years of university-level teaching.

In addition, companies providing equipment for the program are available for any and all questions at any time. Faculty members typically have access to trained company representatives via cell phone.

Students are provided with specific training:

- SURE 115 – Introduction to Computer Mapping, introduces students to CAD environments as applied to Surveying.
- SURE 215 – Surveying Computation, students learn how to use computational tools such as MathCAD and Excel.
- SURE 272 – Programming Applications in Geomatics, students learn how to use programming tools such as MATLAB.

D. Maintenance and Upgrading of Facilities

Describe the policies and procedures for maintaining and upgrading the tools, equipment, computing resources, and laboratories used by students and faculty in the program.

Sufficiency of resources to acquire, maintain and operate facilities and equipment is done through the use of a surveying clerk located in the equipment room and a technician allocated to the Surveying Engineering Program to keep equipment operating. Maintenance and repair on the "consigned equipment" if ever needed, is performed by the instrument manufacturers. Because the instruments are new, maintenance is never an issue.

E. Library Services

Describe and evaluate the capability of the library (or libraries) to serve the program including the adequacy of the library's technical collection relative to the needs of the program and the faculty, the adequacy of the process by which faculty may request the library to order books or subscriptions, the library's systems for locating and obtaining electronic information, and any other library services relevant to the needs of the program.

The Ferris Library for Information, Technology and Education (FLITE) is a multifaceted, complex organization designed to serve the needs of the students of Ferris State University, the faculty and staff, and the community at large. We provide access through various channels to information necessary to the success of our students.

FLITE, built in 2001, provides a modern space for students to work together and to find and use information resources. Located in the heart of the campus, FLITE features a variety of work and study spaces, including an information commons, four instructional studios, six seminar rooms, 54 individual and group study rooms, a reading room, and an extended hours study area, all with wireless access capability. FLITE has a total seating capacity of 1,300, more than 350,000 total volumes (books and periodicals), and 195 public computer workstations. FLITE is a U.S. Government Documents, Patent and Trademark Depository Library for western Lower Michigan, and a depository for U.S. Bureau of the Census publications.

FLITE has a Materials Acquisitions budget of approximately $1 million, which is increasingly spent on electronic resources. FLITE provides access to over 60,000 electronic journal titles, over 100 electronic databases, hundreds of electronic reference resources and approximately 100,000 e-books and e-documents. Content purchased by FLITE is supplemented by content purchased by the Michigan electronic Library (MeL) for use by residents of the state of Michigan. FLITE patrons also have access to books and other library resources held by over 400 academic and public libraries in the state of Michigan through MeLCat, a state-wide library catalog and delivery service, and can use InterLibrary Loan when necessary.

FLITE provides comprehensive library services to faculty and students in the College of Engineering Technology, including bibliographic instruction, research assistance, and acquisition/location of resources. Reference librarians are available in person, by email or telephone, and via our Chat service. A dedicated liaison librarian maintains the collection and works with faculty and students. New service initiatives include individual reference consultations for students and just-in-time library instruction, which allows instructors to bring librarians into the classroom for part of a class period to give immediate guidance about library resources that are tied to an assignment or project.

Freshmen in the College of Engineering Technology take the Ferris State University Seminar, FSUS 100, which includes a visit to FLITE for a library introduction and tour. Students are introduced to the library web page and catalog and learn about library facilities and ways to get help.

A group of computers on the second floor of FLITE is loaded with software specific to the College of Business and the College of Engineering Technology. This software is also available on the computers in the Extended Studies area. The extended studies area is open for student use 24 hours a day from noon Sunday through midnight Friday, and 12-12 on Saturdays.

FLITE collections include books, journals, microforms, maps, government documents and access to a large array of electronic content via online subscriptions and e-books. FLITE's current holdings include 25,464 cataloged titles in the general LC class T of which 7,813 were published after the year 2000. Journal packages with significant content relevant to Engineering and Engineering Technology students and faculty include:

- a package of over 1200 titles from Wiley Blackwell
- a Science Direct package with the Freedom Collection with over 2000 titles
- a package of nearly 450 journals from Springer (formerly Kluwer Academic Publishers journals)

General databases which are of use to the students of the College of Engineering Technology include:

- Gale Academic & General Onefile, with millions of articles including coverage of business and technology
- Newspapers, including Access World News, a package of near 1700 mostly-English newspapers from around the world
- ABI Inform, the premiere business database, with major coverage of technology news and information
- Lexis Nexis Academic Universe, with company information, legal information, and news
- Gale Business and Company Resource Center
- Applied Science & Technology Abstracts
- General Science Abstracts

Legal information is available for Surveying Engineering faculty and students through

- Lexis-Nexis Academic Universe
- Westlaw Campus, which contains the major West Law titles
- Extensive print legal collection including major legal works

Each program area receives an annual allocation for book purchases. Purchases are made as requested by faculty and to fill needs in the collection. Individual relevant Journal/magazine subscriptions are also purchased. Table #1 indicates book and journal expenditures specifically for Surveying Engineering over the past four years. In addition, FLITE purchased a package of Springer e-books which includes a large number of books relevant to Surveying. Journal packages and general databases are paid for out of general funds and are not included in these totals. Over the past few years, FLITE has decreased our print book budget to expand our electronic book and journal collection; while the amount expended for journals seems low, it is important to remember that most subject-relevant titles are made available through databases and online journal packages.

Table 1: Expenditures for Surveying Engineering

	fy07	fy08	fy09	fy10
Money spent for College of Engineering Technology				
Books and other one-time purchases	24,509.52	17,265.49	15,034.34	15,689.33
Serial publications and databases	39,136.85	21,125.29	22,089.77	20,416.32
Money spent for Surveying Engineering				
Books and other one-time purchases	1891.35	967.24	1579.39	894.66
Serial publications and databases	1597.19	1739.05	1631.89	1785.77

F. Overall Comments on Facilities

Describe how the program ensures the facilities, tools, and equipment used in the program are safe for their intended purposes (See the 2011-2012 APPM II.G.6.b.(1)).

It is the responsibility and intent of Ferris State University to protect the health and safety of students, faculty, staff and visitors while engaged in the educational and business activities of the University. To this end, the University will provide the necessary services and controls to promote, create and maintain a safe and healthful campus environment and operations. The purpose of this policy statement is to establish the University's commitment to campus environmental health and safety.

Surveying Engineering students are required to purchase a safety vest as part of their required “tool kit.” They are required to wear their safety vests during outdoor laboratory periods. Additionally, all lab-related syllabi must demonstrate student safety instruction. Students are to be required to have documented understanding of safety policies and procedures within lab areas.

Questions regarding risk management and liability can be directed to Chris Weber, Manager of Risk Management and Insurance, at 231-591-3848. Also Mike McKay, Safety Coordinator, at231-591-2147 is available to consult regarding lab safety, signage, AED’s, procedure, etc.

CRITERION 8. INSTITUTIONAL SUPPORT

A. *Leadership*

Describe the leadership of the program and discuss its adequacy to ensure the quality and continuity of the program and how the leadership is involved in decisions that affect the program.

The College of Engineering Technology is made up of several components. There is the *traditional academic activities* component, then a *college and academic program support* component, and then an *industry services and training* component. These are explained below.

The administrative structure of the *traditional academic activities* component of the college is comprised of a dean, an associate dean, four school directors, and the program coordinators. This individual school model was constructed to optimize the following benefits:

- Better achievement of unique goals and visions among like disciplined programs within each school
- Better sharing of resources between like programs
- Better development of the market requirements for the similar industries served by like programs

This structure allows and supports the administrative advantages of diversity, effectiveness, and efficiency. The full-time directors are able to focus on the necessary administrative support needs of their school. The areas of focus for directors include:

- School costs and budget control
- School curriculum improvements and directions
- School faculty efficiencies and assessment
- The development and maintenance of industry relationships
- Maintenance of the assessment and accreditation processes of the programs
- Participation in school and college strategic planning and marketing

The program coordinators are given partial release time to be able to focus on specific program needs and resources. These include the operational budget control, curriculum and facilities support, outcomes establishment and monitoring, programmatic needs and activities, recruitment, scheduling, and other projects as assigned by the director.

The *college and academic program support* component provides the following services:

- Enhances the monetary support of programs through endowments, donations, and scholarships
- Leads the recruitment efforts of the CET as a whole to promote enrollment and growth
- Provides educational counseling and maintains transfer data and guidelines
- Supports and maintains the relationships of the college with students, parents, and other outside entities that are important to CET and Ferris as a whole

This support system is invaluable in that it assures student satisfaction, aids faculty/student relations, helps support appropriate course work, and aids in establishing future funds for the students and their programs.

The *industry services and training* component provides an avenue for additional funding and recognition to the college. This component works at advancing the related activities of the CET such as: energy, training, applied research, and certifications. The units which make up this component include:

- CPD (Corporate & Professional Development)
    - CCTT (Center for Certification Training & Testing Management)
    - The Energy Center for energy source awareness, support, and development
- ICET (Institute for Construction Education and Training)
    - Extensive certification and testing for the State of Michigan

These units work with individual companies, the state government, and the university community. Resources include grants, required certification programs, university programs, individual contracts, and entrepreneurial activities. The future development of this component will help sustain real dollars for usage within the pure academic activities and facilities of the university. It will also help pave avenues for notable community and statewide initiatives that will enhance the infrastructure of private and governmental entities.

B. Program Budget and Financial Support

1. *Describe the process used to establish the program's budget and provide evidence of continuity of institutional support for the program. Include the sources of financial support including both permanent (recurring) and temporary (one-time) funds.*

   The Surveying Engineering Program maintains very strong financial support from the University and the surveying and mapping community (manufacturers of surveying and mapping hardware and software, alumni and professional societies).

From the university, recurring funds such as faculty salaries, benefits, building, building maintenance, utilities, minor caps (construction renovation) come from the general fund and are reallocated through the divisions for the Surveying Engineering program. S&E money is supplied through the College of Engineering Technology for the Surveying Engineering program for supplies and expenditures. Equipment money is dispensed annually by the Dean of the College of Engineering Technology and the Vice President's office. Equipment funding is both recurring (from Perkins and the Dean's Office) and temporary (from the Vice President's office) as available.

The Dean in the College of Engineering Technology developed a committee of faculty members to research and develop a process for the Supply and Expense (S&E) budget that would more appropriately reflect current enrollment trends rather than historical enrollment trends and was applied this year. This process will support all growth programs now and in the future. The S&E budget includes faculty travel and the other day-to-day expenses such as supplies, telephone charges, copy charges, etc. Major equipment purchases are not included in the S&E budget; however, the Dean maintains a rank ordered list developed in consultation with all school directors. The yearly equipment dollars available through the College of Engineering Technology Dean's office are distributed in accordance with the list mentioned above.

Financial support in the form of professional development is made available through the Dean's office. This money is available on a request basis and has a maximum award of $1,200 per activity. This amount can vary depending on the activity of the faculty member (presenting a paper at the conference vs. simple attendance).

Travel funds are available from University sources in the form of Timme grants. These are travel grants up to $850.00 to attend training and conferences (this too varies depending on activity). This is also a competitive grant and not all applicants get funded.

There are two University programs that fund faculty research and faculty development. The total amount available is $20,000 for each program. These are competitive grants and awards and vary greatly from $1,500 to $5,000

The University also has available the Exceptional Merit Grant operated through the Ferris Foundation that makes available funds for professional development, course improvement, and equipment purchases. The funding can go up to $7,500 and several faculty members in the program have received this grant.

2. *Describe how teaching is supported by the institution in terms of graders, teaching assistants, teaching workshops, etc.*

Faculty's primary focus is teaching – there are no teaching assistants used in the program. Grading and lab components are also the responsibility of each faculty member.

Faculty members also receive faculty development funds to stay current in their field of expertise and to learn new industry developments. Over the last four years, the faculty has been awarded an average of $4,500 per year for their continuing education.

3. *To the extent not described above, describe how resources are provided to acquire, maintain and upgrade the infrastructures, facilities and equipment used in the program.*

An additional source of financial support comes from donations from the major surveying corporations. This past year Leica Geosystems supplied state-of-the-art surveying equipment and software:

- six Leica Robotic Total Stations TCRP1105 R300 totaling $225,765
- six Leica Smart Rover GPS receivers with Wireless RTK totaling of $158,396

Similarly, Trimble Navigation has consigned:

- four Total Stations total valued at $80,000
- five GPS receivers total valued at $86,000.

Environmental Research Institute (ESRI) GIS software and Carlson Surveying and CAD provide the Surveying Department with well over $25,000 in software licenses.

4. *Assess the adequacy of the resources described in this section with respect to the students in the program being able to attain the student outcomes.*

The program has adequate resources (faculty, space, laboratory equipment and funding for Surveying Engineering faculty development) to support attainment of student outcomes.

In addition, the faculty, alumni, and corporations provide scholarships for students:

Surveying Engineering Annual Scholarships (totaling	$21,800.00
The Urban Land Consultants Surveying Scholarship	$ 2,000.00
Lewis & Lewis Professional Surveying, Inc. Scholarship	$ 600.00
John R. & Lynda D. Fenn Surveying Annual Scholarship	$ 2,500.00
The Mary C. Feindt Surveying Scholarship	$ 500.00
The Joseph L. Bishop Surveying Scholarship	$ 500.00
The Robert C. Burtch Geodetic Surveying Scholarship	$ 500.00
The Dr. Khagendra Thapa Surveying Scholarship	$ 500.00

Tingley & Associates Scholarship	$ 500.00
Moore & Bruggink, Inc. Scholarship	$ 2,500.00
Richard L. Rought Surveying Scholarship	$ 700.00
Rowe, Incorporated Scholarship	$ 2,000.00
Kebs, Inc. Scholarship	$ 500.00
Woolpert LLP Scholarship	$ 1,000.00
James D. and Katy Moore Surveying Engineering Scholarship	$ 750.00
Northern Chapter - MSPS Scholarship	$ 500.00
Michigan Society of Professional Surveyor (MSPS)	$ 2,500.00
The West Central Chapter of MSPS Scholarship	$ 750.00
Shellenbarger Engineering & Surveying, P.C. Grant	$ 1,000.00
Craig and Tamara Amey "Beyond The Books" Scholarship	$ 1,000.00
Leica Systems Annual Scholarship	$ 1,000.00
Endowed Scholarships (totaling	$ 3,985.00
David R. Greer Surveying Engineering (est. 1999)	$ 1,685.00
Vijay Mahida Surveying Scholarship (est. 1987)	$ 2,300.00

C. Staffing

Describe the adequacy of the staff (administrative, instructional, and technical) and institutional services provided to the program. Discuss methods used to retain and train staff.

Our immediate support personnel consists of one school director, one faculty member as program coordinator with 1/4 release time, two full-time school secretaries (shared between programs), one part-time equipment room clerk and one full-time technician (shared between programs). All of the other support divisions such as Academic Affairs, Business and Financial, Skilled Trades, etc., are more than ample to support the program educational objectives and program outcomes.

D. Faculty Hiring and Retention

1. *Describe the process for hiring of new faculty.*
   Please see the following University Personnel and Policy documents:

   FSU Academic Affairs Policy letter – vacant position salaries policy and procedures included in this section.

   FSU Academic Affairs Policy Letter [May 9, 2000]

   http://www.ferris.edu/HTMLS/administration/academicaffairs/policyLetters/revisedvacPos.htm

VACANT POSITION SALARIES POLICY AND PROCEDURE POLICY:
Salary savings from vacant positions in Academic Affairs are captured centrally immediately after the position is vacated, and all vacant positions revert to Academic Affairs for review and possible reallocation. The policy for requesting to fill a vacant position, requesting salary augmentation of a vacant position, and access to vacant position salary to meet classroom replacement needs are as follows:

The Hiring Approval Form (HAF) request to permanently fill a vacant tenure-track position or to fill a vacancy with a one-year temporary person must include justification for the request. The justification must include faculty loads, release time or overloads, and adjunct, one-semester or one-year temporary faculty in the program/curriculum for the past two years. In addition, future plans for program focus, enrollment and staffing must be included in the justification.

The justification for the salary request must include data from comparable national or regional institutions of higher education, and/or business and industry data that documents the need for this salary to competitively recruit qualified faculty and staff. This information must accompany the HAF. A copy of the position vacancy announcement must also be included.

If the HAF is approved by the VPAA, the salary for either the permanent replacement (as long as it does not exceed the budget in the vacant position – see #4) or the one-year temporary replacement will be fully funded by the Operations Analyst in the Academic Affairs Office. No additional funding requests will be required.

If the HAF is requesting a salary greater than the budget in the vacant position, a request for salary augmentation must be made on the HAF. If approved by the VPAA, the augmentation will be funded from differential salary funds central to the Division of Academic Affairs, or if such funds are not available, augmentation will be requested from the University's pooled compensation.

If a vacant tenure-track faculty position is not filled during a fiscal year, the dean may request that the classroom duties of that position be met through adjunct, overload, or one-semester temporary replacements (all must be coded 1411 – vacant position replacement – on the EAA). The request must be submitted to the Operations Analyst in the Vice President for Academic Affairs Office, and must identify the vacant position number requiring the replacement need. If the request is approved by the VPAA, a funding source (position number) will be provided from which the associated costs will be funded. **This funding source must appear on the EAA** . If the funding source is not identified on the EAA, it **will not be processed** by the Finance Office, which may result in a delay of a paycheck being issued.

Procedure:

At such time that a replacement adjunct, overload, or one-semester temporary person has been identified to fill a vacancy need, the following steps for funding approval must be completed:

Send an E-mail to the Operations Analyst in the VPAA's Office with the following information:

- vacant position number requiring replacement need
- person who previously filled now vacant position
- type of replacement (adjunct, overload, or one-semester temporary)
- replacement position number
- replacement account number
- name of replacement
- dollar amount needed for replacement expenses

Example:
Vacant Position Number: 11111
Previously Filled By: John Doe
Temporary Replacement Type: one-semester temp
Replacement Position Number: 810XXX
Replacement Account Number: X-XXXXX-**1411**
Replacement Name: Jane Doe
$ needed for Replacement: $5,000

If the funding request is approved by the VPAA, the Operations Analyst will "reply with history" to the E-mail as follows:
"APPROVED – FUND FROM POSITION XXXXXX"
Print a copy of the returned E-mail with the approval and identified funding source.
In the comment section of the EAA, include the words and **highlight**:

"FUNDED FROM POSITION XXXXXX – SEE ATTACHED APPROVAL"
Attach a copy of the E-mail approval to the original EAA and the pink copy that is forwarded to the VPAA's Office, and then distribute the EAA to the appropriate departments.

2. *Describe strategies used to retain current qualified faculty.*

Please see the following University Personnel and Policy documents

College of Engineering Technology Promotion and Tenure Policy included in this section.

College of Engineering Technology Promotion/Merit Policy

PROMOTION AND TENURE POLICY
College of Engineering Technology -
Department Tenure Policy and Procedures

Approving Departments:

- Architectural Technology & Facility Management
- Automotive
- Construction Technology and Management
- Heavy Equipment
- HVACR
- Manufacturing
- Mechanical Design
- Plastics and Rubber
- Printing & Imaging Technology Management
- Surveying Engineering
- Welding Engineering Technology

VPAA Signature:	**Date:**

Revised January 24th, 2008

Preamble
The system of tenure is a device for affecting a stable and professional instructional staff by providing for security in teaching, research, and extramural activities.

An effective tenure program provides that, after a probationary period, members of the college who are qualified for tenure will have continuing employment, and their service will be terminated for adequate cause alone.

Implicit in any tenure program is the necessary assumption that technological change; legislative fiat, public preference, or the judgment of the Board of Trustees would render certain programs within the institution, or the institution itself, purposeless or nonexistent.

Implicit, likewise, in a tenure program, is the presumption that the Board of Trustees, in accordance with the FFA-FSU contract, would exercise the utmost good faith in its efforts to reassign tenured personnel to areas where their abilities would be of benefit to the institution.

Where tenure programs are in operation, the following represents acceptable academic practices:

- Each member of the faculty is expected to demonstrate, throughout all areas of specifically assigned and implied duties, effectiveness, competence, professionalism, good character and conduct; and a functioning spirit and willing cooperation with colleagues.
- The crucial importance of any tenure program lies in its objective mechanism for protecting the tenured faculty member from an unwarranted dismissal arising either out of good faith error or from hasty caprice. It is equally important to preserve the integrity of the tenured faculty members by expressing its sanction of a merited dismissal.
- Evaluations of teaching for tenure purposes are conducted in a manner that does not infringe on academic freedom. Classroom observations are carried out as silently and unobtrusively as possible.

In the event that there is a conflict between this policy and the FSU and FFA agreement, the FSU and FFA Agreement shall be the controlling document.

Document Abbreviations –
CET – College of Engineering Technology
CTRC – Candidate Tenure Review Committee
DTRC – Department Tenure Review Committee
FSU/FFA – FSU & FFA Contract (Expires June 2010)
SAI - Student Assessment of Instruction

This policy shall apply only to those tenure candidates hired after its formal implementation. Tenure candidates hired prior to the implementation of the amendments may elect to be reviewed by the newly implemented policies and procedures or the policy and procedures otherwise applicable pursuant to this Agreement. Selection of amended policy and procedures by a candidate shall not extend their non-tenured period.

I. ***Tenure Attainment Criteria***

A. The primary professional goal of faculty in the College of Engineering Technology is to attain excellence in teaching.

1. ***<u>Teaching:</u>***

The candidate shall demonstrate superior qualities as a teacher as evidenced by:

a) *Development of new or existing programs, courses, and teaching methods.*
b) *Statements by peers, Peer Group Evaluation (Appendix C), relating to an individual faculty member's instructional performance, depth of understanding in their subject area, and related contribution to the university, college, and department.*
c) *Statements by the Candidate's Tenure Review Committee, Candidate's Observation Guide (Appendix B) and Department Chair, Associate Dean Evaluation form (Appendix E), regarding instructional competency.*
d) *Student opinion relating to faculty performance supported by a college approved student evaluation that addresses, as a minimum, the elements in the Student Assessment of Instruction (Appendix A).*

e) *Teaching awards.*

2. *Advising:*

The candidate shall demonstrate superior qualities as an advisor as evidenced by:

a) *Ability to deal with student academic problems and opportunities.*
b) *Advisor to student organizations.*
c) *Special tutor assistance to students in department offered courses.*
d) *Student academic counseling and advising.*

B. Additional activities considered for granting tenure include:

1. Scholarly activities including:

a) Consulting for pertinent professional agencies, business, or industry.
b) Developing new course techniques.
c) Obtaining professional certification or registration (where applicable).
d) Participating in continuing education as a lecturer, author, developer of educational materials, or as a learner.
e) Professional development through practice in business, industry or applied research.
f) Publishing books or monographs.
g) Serving as a journal referee.
h) Serving as a member of a certifying board.
i) Serving as a member of a school or program evaluation team.
j) Submitting grant or contract proposals.
k) Other activities deemed worthy by the program, department and/or college.

2. Service activities including

a) Assisting in program equipment procurement.
b) Demonstrating cooperation with peers in professional and promotional activities of the department/program.
c) Demonstrating willingness to join with colleagues in advancing the common interest of the University.
d) Performing administrative responsibilities such as committee chairpersons, etc.
e) Providing contribution or service to their profession and/or professionally related community service.
f) Providing services to the community.
g) Representing the University to governmental agencies, alumni and other organizations.
h) Serving as officers or active members of a county, state, national, or international professional organization.
i) Serving on department, college and University committees.
j) Serving on the Faculty Senate.

II. Tenure Committees

A. Candidate's Tenure Review Committee (CTRC)

1. *Member's right to a tenure committee* - Each probationary faculty member shall have their own tenure committee until such time as tenure is granted or denied.

2. *Committee Composition* – The committee shall have three tenured voting members chosen as follows:

a) *Member Selection* – The Department Chair shall initially appoint three tenured faculty members, as approved or elected by the tenured department faculty, to serve on the CTRC. Two members of the committee shall teach in the same program(s) as the candidate. The third member shall be from another department within the College of Engineering Technology (CET). When the candidate's program(s) has insufficient tenured faculty, CTRC members shall be selected from other program areas within the department. When there are insufficient tenured faculty in the department, CTRC positions shall be filled through selection by the Department Chair from the CET. Appointments will be subject to member approval and the consent of the tenured faculty members within the department.

b) *Chair Selection –*

- *First year - CTRC Chair is selected by the Department Chair as approved or elected by tenured department faculty.*
- *Subsequent years* - The candidate may select the CTRC member to serve as the Committee Chair.

c) *Vacancies* - The Department Chair, after consultation with the candidate and the CTRC, shall appoint a tenured faculty member to fill any vacancies on the committee per policy.

3. *Committee Responsibility* – The CTRC shall provide an annual report to the Department Tenure Review Committee (DTRC – see section II.B). A copy of the annual report shall be provided to the Associate Dean's Office by the DTRC Chair. The report shall be logged and placed in the candidate's tenure file.

4. *Candidate's File* - The CTRC shall be provided with a locked file, in an office designated by the Associate Dean, for storage of all documents and reviews submitted by the committees, tenured faculty of the program, Department Chair and Associate Dean. The file of any tenure-track candidate shall be available for inspection by tenured faculty members of the department or the CTRC. Candidates shall have access only to their own file in the presence of their CTRC Chair, DTRC Chair, or the Associate Dean.

B. Department Tenure Review Committee (DTRC)

1. *Committee Responsibility* - The DTRC will supervise the actions of the various CTRC's of their department and assure that they operate in conformity with the provisions and timetable of this policy.

2. *Composition* – The DTRC shall consist of all tenured faculty within the department. When the candidate's department has less than three tenured faculty, DTRC members shall be selected from other tenured College of Engineering Technology faculty by the Department Chair.

3. *Chair Selection* - The chair of the Department Tenure Review Committee shall be determined by election within the DTRC.

4.

III. Tenure Evaluation Procedures

- ***This procedure is intended as a complete chronological guide for tenure-track candidates and their tenure committees. In the event that there is a conflict between these procedures and the FSU and FFA agreement, the FSU and FFA Agreement shall be the controlling document. (This document provides convenient tenure event calendar summaries in Appendix F.)***
-

A. First and Subsequent Years (prior to the tenure request year)

The tenure-track period commences the first fall semester after hire. This section provides the evaluation procedure for the tenure candidate up to the last year of the tenure-track period. Section B. contains the procedures for the final tenure-track year - also referred to as the tenure request year.

1. *First Year Introduction to Tenure Process* – Early in the first Fall semester of the tenure-track period, the chair of the Department Tenure Review Committee (DTRC) shall meet with the candidate. At that meeting a copy and explanation of this Department Tenure Policy and Procedures and FSU/FFA Agreement will be provided.
   - Completion by September 30th.
2. *Yearly Resume Update* – The candidate shall present to their tenure committee an up-to-date Yearly Resume (Appendix D-1), which shall have particular emphasis on meeting the suggested tenure criteria. The completed Yearly Resume shall be filed in the candidate's tenure file, located in the Associate Dean's Office.
   - Completion by October 15th.
3. *Student Assessment of Instruction* – SAI surveys will be completed by students enrolled in each course and section instructed by the candidate for both fall and spring semesters.
   a) *Dates of administration –*
      - Fall semester - between October 15th and November 1st.
      - Spring semester - between March 15th and March 30th.
   b) *Procedure -*
      - The candidate will select the proctor to conduct the assessments.
      - Proctor returns completed assessments to the Department Secretary.
      - Department Secretary will forward assessments to the Associate Dean's Office.
      - The Associate Dean's Office will record receipt, send to testing, and file results in the candidate's tenure folder.
      - SAI's and test results will be sent to the candidate before October 1st of the Fall semester and March 1st of the Spring semester.

4. *Candidate Observation Guide* - The Candidate's Observation Guide (Appendix B) shall be completed by each member of the Candidate's Tenure Review Committee and at least one member of the Department Tenure Review Committee during the Fall and Spring semesters. The Department Chair shall complete a Candidate's Observation Guide each Fall semester.

Submission dates are -

- Fall semester by October 15th
- Spring semester by March 30th

Completed forms shall be filed in the candidate's tenure file, in an office designated by the Associate Dean.

5. *Peer Reviews –*

a) The Candidate's Tenure Review Committee shall request that the candidate's program peers and other tenured faculty within the candidate's department complete the Peer Group Evaluation (Appendix C).

b) The Department Chair shall complete the Peer Group Evaluation at least once each Fall semester.

Submission dates are -

- Fall semester by October 15th
- Spring semester by March 30th

Completed forms shall be filed in the candidate's tenure file, in an office designated by the Associate Dean.

6. Tenure Review Committees' Annual Evaluations –

a) *Candidate's Support Documentation* – The candidate may submit support documentation to the CTRC to support their continued non-tenured appointment.

- Submission prior to CTRC Preliminary Evaluation and by November 1st

b) *CTRC Preliminary Evaluation* - The Candidate's Tenure Review Committee will advise the non-tenured member of its preliminary evaluation and recommendation for appointment or non-reappointment.

- Completion by November 1st

c) *CTRC forwards evaluation/recommendation to DTRC.*

- Submission by November 1st

d) *Member meeting with DTRC –*

- The Candidate may submit, to the DTRC Chair, a written request to meet with the DTRC to discuss the preliminary evaluation by November 1st.
- The Candidate will be offered the opportunity to meet on or before November 10th.

e) *DTRC Final Evaluation* - The DTRC shall forward, in writing, their final evaluation and recommendation, along with supporting documents, to the candidate, the Department Tenure Review Committee, Department Chair and the Associate Dean.

- Completion by November 20th

7. *Candidate's Professional Development Plan* – The candidate shall prepare a Professional Development Plan (Appendix D-2). The plan will:

a) outline the candidate's near term strategy for professional development.
b) be updated annually in consultation with the Department Chair and CTRC.
c) be signed by the candidate, the Department Chair and the CTRC Chair. Completed forms shall be filed in the candidate's tenure file, in an office designated by the Associate Dean.

- Submitted by November 20th

8. *Candidate's Written Response* - Candidates who disagree with any or all of the DTRC's annual evaluation must submit a written response to the Associate Dean. The response must identify all aspects with which there is disagreement and factual basis for such disagreement. This response will be attached and remain with the DTRC'S evaluation/recommendation.

- Submission by November 30th

9. Annual Associate Dean Evaluation

a) The Associate Dean shall visit at least one class of each College candidate during the Fall semester.
b) A written copy of the Associate Dean Evaluation (Appendix E) will be provided to the tenure track candidate.

- Submission by December 10th

c) The Associate Dean's evaluation/recommendation, the candidate's Professional Development Plan, the CTRC and DTRC's evaluations/recommendations, candidate responses and other related materials will be forwarded to the Dean.

- By December 10th

10. *Candidate's Written Response* - Candidates who disagree with any or all of the Associate Dean's annual evaluation must submit a written response to the Dean. The response must identify all aspects with which there is disagreement and factual basis for such disagreement. This response will be attached and remain with the review.

- Submission by December 20th

11. *Dean's Recommendation* - The Dean's recommendation will be submitted with all materials to the VPAA.

- Submission on or before January 15th

12. VPAA Decision –

a) *First Year* – The decision to grant or deny reappointment rests solely with the VPAA.

- Formal Notice by March 15th

b) *Subsequent Years* - The decision to grant or deny tenure requires affirmative recommendations by both the DTRC and the VPAA. Failure of DTRC to file paperwork to the Associate Dean in a timely manner constitutes complete concurrence with the VPAA's decision.

- Formal Notice by January 30th

13. *Non-reappointment* – In the event of non-reappointment, the specific reasons will be cited in writing.

a) Appeal Procedure –

- In the event that both the DTRC and VPAA agree for non-reappointment, the appeal is limited to a claim that contractual or department/college procedures were not followed.
- In the event that either the DTRC or VPAA recommend non-reappointment, appeal (not limited to procedure) may be made to the President.

b) Written Appeals must state specific reasons in writing and be delivered to the office of the President of FSU.

- First year - Delivered on or before April 15th.
- Subsequent years - Delivered on or before February 15th.

c) The President's decision is final.

d) Failures on the part of the tenure committees are exempt from the appeal process.

B. Requesting Year

1. *Application for Tenure* - A tenure track candidate must apply for tenure no later than their fifth academic year. Failure to apply for tenure consideration shall result in denial of tenure.

a) A tenure track candidate with an initial academic rank of instructor or assistant professor may not apply for tenure prior to their fifth year.

b) A tenure-track candidate with an initial academic rank of associate professor may not apply for tenure prior to their fourth year.

c) A tenure track candidate with an initial academic rank of professor may not apply for tenure prior to their third year.

2. *Request Notification* - The Department Tenure Review Committee (DTRC) shall send a notice to all candidates in their requesting year to inform them that they are to submit a letter requesting tenure along with credentials to substantiate the request.

- By September 1st

3. *Candidate Letter and Portfolio* - The candidate shall submit a portfolio containing a letter requesting tenure, current resume, classes taken, additional formal education (including progress towards degree requirements) and other supporting material to their Department Tenure Review Committee. The portfolio should be formatted in similar order and content as that of the CET promotion portfolio.

- By October 1st

4. *Notice of Intended Recommendation* - The DTRC will advise candidate of its evaluation and intended recommendation.

- By November 1st

5. *Candidate meeting with DTRC* - The applicant may request in writing a meeting with the DTRC, which shall be scheduled as soon as reasonably possible.

- By November 15th

The final recommendation of the DTRC shall not be made until after the meeting.

6. *Department Vote* -

a) The tenured faculty of the department shall vote by secret ballot to grant or deny tenure. Outcome will be determined by majority vote of the tenured faculty of the department.

- Department vote taken by November 30th

b) Vote Sequence - The voting will be done in two parts.

- A first vote will be taken to grant or deny tenure.
- When majority votes to deny tenure, a second vote shall be taken to determine if the candidate will be denied or given one additional tenure track year.
- *Department Decision* - The results of the vote shall be forwarded, in writing, with all supporting documentation, and recommendation to the candidate, Department Chair, and Associate Dean by December 15th.

c) The written recommendation shall be one of the following:

- Grant tenure beginning with the start of the University's next academic year.
- Grant one additional tenure track year during which the applicant must fulfill specific conditions in order to be eligible for tenure. Upon completion of that conditional year, the tenure application process will again be followed. In the event of denial of tenure, employment will be terminated at the end of the academic year in which tenured is denied.
- Deny tenure and terminate employment at the end of the next regular academic year.

7. The Associate Dean will provide, in writing, their evaluation and recommendation to the Dean of the College of Engineering Technology and to the candidate.

8. The Dean will provide, in writing, their evaluation and recommendation to the Vice President of Academic Affairs.

9. The VPAA shall notify, in writing, their decision to grant or deny tenure.

- By March 1st

10. If either the VPAA or the DTRC recommends the granting of an additional year, that year is granted. A candidate can be granted only one extension. When the DTRC recommends granting of tenure and the VPAA concurs, tenure is awarded. In all other cases it is denied.

11. The candidate's tenure review file shall be kept for an additional three years after the date of denial. The candidate may appeal the denial, in writing, to the President of FSU.

- Appeal deadline March 15th

12. The President of FSU, following a review of the tenure materials, shall communicate in writing their decision to grant tenure, deny tenure, or grant one additional non-tenured year, provided that such a year has not previously been granted. The decision of the President of FSU is final, binding and not subject to arbitration.

13. If tenure is granted, it will begin with the start of the University's next academic year and the candidate's tenure files shall be destroyed.

- Note: Copies of recommendations are to be filed in the candidate's file, located in the Dean's office, and personnel file, located in the Human Resources office.

IV. Review and Amendment

Department Tenure Policy and Procedure guidelines for implementation and amendments are provided within the contract under Section 3 of the FSU-FFA contract.

PROMOTION/MERIT POLICY

I. Introduction

It is the intent of this policy to recognize the unique nature of the programs within the College of Engineering Technology and the diversity of the experiential backgrounds of the faculty involved in these programs. In keeping with the diversity, this policy contains less structured criteria than a policy that may be applicable in a more "traditional" educational setting.

The Ferris philosophy places emphasis on teaching and advising; therefore, in the process of reviewing faculty being considered for promotional recommendations, emphasis will be placed on the teaching and advising capabilities of the faculty. Additional emphasis will be given to areas of professional development and contributions to Ferris. This policy was developed for full-time teaching faculty in the College of Engineering Technology as they become eligible for promotional consideration in the following academic ranks: Assistant Professor, Associate Professor, Professor, and merit within rank.

When a person meets the minimum qualifications for a special instructional rank, it should not be assumed nor construed that the person will be appointed or advanced automatically to that rank. Rather, the intent of this policy is that all eligible persons (i.e., persons who meet the minimum qualifications) will be considered for promotion upon submission of a portfolio to the Promotion Committee; however, promotion in rank will be a selective process from among the candidates, to identify and advance those individuals who are judged to be best qualified to hold the higher rank. Applicants will request consideration for either promotion or merit, but not both.

Current policies of college/group will continue and any changes will be implemented when approved by the Dean, a majority vote of the promotion committee, and a majority vote of the CET faculty.

A. Committee Membership

1. The College of Technology Promotion Committee will consist of twelve (12) members:

one (1) member from each Department.

[a]. All of the Committee members will be tenured bargaining unit faculty from the College of Engineering Technology. Fifty percent (50%) shall be appointed by the Dean through a departmental eligibility list presented to the Dean. Departments without representation shall elect a tenured bargaining unit faculty member as their Committee rep.
[b]. Each rep shall serve a two-year term. Terms will be staggered to replace fifty percent (50%) of the Committee each year
[c]. Appointments and election of members within each Department will occur during April of each year.
[d]. A Committee member will be ineligible for promotion consideration during the term of Committee membership.
[e]. In the event an elected member is unable to complete a term, the Department shall elect a rep to fill the vacancy.

2. The Chair of the Promotion Committee will be elected from the bargaining unit members of the Committee.

B. Promotion Review Process

1. The candidate is responsible to present a portfolio, consisting of no more than a three-ring binder, not to exceed one and one-half (1 ½) inches as measured at both spine and open edge, to the Committee by October 15**.** Since it is possible that some accomplishments or eligibility requirements may have been met prior to the last promotion/merit increase, the candidate must document these achievements within the portfolio. Consideration will be given only to accomplishments of the applicant since his/her last promotion or merit increase, or date of hire, whichever is more recent. The candidate will date all material submitted. If material is not dated, it will be disregarded.

[a]. This portfolio will include information and data pertinent to the candidate's professional qualifications, demonstrating achievement in the following areas: teaching, work experience, professional development, contributions to Ferris beyond teaching, involvement in professional organizations/activities, innovative educational activities, publications, research, and other relevant information. (Candidates are to refer to the Appendix on page 6 in preparing their portfolio according to the defined sequence and section areas.)
[b]. A request for waiver of eligibility requirements is to be submitted on the Waiver Request form with justification and/or supporting statements attached and shall be submitted no later than September 15. The criteria will be waived for the candidate upon a majority vote of the Promotion Committee. The committee determines eligibility for promotion based on the materials provided within the portfolio. It is in the best interest of

the applicant to apply for a waiver if he/she has any doubts regarding eligibility**.** (See "Waiver Procedures" section on page 4).
[c]. The candidate must provide in the portfolio, *summary data* from all SAI's (student assessment instruments) completed since the last promotion or merit. Comment sheets may be included.
[d]. The candidate must have a total of four (4), and only four (4), Colleague Evaluation forms from selected individuals sent directly to the Committee.
(1) Minimum of one evaluation(s) from faculty in the candidate's department.
(2) Minimum of one evaluation(s) from faculty outside the candidate's department, but within the College of Engineering Technology.
(3) Minimum of one evaluation(s) from individual(s) outside the CET, but within the University.
[e]. It is the candidate's responsibility to follow up on the submittal of colleague evaluations.
[f]. All information forwarded to the Promotion Committee will be held in confidence and the candidate's portfolio will be returned to the candidate upon completion of the promotion process. Recommendations and colleague evaluations sent directly to the Committee will not be returned.
[g]. Candidates are responsible to ensure that all pertinent information is included.
[h]. Failure to comply with policy shall be cause for removal of candidate for promotion/merit.

2. The Promotion Committee will undertake the review process of all candidates. A quorum of the Promotion Committee will meet and discuss portfolios prior to the committee submitting the final ranking. The Committee shall transmit a ranked list to the Dean indicating:

[a]. The individuals applying for promotion within the College that it recommends for promotion/merit. The number of recommendations shall be equal to or less than the number of promotions/merits available for the College. If the number of promotions/merits is less than the number of promotions/merits available in the College, the unused promotions/merits may be carried forward for use in future years.
[b]. A rank ordering (extra list) of the additional individuals approved for promotion/merit within the College that the Committee decides to recommend.
[c]. The Promotion Committee will, at this time, notify the individual candidates whether they were or were not on the lists of candidates transmitted to the Dean.
[d]. The Dean may add persons to the extra list in any position order which he/she believes is appropriate, but not altering the relative order established by the Promotion Committee. The Dean shall forward the lists to the Vice President for Academic Affairs.

II. Eligibility

A. To be eligible for promotional consideration, candidates must meet all of the following criteria prior to application. “Professional experience” refers to years of work experience, teaching, military service, or administrative duties, which can be documented and are significantly relevant to the individual’s teaching assignment. All information to be referenced by source, date, and time duration.

1. Instructor Or Technical Instructor To Assistant Professor

[a]. Baccalaureate degree.
[b]. Five years of professional experience, at least three of which must be in teaching.
[c]. Three years at the rank of technical instructor or instructor at Ferris State University.

2. Assistant Professor To Associate Professor

[a]. Masters degree.
[b]. Ten years of professional experience, at least five of which must be in teaching.
[c]. Four years at the rank of Assistant Professor at Ferris State University.
[d]. Four years since last merit increase.

3. Associate Professor To Professor

[a]. Masters degree plus 30 semester/45 term hours of a planned program to support your area of expertise. Time spent in professional development activities may apply towards the semester hours at the rate of 8 contact hours equaling .5 semester credit hours. Time spent in professional development activities may include seminars, workshops, and instructional activities provided by industry, educational institutions, and professional organizations. Participation and completion must be documented. The spirit of this paragraph is on education, not application.
[b]. Fifteen years of professional experience, at least ten of which must be in teaching.
[c]. Four years at the rank of Associate Professor at Ferris State University.
[d]. Four years since last merit increase.

4. Merit Increases

[a]. Merit increases are an addition to advancement in rank, but not a substitute for such advancement. Hence, the criteria and procedures for merit increases are the same as for promotion with the following additions:

1. Merit increases can only be given to those who have been advanced in rank to the maximum rank consistent with their promotion credentials as defined by the appropriate college/university/unit promotion policy.

2. A tenured bargaining unit member is eligible to apply for a merit increase only after a minimum of four years since his/her last advancement in rank or prior merit increase.

3. Consideration will be given only to accomplishments of the applicant since his/her last promotion or merit increase, or date of hire, whichever is more recent.

B. Waiver Procedures

1. The Promotion Committee may waive any eligibility requirements by a majority vote. Recommendations for exceptions to academic requirements will be considered when other conditions warrant (e.g., license or certification, additional professional experience, related professional recognition or achievement).

2. Requests for consideration for this waiver must be in writing to the Promotion Committee, submitted on the Promotion Policy Waiver request form with justification and/or supporting statement attached. Also attach a copy of the Information Request form (see page 8).

3. If the request for waiver is approved, the approval letter must be submitted along with and in the front of the portfolio. An approved waiver is valid for one year.

4. If a candidate's request for a waiver is denied based on an application for promotion, that candidate does not automatically become eligible for consideration for a merit award; the candidate may then submit his or her portfolio with an application for merit award if he/she meets those requirements.

E. Support of Faculty Professional Development

Describe the adequacy of support for faculty professional development and how such activities such as sabbaticals, travel, workshops, seminars, etc., are planned and supported.

Support for faculty development comes from three major areas: One is S&E money which is used to support professional development. This year, we spent $8,300 on professional development with another $2,500 coming from the College of Engineering Technology Professional Development Fund and Academic Affairs. The other avenue that we have for professional development is the Timme Grant which is available for application through the University's Faculty Center for Teaching and Learning twice annually. The Senate Professional Development committee also has grants available through a competitive process.

PROGRAM CRITERIA

Describe how the program satisfies any applicable program criteria. If already covered elsewhere in the self-study report, provide appropriate references.

These program criteria apply to engineering programs including "surveying" and similar modifiers in their titles.

1. Curriculum
   The curriculum must prepare graduates to work competently in one or more of the following areas:
   - boundary and/or land surveying, geographic and/or land information systems, photogrammetry, mapping, geodesy, remote sensing, and other related areas.

   Prepared surveys from faculty, students, advisory committee, alumni, and employers as referenced in Criterion 4.

2. Faculty
   Programs must demonstrate that faculty members teaching courses that are primarily design in content are qualified to teach the subject matter by virtue of professional licensure or by educational and design experience.

   Faculty as referenced in Criterion 6 and their vitae in Appendix B.

Appendix A – Course Syllabi

COURSE: SURE 110 FUNDAMENTALS OF SURVEYING (REQUIRED)

Credits:	4 Hours
Contacts:	2 Lecture, 6 Lab Hours per week
Course Description:	Orientation and introduction in proper field surveying theory and techniques. Subject areas include taping, tape corrections, leveling, angle measurements, traversing, traverse adjustments, contouring, fundamentals of mapping, and proper use and care of surveying instruments.
Course Prerequisites:	MATH 120
Required Textbooks:	Kavanagh, B., (2009) **Surveying: Principles and Application**, 8th Edition, Prentice Hall, New Jersey
Reference Text:	Anderson, J., and Mikhail, E., (1998), **Surveying, Theory and Practice**, 7th Edition, McGraw-Hill, Boston
Required Materials:	Student lab kit

Course Learning Outcomes

Upon completion of the course, the student should be able to

1. understanding of units of measurements and the accuracy of the surveying instruments and the errors associated with them [Program Outcome (PO 1, 3 ABET a)
2. the ability to use various surveying instruments (PO 2, ABET a,k)
3. the ability to perform computations using data taken from field notes (PO 2, ABET a,k)
4. the ability to draw maps & write report from the field and computed data (PO 4,5, ABET a,e)

Topics Covered:

1. Introduction, Orientation & Safety (2 classes)
2. Types of Surveys, Types of Measurement and Fundamental principles of surveying (3 classes)
3. Taping and Tape Corrections (3 classes)
4. Levels and Leveling Definitions (1 class)
5. Leveling Procedures (4 classes)
6. Angle Measurements (5 classes)
7. Traversing and Traverse Adjustment Including Area Computations (4 classes)
8. Detail survey by stadia method (3 classes)
9. Topographic mapping (2 classes)

Computer usage: None

Required Laboratory Schedule

1. Leveling - Instrument Instruction, Differential Leveling Loop, Profile, and Peg Testing (3 weeks)
2. Taping - Tape use, Horizontal Taping, Slope Taping (1 week)
3. Angular Measurements - Angle Measurement Techniques, Traverse (3 weeks)
4. Detail Survey by Stadia (3 weeks)
5. Report writing and plotting of map (3 weeks)

Contribution of the course to meeting the requirements of Criterion 5: This is the first technical course in the program and as indicated above in course outcomes, it partially satisfies Program Outcomes (PO) 1,2,3,4, & 5.
Relationship of the course to Program Outcomes: As indicated above, this course partially satisfies PO 1,2,3,4 &5.
Person who prepared this description and date of preparation: K. Thapa, 12/3/09

Course: SURE 115 Introduction to Computer Mapping

Credits:	1 Hour
Contacts:	3 Lab Hours (6:00-8:50 Swan 206) per week
Course Description:	This course is an introduction to Computer Aided Drafting (CAD) as applied to Surveying Engineering and Computer Aided Mapping (CAM). The emphasis of this course is “hands on” exercises in CAD and CAD integrated surveying software.
Course Prerequisites:	None
Course Outline:	Attached to this document
Required Textbooks:	*Discovering AutoCad*, by Mark Dix and Paul Riley
Reference Textbooks:	*Carlson 2009 User’s Manual*, Volumes 1 and 2, Carlson Software, Inc. 2008
Required Materials:	Student Lab Kit, Some form of memory device such as a USB memory stick, external hard drive, etc.

Student Learning Outcomes

Students satisfactorily completing this course will achieve/complete/demonstrate:

1. an understanding of basic CAD mapping concepts (PO 5)
2. competence in the use of graphic object construction and editing (PO 2)
3. the ability to apply CAD concepts to surveying and mapping (PO 2)

Course Assessments

Course assessment will be performed using examinations, homework, and laboratory exercises.

Person who prepared this description and date of preparation: C. Shangraw

COURSE: SURE 215 SURVEYING COMPUTATIONS (REQUIRED)

Credits:	3 Hours
Contacts:	2 Lecture 3 Lab Hours per week
Course Description:	A study of principles and methods of surveying computation related to Cartesian coordinate systems, coordinate geometry including a four-parameter similarity transformation and an introduction to spherical coordinate systems as applied to spherical astronomy and the use of mathematical software with programming features. Typically Offered Fall, Spring
Course Prerequisites:	SURE 110
Required Textbooks:	**Surveying Theory and Practice**, 7th edition, by Anderson and Mikhail, published by McGraw-Hill
Reference Text:	Lecture Notes by S. Hashimi
Required Materials:	Student lab kit

Course Learning Outcomes

Students satisfactorily completing this course will have an understanding of:

1. traverse computation and two dimensional coordinate geometry calculations (PO 2, 3)
2. horizontal circular curve geometry and layout calculations (PO 2, 3)
3. coordinate geometry, line/line, line/circle, circle/circle 3-point resection (PO 2, 3)
4. the reduction of solar and astronomic observations for azimuth (PO 2, 3)

Topics Covered:

1. Review of traverse computations
2. Two-dimensional coordinate geometry; line/line, line/circle, and circle/circle intersections, three-point resection, area partitioning
3. Circular curve layout by deflection and offsets method
4. Equal tangent vertical curves
5. Four-parameter Coordinate Transformation
6. Solution of PZC spherical triangle for azimuth
7. Solar and Polaris observation reductions to azimuth

Computer usage: Spreadsheet, MathCad

Required Laboratory Schedule

1. Traverse computation and adjustment (1 week)
2. Equation of a line, slope of a line, solution of linear equations (1 week)
3. Line/Line intersection (1 week)
4. Horizontal Circular Curve Geometry (1 week)
5. Line/Circle intersection (1 week)
6. Circle/Circle intersection (1 week)
7. Missing Data Calculation (1 week)
8. Area partitioning (2 weeks)
9. Three-point resection (1week)
10. Four-parameter Coordinate Transformation (1 week)
11. Equal Tangent Vertical Curves (1 week)
12. Polaris and Solar Observations reduction for azimuth (3 weeks)

Contribution of the course to meeting the requirements of Criterion 5: This is the first technical course in the program and as indicated above in course outcomes, it partially satisfies Program Outcomes (PO) 2 & 3.
Relationship of the course to Program Outcomes: This course partially satisfies POs 2 & 3.
Person who prepared this description and date of preparation: S. Hashimi, 04/10/10

Course: SURE 230 ADVANCED SURVEYING

Credits:	4 Hours
Contacts:	2 Lecture 3 Lab Hours per week
Course Description:	An advanced study of the methods and instrumentation used in the surveying profession. The theory and application of electronic distance measuring devices, use of total stations and digital levels, GPS principles and applications, introduction to practical astronomy and the application of state plane coordinates.
Prerequisites:	SURE 110 and SURE 115.
Required Textbooks:	Anderson, J., and Mikhail, E.; (1998); **Surveying, Theory and Practice**, **7th Edition**; McGraw-Hill; Boston, MA. Shangraw, C.; (2009); **Class Notes, SURE 230, Advanced Surveying.**
Reference Textbooks:	Ghilani, C. and Wolf, P.; (2007); **Elementary Surveying, an Introduction to Geomatics, 12th Edition;** Pearson, Prentice Hall; Upper Saddle River, NJ. Ghilani, C. and Wolf, P.; (2006); **Adjustment Computations, Spatial Data Analysis, 4th Edition**; John Wiley and Sons, Inc.; Hoboken, NJ.
Required Materials:	Student Lab Kit, Some form of memory device such as a USB memory stick, external hard drive, etc.

Student Learning Outcomes

Students satisfactorily completing this course will achieve/complete/demonstrate:

5. a basic understanding of the errors and error propagation inherent in surveying operations. (PO 2,3)
6. fundamental knowledge of the design and establishment of vertical and horizontal control networks. (PO 3,4)
7. the ability to act as a member of a team in collecting, assessing, interpreting and presenting survey information in the form of survey reports and a topographic map. (PO 4,5)

Person who prepared this description and date of preparation: C. Shangraw

COURSE: SURE 272 PROGRAMMING APPLICATIONS IN GEOMATICS

Credits:	2 Hours
Contacts:	1 Lecture, 3 Lab Hours per week
Course Description:	Exploring fundamental concepts of visual programming to solve surveying and mapping related problems. Topics covered include: object oriented syntax for looping and if statements, input/output statements, arrays, user-defined functions and procedures, reading and writing text and binary files, and introduction to database programming and graphics. Programming projects may include: angular units conversion; transformation of coordinates from polar to rectangular and rectangular to polar; traverse computation, adjustment and plotting.
Course Prerequisites:	SURE 215 – Surveying Computations MATH 130 – Advanced Algebra and Analytical Trig.
Required Textbooks:	Mastering MATLAB 7, by D. Hanselman and B. Littlefield – Prentice Hall

Student Learning Outcomes

1. Be able to understand how to develop a solution algorithm to solve numerical problems using a high level computer programming language (PO 2, 3, 4).
2. Be able to understand program control; looping, IF and Case statements (PO 2, 3).
3. Be able to understand array concepts and array applications into a programming environment (PO 2, 3)

Topics Covered

1. Relational and Logical Operations
2. Arrays and Array Operations
3. Numeric and Character Data Types
4. Program Control Flow; Loops, IF, and Case statements
5. Import and Export Data
6. Program Graphics User Interface (GUI); Dialog Boxes
7. Objects: properties, methods and event handlers
8. Linking two or more objects

Required Laboratory Schedule

1. The first four to five weeks of the semester consists weekly laboratory assignments dealing with the coverage of the programming language syntax, program controls, object programming concepts
2. The remaining two thirds of the semester the students work on a project culminating into a final presentation by each student. Typical projects over the past few years have consisted of interactive COGO, Reduction of observations using State Plane Coordinates, Solar observations reduction for azimuth where the solar ephemeris is built in the program, Horizontal circular curve calculation and layout.

Contribution of the course to meeting the requirements of Criterion 5: It partially satisfies Program Outcomes (PO) 2 & 3.
Person who prepared this description and date of preparation: S. Hashimi, 04/10/10

COURSE: SURE 331 ETHICS AND PROFESSIONALISM IN ENGINEERING AND TECHNOLOGY

Credits:	3 Hours
Contacts:	3 Lecture, 0 Lab Hours per week
Course Description:	Discusses the codes of ethics which have been adopted by many engineering societies. Explain meaning and attributes of professionalism along with the ethical, moral, and social responsibilities of technologists and engineers. Also standards, law, safety, risks, obligations of loyalty to employer, professional client relationship, global awareness, bribery, contracts, and intellectual property are discussed. This course meets General Education requirements: Cultural Enrichment.
Course Prerequisites:	ENGL 150
Required Textbooks:	**Ethical Issues in Engineering** by D. Johnson, Prentice Hall, NJ.

Student Learning Outcomes

Upon completion of the course, the student should be able

1. To introduce the concepts moral thinking moral theories (PO 1, 7, 8, ABET c,d,f,j)
2. To environmental ethics and ethics and safety obligations (PO 6, 7, 8, ABET c,d,f,j)
3. To introduce the concepts of ethics and professionalism as applied to engineering and technology (PO 5, 7, ABET c,d,f,g,j)
4. To understand the impact of surveying and engineering projects on society (PO 1, 5, 6, 7, 8, ABET c,d,f,g,j)

Topics Covered:

Codes of ethics, attributes of a professional, ethical, moral, and social responsibilities of engineers and technologists, global awareness, bribery, intellectual property.

1. Introduction: Moral Thinking 6
   What is morality? Realism vs. Constructivism
2. Moral Theories: 6
   Utilitarianism, Kantianism, Virtue Ethics, Divine Command
   Social Contract Theories

3.	Environmental Ethics Cost Benefit Analysis, Animal Rights, Biocentric Individualism Ecocentric Holism, Deep Ecology	7
4.	Ethics and Safety Obligations Concern for Safety, Safety and Risk, Risk-Benefit Analysis Consequences of not Following Safety Precautions Case Studies from different Engineering Disciplines Interaction of Law with Professional Engineers, Professional Liability	6
5.	The Definition of a Profession Attributes of a Profession, Engineers' Creed, Code of Ethics for Engineers Pofessional Licensure	6
6.	Engineers' and Technologists' Responsibilities to the Society	5
	Public Health, Public Safety, Trade Secrets, Patents, Intellectual Property	
7.	Obligations of Loyalty to Employers Moral status of Loyalty, Whistle-Blowing, Employee Rights, Professional Rights, Confidentiality, Moral Justification for Whistle-Blowing The Role of Law in Protecting Scientific and Technical Dissent	4
8.	Obligations to Clients and Fair Play in Engineering Conflict of Interest, Bribery, Gift Giving and Morality, International Bribery,Ethics and Corrupt Practices	2
	Three Tests	3
	Total	**45**

Contribution of the course to meeting the requirements of Criterion 5: This course satisfies the cultural enrichment in the program. It partially satisfies Program Outcomes (PO) 1, 5, 6, 7 & 8.
Relationship of the course to Program Outcomes: As indicated above, this course partially satisfies (PO) 1, 5, 6, 7, 8.
Person who prepared this description and date of preparation: K. Thapa, 12/3/09

Course: SURE 340 Photogrammetry

Credits:	3 Hours
Contacts:	2 Lecture, 3 Lab Hours per week
Course Description:	An introductory course in photogrammetry covering, in part, the history of photogrammetry, aerial cameras and camera calibration, geometry of the aerial photograph, stereoscopy and stereoscopes, parallax, and the theory and techniques of orientation. Students will perform basic mapping tasks in the stereoplotter.
Course Prerequisites:	SURE 110
Required Textbooks:	Photogrammetry: Geometry from Images and Laser Scans, by K. Kraus, de Gruyter.
References:	Elements of Photogrammetry, 3rd edition, by P. Wolf and B. Dewitt, McGraw-Hill Co.
Other Material:	Three photo set of campus, engineers scale, triangles.

Course Learning Outcomes

Students satisfactorily completing this course will have an understanding of:

1. The student will be able to make simple computations on aerial photographs such as scale, ground coordinates (local), and height of objects on vertical and near-vertical photography. (PO 2, 4)
2. The student will be able to apply parallax measurements to determine elevation and basic photographic calculations. (PO 2, 4)
3. The student will be able to describe how imagery is acquired using both analog (film-based) and digital cameras and the possibilities of errors within these image-capture devices. (PO 2,4)
4. The student will be able to explain how to orient a stereomodel (interior, relative, and absolute) using stereoplotters of different vintage with particular emphasis on control requirements. (PO 2,4)
5. The student will calculate basic planning parameters, understand basic contracting principles for photogrammetric services, and identify qualifications-based selection. (PO 3)

Topics Covered:

8. Introduction to photogrammetry with history
9. Principles of photography and imaging
10. Aerial camera
11. Geometry of aerial photo – vertical and tilted photography
12. Stereoscopy and parallax
13. Theory and techniques of orientation
14. Topographic mapping, standards and specifications, project planning

Computer usage: Mapping Software, Spreadsheet/MathCAD/Matlab

Required Laboratory Schedule

13. Research paper – 2 total with overview of aerial camera (3 weeks)
14. Geometry of aerial photography and stereoscopy (4 weeks)
15. Plotter orientation (2 weeks)
16. Digital photogrammetry operations (5 weeks)

Contribution of the course to meeting the requirements of Criterion 5: This is the first photogrammetry course in the program and as indicated above in course outcomes, it partially satisfies Program Outcomes (PO) 2, 3, 4.
Relationship of the course to Program Outcomes: This course partially satisfies POs 2, 3, 4.
Person who prepared this description and date of preparation: R. Burtch, 05/30/11

Course: SURE 365 LEGAL ASPECTS OF SURVEYING I

Credits:	3 Hours
Contacts:	3 Lecture hours per week
Course Description:	An introductory study to rights and interests in land, the Public Land Survey System, theory of original survey, resurvey, subdivision survey and the methods of describing real property along with the more important federal statutes affecting the surveyor. This is a writing intensive course. Students will prepare four 3-5 page papers on various topics assigned by the instructor. In addition, students will write a number of legal property descriptions in various formats. Also included will be the use of memoranda and professional correspondence.
Course Prerequisites:	SURE 215, Surveying Calculations (co-requisite); ENGL 250, English 2. It is expected that the student have proficiency in the following areas: English composition, fundamental traverse, coordinate and area calculations, CAD.
Required Textbooks:	Brown, Curtis M.; Robillard, Walter G.; Wilson, Donald A.; *Brown's boundary Control and legal Principles, 6th Ed.*; John Wiley and Sons, Inc.; New York; 2009. Berry, Ralph M.; *Special Instructions to the Deputy Surveyors of Michigan 1808-1854;* Michigan Museum of Surveying; Lansing, MI; 1990 Kramer, Melinda G., et al; *Prentice Hall Handbook for Writers, 12th Ed.;* Prentice Hall, Inc.; Englewood Cliffs, NJ; 1995. C. Shangraw; *Class Notes 2010.*
Rererence Textbooks:	Wattles, Gurdon G.; *Writing Legal Descriptions in Conjunction with Survey Boundary Control*; Wattles Publications; Tustin, CA; 1979 *Manual of Instructions for the Survey of the Public Lands of the United States;* Bureau of Land Management, United States Department of the Interior; Washington, D. C., 2009.
Required Materials:	None

Course Learning Outcomes

Students satisfactorily completing this course will achieve/complete/demonstrate…:

1. A basic understanding of and an appreciation for the Public Land Survey System. (SO 3, 8)
2. The quasi-judicial capacity of the surveyor. (SO 7)
3. The fundamentals of writing and interpreting legal property descriptions. (SO 5)
4. The core concepts of the US legal system. (SO 8)

Person who prepared this description and date of preparation: C. Shangraw

Course: SURE 366 Evidence and Procedures for Boundary Location

Credits:	3 Hours (2+2)
Contacts:	2 Lecture (Monday and Wednesday, 8:00-9:50 Swan 211) per week 2 Lab (Thursday, 3:00-4:15 Swan 207) per week
Course Description:	A study of the rules of evidence and their application in conducting boundary surveys. It includes an introduction to littoral and riparian rights and major environmental considerations and their applications to survey projects. The course focuses on statutory law and case studies melding the theoretical with the practical
Course Prerequisites:	SURE 365, Legal Aspects of Surveying I; ENGL 250, English 2. It is expected that the student has proficiency in English composition, basic land boundary theory, history of surveying, basic CAD functions, fundamental traverse, coordinate and area calculations.
Required Textbooks:	*Manual of Instructions for the Survey of Public Lands of the United States;* Bureau of Land Management, United States Department of the Interior; Washington, D.C.; (2009) Keen, John E.; *Land Surveying Law, 2nd Rev.*; Land Surveyors' Workshops; Spruce Pine, NC; 2003.
Reference Textbooks:	Wattles, Gurdon G.; *Writing Legal Descriptions in Conjunction with Survey Boundary Control*; Wattles Publications; Tustin, CA; 1979
Required Materials:	None

Course Learning Outcomes

Students satisfactorily completing this course will achieve/complete/demonstrate…:

5. The importance of research and the proper evaluation of evidence in retracement surveys. (SO 3 and 7)
6. An appreciation of the complexities in dealing with riparian/littoral issues along with environmental impacts. (SO 1)
7. A basic knowledge of Federal case law relating to boundary issues. (SO 8)
   SO = Student Outcomes

Course Assessments

Course assessment will be performed using examinations, quizzes, homework assignments and a project.

Person who prepared this description and date of preparation: C. Shangraw

COURSE: SURE 372 ADJUSTMENT COMPUTATIONS I (REQUIRED)

Credits: 3 Hours

Contacts: 3 Lecture, 0 Lab Hours per week

Course Description: This is the first of the two sequential courses on adjustment computations. Topics to be covered include: use of vectors, set theory, partial differentiation, matrix differentiation, statistical inference and hypothesis testing, an introduction to differential equations, propagation of random errors, and the relationships between variance covariance, weight and cofactor matrices as applied to least squares adjustment.

Course Prerequisites: SURE 230, Math 322 & SURE 272 or equivalent and/or ability to program in any high level language.

Required Textbooks: **Advanced Surveying Calculations: Lecture Notes**, 2009. Dr. Khagendra Thapa.

Reference: **Surveying Theory and Practice,** by Anderson and Mikhail, 7th Edition

Student Learning Outcomes

Upon completion of the course, the student should be able to:

8. Understand statistical concepts such as: measure of central tendency, measures of variability, hypothesis testing of the mean and variance (PO 2, 3, 4, ABET a,b,c,e,k).
9. Comprehend concepts of elementary differential equations (PO 2, 3 ABET a,b,c,e).
10. Understand the application of partial differentiation to the propagation of random errors in surveying (PO 2, 4, ABET a,b,e,j,k).
11. Know the relationship between weight matrix and variance covariance matrix (PO 2, 4, ABET a,b,e,j,k).

Topics Covered:	Lecture Hours
1. Introduction, set theory: sets, elements, set operations & ven diagrams: union, intersection, difference (relative complement), absolute complement, finite and countable sets, classes of sets.	2
2. Vector and vector Analysis: Vector representation, vector operations, scalar and vector products, use of vectors in Surveying Engineering, vector spaces and subspaces, linear independence and dependence	5
3. Partial Differentiation: Its application to surveying engineering,	5

	differentiation of matrices and vectors, concept of propagation of errors	
4.	Measures of Central Tendency (mean, mode, median) and their application to Surveying engineering Problems, Measures of Dispersion (range, variance, and standard deviation, skewness, and Kurtosis, frequency distribution) their application to Surveying engineering Problems, graphical representation of data (Pie Charts, Histogram, Frequency Polygon), concept of probability, distribution theory, Normal distribution, estimation, point and interval estimates, hypothesis testing null and alternate hypothesis, type I and type II errors, level of significance, power of a test, one and two tailed tests, sampling Distributions, t –tests, Chi-square and F tests, covariance and correlation coefficient and its use in surveying engineering.	15
5.	Propagation of Random Errors: Formulation of variance/covariance matrix, propagation of error where one variable is a function of one or variables, propagation of error where two or more variables are functions of two or more variables, relationships between weight, covariance and cofactor matrices	10
6.	Solution of ordinary differential equations encountered in surveying engineering.	5
7.	Three unit examinations plus a final.	4
	Total	45

Contribution of the course to meeting the requirements of Criterion 5: This is the first course in adjustment computations and as indicated above in course outcomes, it partially satisfies Program Outcomes (PO) 2, 3, & 4.
Relationship of the course to Program Outcomes: As indicated above, this course partially satisfies PO 2, 3, & 4.
Person who prepared this description and date of preparation: K. Thapa, 4/3/2010

COURSE: SURE 373	ADJUSTMENT COMPUTATIONS II
Credits:	3 Hours
Contacts:	3 Lecture, 0 Lab Hours per week
Course Description:	This is a continuation of Adjustment Computations 1 – SURE 372. Topics covered include: review of error propagation, development and application of least squares, horizontal and vertical control network designs; adjustment of indirect of observations, adjustment of observations and parameters combined. Student adjustment projects include: level network, traversing, triangulation, trilateration, and GPS network.
Course Prerequisites:	SURE 372 - Adjustment Computations 1
Required Textbooks:	**Surveying Theory and Practice**, by Anderson and Mikhail, 7th Edition
Required Materials:	Lecture Notes by Sayed Hashimi

Student Learning Outcomes

a. Be able to understand the laws of propagation of random errors through the application of mathematical and statistical concepts (PO 2, 3).
b. Be able to understand the development and application of least squares principles into surveying (PO 2, 3).
c. Be able to apply design concepts into horizontal and vertical control networks (PO 4).
d. Be able to develop a high level language computer program to perform a least squares adjustment (PO 2, 3).

Instructional Unit Topic Descriptions and Time Allocations

NO.	UNIT TOPIC DESCRIPTION SUMMARY	LECTURE HOURS
I.	Concepts of Measurement and Error, Types of Errors	2
II.	Variance Covariance Propagation	6
III.	Adjustment of Indirect Observations - linear and nonlinear cases	14
IV.	Control Network Design: Level Network, Horizontal network, 3-D network	4
V.	Adjustment of Observations and Parameters Combined	6
VI.	Pre-analysis of Survey Measurements: Distance and angle measurements, Elevation difference using differential leveling	3
VII.	Statistical Analysis: Error Ellipses, Test of Variances using Chi-square distribution	6
VIII.	Four Tests	4
	Total Hours	45

Contribution of the course to meeting the requirements of Criterion 5: This is the first technical course in the program and as indicated above in course outcomes, it partially satisfies Program Outcomes PO 1, 3, & 4.
Relationship of the course to Program Outcomes: As indicated above, this course partially satisfies PO 1, 3, & 4.
Person who prepared this description and date of preparation: S. Hashimi 4/14/10

Course: SURE 420 Professional Practice of Surveying

Credits:	3 Hours
Contacts:	3 Lectures hours per week
Course Description:	A study of business practices as they apply to the organization offering professional engineering and/or surveying practices. This course meets General Education requirements: Writing Intensive Requirement.
Course Prerequisites:	SURE 365, ENGL 250
Required Textbooks:	*The Wall Street Journal*, Dow Jones and Company, New York, NY; *Prentice Hall Handbook for Writers, 13th Ed*., Kramer, et. al., Prentice Hall, Inc., Englewood Cliffs, New Jersey,2008; C. Shangraw, *Class Notes*, Winter, 2011
Reference Textbooks:	*What Color is Your Parachute;* Richard Nelson Bolles; Ten Speed Press; Berkely, CA.; 1999; *Sample Contracts Manual;* American Congress on Surveying and Mapping; Falls Church, VA.; 1988; *Surveyors and Engineers Small Business Handbook;* CED Technical Services; Tuscaloosa, Alabama; 1995
Required Materials:	Portfolio covers

Student Learning Outcomes

Students satisfactorily completing this course will achieve/complete/demonstrate:

1. the importance and relevance of licensure as a Professional Surveyor and a Professional Engineer along with Michigan requirements for obtaining them and renewing them. (ABET Criteria 3i), (PO 8)
2. the fundamentals of operating a successful professional consulting business (ABET Criteria 3d, 3f, 3g, 3h & 3j)(PO 7).
3. Integrating the practices of surveying engineering with the concepts of ethical conduct and sustainable development (ABET Criteria 3f & 3i)(PO 7).
4. Effective written communication(Abet Criteria 3g) (PO 5)

Person who prepared this description and date of preparation: C. Shangraw

Course: SURE 440 Photogrammetry

Credits: 3 Hours

Contacts: 2 Lecture, 3 Lab Hours per week

Course Description: This course acquaints the student to advanced photogrammetric concepts that are normally encountered in photogrammetric practice. Topics include an introduction to analytical photogrammetric principles, concepts of the bundle adjustment, principles of advanced sensors, orthophotography, and principles of digital photogrammetry.

Course Prerequisites: SURE 340, SURE 373

Required Textbooks: Photogrammetry: Geometry from Images and Laser Scans, by K. Kraus, de Gruyter.

References: Manual of Photogrammetry, 5th edition, by J. C. McGlone, E. M. Mikhail, and J. S. Bethel, American Society for Photogrammetry and Remote Sensing

Course Learning Outcomes

Students satisfactorily completing this course will have an understanding of:

6. Be able to transform coordinates to photo system and apply corrections to those transformed coordinates . (PO 2, 4)
7. Be able to describe the physical concept of the collinearity condition equation and derive the observation equations for Case 1, Case II, Case III, and Case IV theory. They will also be able to write a least squares adjustment program. (PO 2, 4)
8. Be able to understand the concepts of direct sensor orientation, airborne GPS, and mobile mapping, including the utilization of lidar data (PO 2,4)
9. Be able to understand the process of orthophotography and rectification of digital imagery, including satellite sensors (PO 2,4)
10. Be able to describe the basic principles of digital image processing. (PO 2, 4)

Topics Covered:

15. 2-D and 3-D coordinate transformation theory
16. Atmospheric refractions, lens distortion, earth curvature, film deformation and Third order theory
17. Collinearity and coplanarity conditions and linearization, numerical resection and orientation
18. Airborne GPS, direct sensor orientation, mobile mapping
19. Laser scanning
20. Orthophotography
21. Image processing (resampling, filtering, geometric corrections, image transformation) and digital photogrammetry

Computer usage: Mapping Software, Spreadsheet/MathCAD/Matlab

Required Laboratory Schedule

17. Transformation and correction of photo coordinates
18. Write program for single photo resection and orientation
19. Create orthophotograph of area on campus

Contribution of the course to meeting the requirements of Criterion 5: This is the first photogrammetry course in the program and as indicated above in course outcomes, it partially satisfies Program Outcomes (PO) 2, 4.
Relationship of the course to Program Outcomes: This course partially satisfies POs 2, 4.
Person who prepared this description and date of preparation: R. Burtch, 05/30/11

COURSE: SURE 452 GEODESY I

Credits: 4 Hours

Contacts: 3 Lecture, 3 Lab Hours per week

Course Description: This is the first of the two sequential courses in geodesy. Topics covered include: ellipsoidal geometry, direct and inverse solution of geodetic line, geodetic datum, coordinate systems, deflections of vertical, celestial sphere, solution of spherical triangles, time systems, astronomical azimuth and Laplace's equation, developable surfaces, basic properties and characteristics of most common map projections with stronger emphasis on the projections used in State Plane Coordinates such as Lambert conformal, transverse Mercator and UTM.

Course Prerequisites: Sure 230 and Sure 372

Required Textbooks: **Geodesy and Map Projections**, by K. Thapa, Ph.D. January, 2009

References: **Geodesy**, by G. Bomford
Geodesy the Concepts, by Vanicek and Krakiwsky
State Plane Coordinates of 1983, by James Stem, 1990, NGS

Student Learning Outcomes

Upon completion of the course, the student should be able

1. To understand basic ellipsoidal geometry, and direct and inverse problem. (PO 2, 3, 8, ABET a, c, i, e, k).
2. To understand the concepts of datum, and coordinate systems. (PO 2, 3, 4, ABET a, b, j, k).
3. Be able to reduce observations to the computational surface. (PO 2, 3, ABET a, c, e, k).
4. Be able to understand the theory of map projections and application of map projection to state plane coordinates (PO 2, 3, 4, 8, ABET a, b, j, k).

Topics Covered:

1. History of Geodesy	2
2. Geometry of sphere & ellipsoid	10
3. Coordinate systems (plane, sphere, ellipsoid)	6
4. Motions of the Earth, Stars, and Sun	1
5. Time Systems	2
6. Direct and Inverse Geodetic Problems	2
7. Gaussian Fundamental Quantities	1
8. Theory of Distortions in Map Projection	3
9. Fundamental Methods of Map Projection	6
10. Conformal Projections (State Plane Coordinates)	9
11. Three Test	3

Total	45

Contribution of the course to meeting the requirements of Criterion 5: This is the first course in Geodesy and as indicated above in course outcomes, it partially satisfies Program Outcomes (PO) 2, 3, 4, & 8.

Relationship of the course to Program Outcomes: This course partially satisfies (PO) 2, 3, 4, & 8.

Person who prepared this description and date of preparation: K. Thapa, 12/3/09

Course: SURE 453 Geodesy II

Credits: 4 Hours

Contacts: 3 Lecture, 3 Lab Hours per Week

Course Description: This course is a continuation of SURE 452, Geodesy 1. Topics covered include: introduction to physical geodesy, gravity observations and reduction, Stoke's integral, Bruns formula, basic concepts of positioning by observing satellites, satellite geodesy, Global Positioning System (GPS) including both theoretical and practical aspects, VLBI, lunar and satellite laser ranging, satellite altimetry, and inertial positioning system.

Course Prerequisites: SURE 452 and SURE 373

Required Textbooks: GPS Theory and Practice, by B.Hofmann-Wellenhof, H. Lichtenegger, and J.Collins, Springer Verlag. Fifth Revised Edition, 2001

References: Satellite Geodesy by Gunter Seeber, Walter DeGruyter, New York, 2002
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Student Learning Outcomes

Upon completion of the course, the student should be able to:

1. Comprehend standards & specifications geodetic networks and datum transformation. (PO 2, 3, 4, ABET a,b,c,e, k)
2. Understand Gravity and its potential, gravity anomalies different types of heights (PO 2, 3, 4, ABET a,b,c,e, k)
3. Learn about Theory of Satellite Positioning, GPS, and use of GPS equipment to establish geodetic networks (PO 2,3,4,6,7, ABET a,b,c,d,e,f,k)
4. Understand the concepts of laser ranging, inertial positioning and VLBI and their use in Geodesy. (PO 2, 3,5, 8, ABET a,c,e,g, i,k)

Contribution of the course to meeting the requirements of Criterion 5: This is the second course in Geodesy and it partially satisfies Program Outcomes (PO) 2,3,4, 5,6,7,8.
Relationship of the course to Program Outcomes: This course partially satisfies (PO) 2,3,4, 5,6,7, & 8

Topics Covered:

1. History of Geodesy, Eratosthenes, Ptolemy, Shape and size of the earth	1
2. Importance of Geodesy and its relationship to other disciplines	1
3. Geodetic survey planning standards and accuracy	2
4. Geodetic networks and functions of NGS	1
6. Coordinate systems and transformations	1
7. Gravity and its potential	3
8. Gravity Reductions	3
9. Solution of Laplace equation	1
10. Stoke's and Vening-Meinesz Equations	1
11. Disturbance Potential and Bruns Formula	1
12. Satellite orbits Keplerian elements	3
14. Global Positioning System (GPS)	2
15. Antennas and Receivers	2
16. Biases and errors	
17. GPS survey design and its practical aspects	5
18. Observation Equations	2
19. GPS observations and positioning	6
20. Inertial Positioning system	2
21. VLBI and Laser ranging	2
22. Three Tests	3
Total	45

Required Laboratory Schedule

1. Datum Transformation
2. Baseline Observation
3. Establish a geodetic network in the campus and its vicinity
4. Real Time Kinematic Survey (RTK)

Course: SURE 465 LEGAL ASPECTS OF SURVEYING II

Credits:	3 Hours
Contacts:	3 Lecture (M,W, F; 1:00-1:50 Swan 111) per week
Course Description:	A study of the total body of law as it applies to the practice of Land Surveying. Both statute law and common law are covered. A number of court cases are studied for the purpose of defining the land surveyor's role in the judicial process and the use of legal precedent in answering the related questions of law and fact. Practical description writing and interpretation is an essential portion. Writing intensive.
Course Prerequisites:	SURE 365, Legal Aspects of Surveying I; ENGL 250, English 2. It is expected that the student have proficiency in the following areas: English composition, basic land boundary theory, history of surveying, fundamental traverse, coordinate and area calculations CAD.
Required Textbooks:	*Clark on Surveying and Boundaries, 7th Ed.*; Robillard, W.G. et al.; Lexis Law Publishing (VA); (1998); Keen, John E.; *Easements;* Land Surveyors Workshops; Spruce Pine, NC (1998); Shangraw, C.; *Class Notes SURE 465 2010.*
Reference Textbooks:	*Prentice Hall Handbook for Writers, 12th Ed.*,;Kramer, et. al.;Prentice Hall, Inc., Englewood Cliffs, NJ;(1995). *Land Surveying Law, 3d Ed. Manual of Instructions for the Survey of the Public Lands of the United States;* Bureau of Land Management, United States Department of the Interior; Washington, D. C., 2009.
Required Materials:	Some form of memory device such as a USB memory stick, external hard drive, etc.

Student Learning Outcomes

Students satisfactorily completing this course will achieve/complete/demonstrate…:

1. Acquire a working knowledge of the major statutory laws affecting the practice of surveying in the State of Michigan. (P.O. 1, 3 & 7)
2. Know how to research court cases and public documents (P.O. 1, 3 & 7).
3. Have a basic knowledge of Riparian issues in the State of Michigan. (P.O. 1, 3 & 7)
4. Be familiar with advanced concepts of the Public Land Survey Syste. (P.O. 1, 3 & &)
5. Continue to gain competence in the preparation and interpretation of legal descriptions (P.O 5).
6. Explore the fundamental concepts of easements (P.O. 1, 3 & 7)
7. Further develop effective writing skills (P.O. 5)

Course Schedule and Outline

Date	Lecture Topic	Preparation	Assignment
Week 1	**Effective writing:** Role of writing in professional/academic settings, strategies for determining appropriate document type and style, effective writing for different audiences, organization of papers for various purposes.	Lecture Notes	
Weeks 2 & 3	**Duties and liabilities of the surveyor**: The legal role of the surveyor, the American and Michigan judicial systems, professional liability, negligence, torts.	Lecture Notes Clark, Ch. 2	
Weeks 4 & 5	**Public Land Survey System:** PLSS Datum, State Plane Coordinates with the PLSS, Laying off latitude, restoration of corners.	Lecture Notes Clark, Ch.5, 9, 11, 17	
Weeks 6, 6, & 7	**Legal Descriptions:** Types, Writing and Interpreting, Simultaneous v. Sequential Conveyancing	Lecture Notes Clark, Ch. 12, 16, 20	
Weeks 8 & 9	**Riparian Issues in Michigan** Michigan Riparian Rights, Bottomland ownership, Public Rights in Michigan Waters, islands and swampland grants.	Lecture Notes Clark, Ch.23, 24, 25	
Week 10	**Easements** Creating. Functions, operational effects	Keene	Lab 8
Weeks 11 & 12	**Michigan Public Acts Affecting the Surveyor I**. Part IIB, Certified Surveys, Corner Recordation Act, Michigan Coordinate Systems, Recording Affidavits, Right of Entry, appropriate rules	Lecture Notes	
Weeks 13, 14 & 15	**Michigan Public Acts Affecting the Surveyor II** Condominium Act, Land Division Act, Natural Resources and Environmental Protection Act, State Survey and Remonumentation Act, Land Division Act, Drain Code	Lecture Notes	

Person who prepared this description and date of preparation: C. Shangraw

COURSE: CENG 220 ENGINEERING SURVEYING

Credits:	4 hours
Contacts:	2 lecture, 6 lab hours per week
Course Description:	A continuation of SURE 110. Engineering surveying theory and techniques. Subject areas include state plane coordinates; horizontal, vertical, and easement curve calculations and layout; slope staking; earthworks; introduction to GPS; water levels; and aspects of hydrographic, tunnel, and mine surveying.
Course Prerequisites:	Sure 110 Fundamentals of Surveying

Required Textbooks:	SURVEYING, Principles and Applications, 8th ed., Barry Kavanagh
Course Web Site:	MyFSU/Courses/CENG 220

Course Learning Outcomes

Students satisfactorily completing this course will achieve/complete/demonstrate:

1. Understand procedures for horizontal and vertical measurements for route surveying and engineering projects (PO 2).
2. Appreciate the requirements of good field notes (PO 2).
3. Ability to work effectively and interdependently as a team (PO 6).
4. Knowledge of how to use modern equipment and techniques for field procedures (PO 2).
5. Understand and apply the basics of mapping methods and computer assisted drafting (PO 3).
6. Develop geometry for calculations of surveying and engineering projects (PO 3).

(PO = Program Outcome)

Course: CENG 240 Engineering Statics

Credits: Three Hours

Contacts: Three Lecture, No Lab Hours per Week

Course Description: The first course in mechanics for engineers focuses on rigid bodies and, more specifically, statics. Statics is the study of rigid bodies at rest. Using vector mechanics as appropriate, the principles of mechanics and their application to the solution of engineering problems are explored.

Course Prerequisites: PHYS 241 – General Physics 1 (Can be a co-requisite)
MATH 230 – Analytical Geometry and Calculus 2

Required Textbooks: *Vector Mechanics for Engineers:Statics*, 8th edition, Beer Johnston and Eisenberg, McGraw-Hill, 2007

Required Materials: Calculator with exponential functions
Engineering Paper

Course Learning Outcomes

ts satisfactorily completing this course will have an understanding of:

11. Equilibrium as it relates to rigid body statics (PO 2,3)
12. Drawing free body diagrams for force systems and static equilibrium (PO 2,3)
13. Determining the values of section profile properties (PO 2,3
14. Calculating forces within structural members (PO 2,3)
15. Calculating the forces of friction (PO 5,7,8)

Topics Covered

1. Statics of particles
2. Equivalent force systems of rigid bodies
3. Equilibrium of rigid bodies
4. Centroids and center of gravity
5. Analysis of structures
6. Forces in beams and cables
7. Friction
8. Moments of Inertia

Computer usage: Spreadsheets

5.
7.
3.
).

Contributions of the course to meeting the requirements of Criterion 5: This is a required Civil Engineering course and as indicated in course outcomes it partially satisfies Program Outcomes (PO) 2,3

Relationship of the course to Program Outcomes: This course partially satisfies POs 2,3

Person who prepared this description and date of preparation: D. Hanna, 05/16/11

Required Laboratory Schedule

NO.	UNIT TOPIC DESCRIPTION SUMMARY	LECTURE HOURS	LAB HOURS
I.	Introduction and orientation	1	0
II.	Basic properties of fluids	1	0
III.	Overview of hydrology and hydraulics	0	2
IV.	Viscosity of fluids	1	0
V.	Pressure of fluids	2	2
VI.	Buoyancy	1	2
VII.	Fluid flow and the Bernoulli Theorem	5	2
VIII.	Pressure conduits and flow classification	6	2
IX.	Piping systems and headlosses	6	6
X.	Open channel flow and flow measurement	4	2
XI.	Pumping systems	4	1
XII.	Hydrology	4	1
XIII.	Runoff, precipitation, infiltration	3	2
XIV.	Groundwater	3	2
XV.	Frequency analysis	1	0
XVI.	Drainage systems and culverts	3	0
XVII.	Interview Report	0	0
XVIII.	Examinations	0	6
	Total Hours	45	30

Course: CENG 321 Hydraulics Engineering

Credits: Four Hours

Contacts: Three Lecture, Two Lab Hours per Week

Course Description: Combined presentation of hydraulics and hydrology. Course shall include the natural occurrence of water on the earth and the study of fluid mechanics, kinematics of fluid flow, energy and momentum relating to the movement of water. Open channel flow and pressure conduits leading to gravity drainage design and pressure water supply systems.

Course Prerequisites: PHYS 242 – General Physics 2
MATH 230 – Analytical Geometry and Calculus 2

Required Textbooks: *Applied Fluid Mechanics*, R.L.Mott, 6th Edition, Pearson/Prentice Hall

Required Materials: Calculator with exponential functions
Engineering Paper
Technical literature supplied by the Instructor

Course Learning Outcomes

Students satisfactorily completing this course will have an understanding of:

1. Fluid properties and characteristics (PO 2,3)
2. Pressure piping flow and headlosses (PO 2,3)
3. Open channel flow and flow measurement (PO 2,3
4. Hydrologic cycle, statistical development, and runoff prediction (PO 2,3)
5. Role of and interaction with Professional Civil Engineers (PO 5,7,8)

Topics Covered

1. Properties and characteristics of fluids
2. Fluid statics, pressure and buoyancy
3. Fluid flow and the Bernoulli theorem
4. Pressure flow of fluids and piping headlosses
5. Open channel flow
6. Pumping systems design
7. Hydrologic estimation of precipitation and runoff
8. Drainage system design

Computer usage: Spreadsheets, MathCad

Required Laboratory Schedule

1. Nature and properties of fluids
2. Pressure if fluids
3. Statics and buoyancy
4. Fluid Energy and the Bernoulli Theorem
5. Energy losses in closed conduits
6. Series and parallel piping systems
7. Hazen Williams equation
8. Pump selection and system curves
9. Open channel flow

10. Flow measurement
11. Hydrology and rainfall
12. Wells, groundwater, drainage

Contributions of the course to meeting the requirements of Criterion 5: This is a required Civil Engineering course and as indicated in course outcomes it partially satisfies Program Outcomes (PO) 2,3,5,7,8

Relationship of the course to Program Outcomes: This course partially satisfies Pos 2,3,5,7,8

Required Laboratory Schedule

NO.	UNIT TOPIC DESCRIPTION SUMMARY	LECTURE HOURS	LAB HOURS
I.	Introduction and orientation	1	0
II.	Basic properties of fluids	1	0
III.	Overview of hydrology and hydraulics	0	2
IV.	Viscosity of fluids	1	0
V.	Pressure of fluids	2	2
VI.	Buoyancy	1	2
VII.	Fluid flow and the Bernoulli Theorem	5	2
VIII.	Pressure conduits and flow classification	6	2
IX.	Piping systems and headlosses	6	6
X.	Open channel flow and flow measurement	4	2
XI.	Pumping systems	4	1
XII.	Hydrology	4	1
XIII.	Runoff, precipitation, infiltration	3	2
XIV.	Groundwater	3	2
XV.	Frequency analysis	1	0
XVI.	Drainage systems and culverts	3	0
XVII.	Interview Report	0	0
XVIII.	Examinations	0	6
	Total Hours	45	30

Course: CENG 485 Sustainable Land Use

Credits:	3 Hours
Contacts:	3 Lecture3 Lab Hours per Week
Course Description:	A senior capstone course including in part land use controls, land study and development design, site feasibility and utility service, site ecology, and social and psychological analysis of development. The roles and tasks of the site design professional are studied. A major design project will be undertaken. Emphasis will be on subdivision design, site design, cost analysis of development, and use of technical design software.
Course Prerequisites:	Senior Status & Surveying Students only
Required Textbooks:	City Planning for Civil Engineers, Environmental Engineers, and Surveyors, by Kurt Bauer, published by CRC Press, 2010.
References:	Land Development Handbook, 2nd edition, The Dewberry Companies, published by McGraw-Hill.
Other Material:	Additional reference materials, mandatory reading assignments, and other information provided through FerrisConnect and class handouts.

Course Learning Outcomes

Students satisfactorily completing this course will have an understanding of:

5. Acquire an understanding of land use planning, and for the procedures for designing streets, utilities, land divisions, condominiums, and subdivisions. (PO 1, 3, 4)
6. Appreciate the history of urban development and how social, political, demographics, transportation, and economic result in change. (PO 1, 7, 8)
7. Students can draw upon their diverse backgrounds in a major design project. (PO 4)
8. Know how legal restrictions, site conditions, aesthetic, environmental condition, and economic goals of sustainable developments are met. (PO 1, 3, 4)

Topics Covered:

22. History of planning and subdivision design
23. Zoning principles, master plan
24. Subdivision design principles and the Land Division Act
25. Traditional neighborhood design, PUDs, condominium law
26. Transportation systems
27. Sewage systems, drainage, grading and erosion control
28. Water supply systems
29. Social and cultural issues

Computer usage: CAD

Required Laboratory Schedule

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20. Certified survey (Act 132 drawing) (3 weeks)
21. Preliminary plat design (4 weeks)
22. Final plat (2 weeks)
23. Right to Farm Act (1 week)
24. Engineering Drawings – plan and profile, sanitary sewer design

Contribution of the course to meeting the requirements of Criterion 5: This is the capstone course in the program and as indicated above in course outcomes, it partially satisfies Program Outcomes (PO) 1, 3, 4, 7, 8.
Relationship of the course to Program Outcomes: This course partially satisfies POs 1, 3, 4, 7, 8.
Person who prepared this description and date of preparation: R. Burtch, 05/30/11

COURSE: GISC 225 PRINCIPLES OF GEOGRAPHIC INFORMATION SYSTEMS (REQUIRED)

Credits:	3 Hours
Contacts:	2 lectures, 3 Lab Hours per week
Course Description:	This course explores fundamental principles of Geographic Information Systems (GIS) and its applications including hardware and software. Topics covered include: database concepts, algorithms to manage spatial data, cost benefit analysis, GIS project management, and digital data dissemination methods using internet technologies. Students will work with database management system, raster and vector GIS applications software on various case studies including nature and environmental conservation, real estate administration, marketing and city management
Course Prerequisites:	Basic computer skills
Required Textbooks:	Tim Ormsby et al. (2008) Getting to Know ArcGIS Desktop, Second Edition, Updated for ArcGIS 9.3 Basics of ArcView, ArcEditor, ArcInfo.
Reference Text:	1. Stephen Wise (2002) GIS basics, London: Taylor & Francis (G70.212 .W57 2002). 2. Kang-Tsung Chang (2009). Introduction to Geographic Information Systems with Data Files CD-ROM, 5th ed. McGraw-Hill
Required Materials:	Some form of memory device such as a USB memory stick, external hard drive, etc.

Course Learning Outcomes

Students satisfactorily completing this course will achieve/complete/demonstrate…:

20. Understanding of the role of GIS in the various applications (surveying engineering, homeland security, environmental biology, etc.) and the GIS specialist role in the implementation and maintenance of a GIS (PO 1, 4).
21. Ability to work with GIS software to solve spatial problems (PO 2, 3).
22. Written reports and papers and orally present the research findings in a group environment (PO 5, 6).
23. Knowledge in the effects that a GIS has on society and the economic and legal ramifications that a GIS presents (PO 7, 8).

Topics Covered:

1. Introduction to GIS (1 class)
2. Computer hardware, Binary data (2 classes)
3. Database management systems, SQL - Structured Query Language(2 classes)
4. Algorithms, sequential and binary search. Bubble sort and Quick sort (2 classes)
5. Characteristics of maps: Accuracy, Scale, Coordinate Systems and projections(2 classes)
6. Spatial Data collections techniques(1 class)
7. Spatial Data , vector features(points, lines, polygons) (2 classes)
8. Raster Data (Ascii format), Raster Vs. Vector(1 classes)
9. Topology (Arc-node data model) (2 classes)
10. GIS operations and functions on vector data (line intersection, map overlay) (3 classes)
11. Legal issues in GIS (Liability, digital files as court evidence, Freedom of Information act) (2 classes)
12. Cadastre and land information systems (1 class)
13. Surfaces, Triangulation and Interpolation(2 classes)
14. Cost and benefits of a GIS project (1 class)
15. Management of GIS (Federal, State, County) (2 classes)
16. Environmental applications of GIS (2 classes)
17. Homeland security applications of GIS (1 class)

Computer usage:

Microsoft Access, GIS software (ArcGIS), AutoCAD Map, Excel, GPS

Required Laboratory Schedule

1. Microsoft Access, office management database (3 weeks)
2. Getting to know ArcGIS tutorial (6 week)
3. AutoCAD Map – CAD to GIS project (2 weeks)
4. Mapping and data compilation project (3 weeks)
5. Report writing and project presentation (1 weeks)

Contribution of the course to meeting the requirements of Criterion 5: This is the first course in the chain of Information science courses were the students utilize advanced technologies and data to analyze and solve an engineering problems. The course partially satisfies Program Outcomes (PO) 1-8.

Relationship of the course to Program Outcomes: As indicated above, this course partially satisfies Pos 1-8.

Person who prepared this description and date of preparation: Y. Felus, 2/5/10

COURSE: GISC 239 **REMOTE SENSING**

Credits:	3 Hours
Contacts:	2 Lecture, 3 Lab Hours per week
Course Description:	This course explores the fundamental principles of remote sensing as they relate to engineering and environmental problems. Topics covered include energy interactions, reflectance, scanning systems, satellite sensors, digital image process, and image classification. Students will work with image processing software.
Course Prerequisites:	PHYS 211 or PHYS 241
Required Textbooks:	**Introduction to Remote Sensing**, J. Campbell, Guilford Press.
Reference Text	1. **Remote Sensing Engineering and Design EM1110-2-2907** (2003), Us Army Corps of Engineers Washington DC. 217 pp 2. **Tutorial: Fundamentals of Remote Sensing**, Canada Centre for Remote Sensing
Required Materials:	**ERDAS IMAGINE Essentials Tour Guides**, Lab tutorial

Course Learning Outcomes

Students satisfactorily completing this course will achieve/complete/demonstrate…:

1. Know the basic principles of remote sensing and how it is utilized in mapping today
(PO 1).
2. Be able to evaluate the design necessary for an effective remote sensing data collection strategy (PO 2, 3).
3. Be able to analyze and enhance remote sensing images (PO 2, 4).
4. Prepare written reports and papers and to orally present the findings in a group environment (PO 5, 6).
5. Know the role and applicability of remotely sensed data in society such as the economic role, political role and engineering role (PO 7, 8).

Topics Covered:

1. Introduction to remote sensing (1 class)
2. Electromagnetic radiation and Atmospheric interaction (3 classes)
3. Sensors and telescopic systems (3 classes)
4. Image Interpretation and human vision (2 classes)
5. Satellite orbits (Keplers laws) (2 classes)
6. Satellite remote sensing systems(2 classes)
7. Digital analysis and image processing techniques (5 classes)
8. Image transformations (2 classes)
9. Image classification (3 classes)
10. Microwave remote sensing (1 class)
11. Thermal imaging (1 class)
12. Technologies for acquiring and processing Hyperspectral data (1 class)
13. Bathymetric mapping (1 class)
14. Remote Sensing applications (2 classes)

Computer usage:

Remote Sensing software (ERDAS 9.3), Google Earth, Matlab, GPS

Required Laboratory Schedule

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1. Erdas Essentials (8 weeks)
2. Image interpretation with Google Earth (1 week)
3. Matlab image processing (2 weeks)
4. Mapping and image processing project (3 weeks)
5. Report writing and project presentation (1 week)

Contribution of the course to meeting the requirements of Criterion 5: This is the second course in the chain of Information science courses were the students utilize advanced technologies and data to analyze and solve an engineering problems. The course partially satisfies Program Outcomes (PO) 1-8.

Relationship of the course to Program Outcomes: As indicated above, this course partially satisfies POs 1-8.

Person who prepared this description and date of preparation: Y. Felus, 2/5/10

COURSE: GISC 425 TECHNICAL ISSUES IN GEOGRAPHIC INFORMATION SYSTEMS AND CARTOGRAPHY

Credits:	3 Hours
Contacts:	2 Lecture, 3 Lab Hours per week
Course Description:	Advanced concepts of geographic information systems and modern cartography will be studied. Topics covered include: metadata, federal and state spatial databases, map generalization, map labeling, advanced spatial data analysis, Digital Elevation Model s(DEM), interpolation methods, DEM analysis such as slope, aspect, watershed, line of sight and grid operations. These topics will be linked to the data collection courses photogrammetry, remote sensing, land surveying and geodesy. Laboratory assignments will be project oriented using existing raster and vector GIS software.
Course Prerequisites:	SURE 227 – Programming Applications in Geomatics, GISC 225 - Introduction to GIS
Required Textbooks:	None
Reference Text	**Introduction to Geographic Information Systems**, Kang-Tsung Chang, McGraw-Hill Science Engineering **Data in Three Dimensions: A Guide to ArcGIS 3D Analyst**, Heather Kennedy OnWord Press
Required Materials:	None

Course Learning Outcomes

Students satisfactorily completing this course will achieve/complete/demonstrate…:

1. Understand the technical aspects of GIS and Cartography including spatial data visualization, surface analysis, and advanced algorithms (ABET Criteria 3a & 3e).
2. Work on the design and implementation of a GIS Project (ABET Criteria 3b & 3c).
3. Understand the role that GIS has in society such as technical design issues required for particular client GIS needs (ABET Criteria 3h & 3k).

Topics Covered:

1. GIS resources, Metadata and spatial data standards (2 classes)
2. Introduction to cartographic enhancement using GIS (2 classes)
3. Generalization/simplification (2 classes)
4. Map conflation, integrating diverse data sources (2 classes)
5. Label placement rules and algorithms (1 class)
6. Introduction to surface analysis (1 class)
7. Local and global interpolation strategies (3 classes)
8. Slope and aspect computation (1 class)
9. Drainage, line of sight, and viewshed analysis (2 classes)
10. Digital Elevation Model (DEM) visualization (2 classes)
11. Map algebra, decision support GIS (2 classes)
12. Raster to vector operation (2 classes)
13. Errors and quality control in GIS (3 classes)
14. Advanced GIS operations (network and pattern analysis) (3 classes)

Computer usage:

ArcGIS software (ArcGIS 9.3), AutoCad, Matlab, GPS

Required Laboratory Schedule

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1. Creating a portfolio of maps from different resources (4 weeks)
2. Using 3D analyst lab tutorials (3 weeks)
3. Matlab geographical data processing (2 weeks)
4. Working on a mapping project (3 weeks)
5. Using Laser Scanning data (1 week)
6. Converting raster to vector using AutoCAD raster design (1 weeks)
5\. Report writing and project presentation (1 week)

Contribution of the course to meeting the requirements of Criterion 5: This is the third course in the chain of Information science courses were the students utilize advanced technologies and data to analyze and solve an engineering problems. The course partially satisfies Program Outcomes (PO) 1-8.
Relationship of the course to Program Outcomes: As indicated above, this course partially satisfies Pos 1-8.
Person who prepared this description and date of preparation: Y. Felus, 2/5/10

Course: CONM 121 Materials Properties and Testing

Credits: Three Hours

Contacts: Two Lecture, Two Lab Hours per Week

Course Description: Application and properties of construction materials. The sampling, testing and application of the physical properties of aggregates and Portland cement concrete; bituminous materials, metals and wood.

Course Prerequisites: Grade of C- or better in MATH 110 or ACT placement of 19 or above

Required Textbooks: *Basic Construction Materials,* Marotta

Required Materials: Scientific Calculator
Safety glasses

Course Learning Outcomes

Students satisfactorily completing this course will have an understanding of:

1. Types and qualities of aggregates, sampling techniques, gradation, engineering properties, compliance with specifications and laboratory testing methods (PO 1)
2. Properties of Portland Cement Concrete, including engineering properties, mix design methods, mixing placing and curing of concrete, and testing of concrete (PO 1)
3. Properties of steel and other metals, including stress and strain, elasticity, behavior under load, and strength of connections (PO 1, 3)
4. Properties of wood, including terminology, products, grading and preservation (PO 1, 3)
5. Properties of hot mix asphalt, including an understanding of mix design methods, production and placement (PO 4)

Topics Covered

1. English and metric units and conversions of units.
2. Standard ASTM laboratory testing techniques
3. Origins, engineering properties, sampling and testing of aggregates.
4. Properties, types, mix designs, mixing, placing, curing and testing Portland cement concrete.
5. Properties, uses, specifications and mix design methods for asphalt concrete.
6. Properties and uses of masonry and mortar.
7. Properties, uses and testing of steel and other metals.
8. Properties and specifications of wood and wood products.

Computer usage: None

Required Laboratory Schedule

4.

13. Laboratory techniques, safety and testing procedures.
14. Aggregate sampling and sieve analysis.
15. Aggregate weight/volume and moisture relationships.
16. Aggregate quality testing.
17. Design of Portland cement concrete mixes.
18. Mixing and pouring concrete beams and test cylinders.
19. Testing Portland cement concrete specimens.
20. Mixing and testing mortar specimens.
21. Steel stress-strain calculations and graphing.
22. Determining strength of steel connections.

Contributions of the course to meeting the requirements of Criterion 5: *This is a required Civil Engineering course and as indicated in course outcomes it partially satisfies Program Outcomes (PO) 2,3,5,7,8*

Relationship of the course to Program Outcomes: *This course partially satisfies Pos 2,3,5,7,8*

COMM 121
Fundamentals of Public Speaking

Required Materials:
Textbook: O'Hair, D., Rubenstein, H., & Stewart, R. (2010). A Pocket Guide to Public Speaking (3rd ed). Bedford/St. Martin's: Boston.
Writing materials (Paper, pen, #2 pencil)
Note cards (approx. 40 – 4"x6")
Recordable Mini-DVD (1)

Course Description:
COMH 121 is a 3-credit, general education course aiming to build public communication skills. Speaking opportunities, instructor, peer, and self-evaluation, textbook reading, instructor lecture, class discussion, and class activities accomplish this goal. Informative, persuasive and special occasion speech construction, continual improvement of speech delivery, and audience adaptation are the main focus of study considering such communication elements as empathy, cultural awareness, perception, communication context, and ethics.

General Education Speech Communication Outcomes:
Students should be able to:
1. Identify and describe the components of the human communication process. *(Classroom Discussion, Mid Term Exam, Cumulative Exam)*
2. Identify and describe the literal message content and the relationship variables between communicators in interpersonal, small group or presentational contexts. *(Classroom Discussion, Mid Term Exam, Cumulative Exam, All Speeches and Outlines Informative Speech Video Self-Analysis)*
   Select, present, interpret and respond appropriately and effectively to verbal and nonverbal messages in interpersonal, small group or presentational contexts.*(Classroom Discussion, Mid Term Exam, Cumulative Exam, All Speeches, Informative Speech Video Self-Analysis)*
3. Use verbal and nonverbal messages to achieve personal, interpersonal, small group, or presentational goals, while developing and maintaining relationships with others. *(Classroom Discussion, Mid Term Exam, Cumulative Exam, All Speeches, Informative Speech Video Self-Analysis)*

Public Speaking Outcomes:
Students should be able to:
1. Choose and narrow a topic appropriately for the audience and occasion.*(Classroom Discussion, Mid Term Exam, Cumulative Exam, All Speeches, Speech Worksheets)*
2. Communicate the thesis in a manner appropriate for audience and occasion. (*Classroom Discussion, Mid Term Exam, Cumulative Exam, All Speeches, Speech Worksheets and Outlines)*
3. Provide effective supporting material based on the audience and occasion. (*Classroom Discussion, Mid Term Exam, Cumulative Exam, All Speeches, Speech Worksheets and Outlines, Library Research Instruction, Peer Speech Evaluations)*

4. Use an organizational pattern appropriate to topic, audience, occasion and purpose. *(Classroom Discussion, Mid Term Exam, Cumulative Exam, All Speeches, Speech Worksheets and Outlines, Peer Speech Evaluations)*
5. Use language that is appropriate to the audience, occasion, and purpose. *(Classroom Discussion, Mid Term Exam, Cumulative Exam, All Speeches, Speech Outlines, Informative Speech Video Self-Analysis, Peer Speech Evaluations)*
6. Use vocal variety in rate, pitch and intensity to heighten and maintain interest. *(Classroom Discussion, Mid Term Exam, Cumulative Exam, All Speeches, Informative Speech Video Self-Analysis, Articulation Exercises, Peer Speech Evaluations)*
7. Use pronunciation, grammar, and articulation appropriate to the designated audience. *(Classroom Discussion, Mid Term Exam, Cumulative Exam, All Speeches, Speech Outlines, Informative Speech Video Self-Analysis, Articulation Exercises, Peer Speech Evaluations)*
8. Use physical behaviors that support the verbal message. *(Classroom Discussion, Mid Term Exam, Cumulative Exam, All Speeches, Informative Speech Video Self-Analysis, Peer Speech Evaluations)*

Students should also:
1. Know the criteria for an effective public speech. *(Classroom Discussion, Mid Term Exam, Cumulative Exam, All Speeches, Speech Worksheets and Outlines, Peer Speech Evaluations)*
2. Know and demonstrate appropriate communication anxiety management strategies. *(Classroom Discussion, Mid Term Exam, Cumulative Exam, PRPSA Instrument, All Speeches, Informative Speech Video Self-Analysis. Peer Speech Evaluations)*
3. Know several ways to organize a public speech. *(Classroom Discussion, Mid Term Exam, Cumulative Exam, Speech Worksheets and Outlines, Informative Speech Video Self-Analysis, Informative Speech Rough Outline)*
4. Know and demonstrate appropriate and effective use of visual aids. *(Classroom Discussion, Mid Term Exam, Cumulative Exam, All Speeches, Speech Worksheets, Peer Speech Evaluations)*
5. Know and demonstrate ability to build a persuasive argument, using appropriate and effective evidence. *(Classroom Discussion, Cumulative Exam, Persuasive Speech, Speech Worksheets and Outlines, Peer Speech Evaluations)*
6. Know and demonstrate critical listening. *(Classroom Discussion, Mid Term Exam, Cumulative Exam, Peer Speech Evaluations, Informative Speech Video Self-Analysis)*

Specific Course Outcomes:
All students completing introductory Public Speaking courses will have:
1. Presented at least 3 prepared speeches, including at least one informative speech and one persuasive speech at least 4 minutes 30 seconds long.
2. Written assessed outlines for each 5 to 7 minute prepared speech.
3. At least one prepared speech will require the use of a visual aid.
4. Skills outcomes assessment will be based on standards established by the National Communication Association.

ENGL 150 - English I

1. **DESCRIPTION:** Students will organize and develop papers for diverse audiences and purposes, including how to discover and focus on a topic, develop ideas, provide support, and draft and revise papers effectively. Fundamental language skills will be covered and library research and argumentation will be introduced.

2. **PREREQUISITES:** ACT over 14 or ENGL 074.

3. **TEXTBOOK:** Varies by section.

4. **OBJECTIVES:** By the end of the course students will be able to produce both expository and argumentative papers of at least 1000 words (approximately 4 pages). Students will learn to analyze the context of the writing problem, develop ideas for their writing, and locate reliable information and resources, including library sources. Students will also learn to move from writer centered to reader centered prose, adjust writing so that it is appropriate for a particular audience and to use feedback to improve their content, style, organization, and use of standard conventions. (ABET Criteria 3g, 3h & 3i)

5. **TOPICS:** Awareness and knowledge of audience, purposes for writing, problem solving and researching, developing and organizing ideas, revising, editing, and collaborating.

6. **CLASS/LABORATORY SCHEDULE:**

	Units of Instruction	**Time Weight** Lecture Hours
a.	Prewriting and planning strategies.	4
b.	Effective organization strategies.	7
c.	Paragraphing skills.	5
d.	Mastering the conventions of written English.	12
e.	Analytic and reasoning strategies.	7
f.	Self evaluation and revision skills.	5
g.	Introduction and use of library research materials.	5
	Total	45

7. **RELATIONSHIP TO PROGRAM OBJECTIVES:** To provide broad educational experience including communication skills, mathematics, basic science preparing students for life-long learning.

8. **PREPARED BY:** N. Garrelts **DATE:** May 2011

ENGL 250 - English II

1. **DESCRIPTION:** The second of a two-course sequence, this course focuses on research. Students will learn how to use informational resources to produce a documented paper, to evaluate conflicting claims and evidence, to write an extended argument. The course will stress problem solving, reasoning skills, as well as accepted English usage appropriate to academic writing situations.

2. **PREREQUISITES:** ENGL 150 or equivalent.

3. **TEXTBOOK:** Varies by section.

4. **OBJECTIVES:** Upon completion of English 250, students should be able to analyze and define the purpose of their writing, analyze and define the needs of their intended audience, locate and document information appropriate to their writing, and choose appropriate methods of organization. Students should be able to produce effective written communication, demonstrating appropriate use of language, sentence structure, grammar, and mechanics. Students should also be able to work effectively with others to produce and/or revise written materials. (ABET Criteria 3g, 3h, and 3i)

5. **TOPICS:** Purposes for writing, knowledge of audience, problem solving, researching, documenting, organizing, editing, and collaborating.

6. **CLASS/LABORATORY SCHEDULE:**

	Units of Instruction	**Time Weight**
		Lecture Hours
a.	Analyze varieties of argument.	12
b.	Find a workable topic.	5
c.	Gather evidence.	10
d.	Work with evidence located in the library.	9
e.	Report research findings to a professional audience.	4
f.	Presentation techniques.	5
	Total	45

7. **RELATIONSHIP TO PROGRAM OBJECTIVES:** To provide broad educational experience including communication skills, mathematics, basic science preparing students for life-long learning.

8. **PREPARED BY:** N. Garrelts **DATE:** March 2011

10 FALL MATH 220-001 COURSE OUTLINE

COURSE	**Math 220-001** 8:00-8:50 AM, M-F SCI 136
INSTRUCTOR	Dr. Hengli Jiao, Office 2028 ASC, Contact: 591 – 2825, jiaoh@ferris.edu
OFFICE HOURS	10:00AM-11:00 AM MTWR and 11:00 AM- 12:00 Noon MW or by **appointment.**
TEXTBOOK	Calculus, 8th Edition, Larson, Hostetler, and Edwards, Published by Houghton Mifflin
PREREQUISITE	Math130 with a grade of C- or better or equivalent.
GENERAL OVERVIEW	Calculus is the branch of mathematics which studies quantities undergoing change. Calculus is used to study the change in the position of planets with respect to time or the change in demand for gas guzzling cars with respect to the price of gasoline. Since almost everything in the world changes, calculus has applications in every part of science and engineering. Yet, in its narrowest sense, calculus may be regarded as treating two geometric problems: computing the tangent lines to the graphs of functions and computing the area of regions bounded by the graphs of functions. The main delivery method of this course is lecturing. There are online quizzes and worksheets. You are encouraged to form a study or discussion group.
COURSE OBJECTIVES	❖ To become familiar with the major concepts and techniques of differential calculus. ❖ To be introduced to the major concepts of integral calculus. ❖ To develop skills in formulating, solving, and interpreting mathematical problems. ❖ To gain experience with applications of integral and differential calculus concepts. ❖ To learn to use a graphing calculator to explore concepts of calculus. ❖ To practice communicating mathematical ideas to others. ❖ To become a more independent learner and logical thinker.
ATTENDANCE	Students are expected to be present for all classes. Attendance will be taken. This course is a 5 credit hour course. Therefore, students should plan to spend 5 hours in class and more than 15 hours outside of class every week in order to be successful in this course. If you are absent from class, you are responsible for the material covered; arrange to copy another student's notes and be informed of any announcements made during class. Athletes who anticipate missing class due to scheduled events must notify the instructor in advance in writing. In addition, athletes should provide a copy of their performance schedule to the instructor ASAP. If you are not in the room when attendance is taken, you may assume that you have been marked absent. If you walk in late, you must see the instructor after that class to be sure that your presence is noted. Students should realize that **extreme or chronic tardiness** and **bad behavior** are not acceptable and can be expected to affect the final grade.
BEHAVIOR	Do not interrupt the class unless you have a special reason and inform the instructor in advance. The following behaviors are **absolutely not tolerated**: ❖ Talking while the instructor is lecturing. ❖ Using phone in class. When you walk into the class your phone should be **turned off**. ❖ Regularly walking out and in the classroom while class is in session. ❖ Leaving class early without approval from the instructor in advance.
EVALUATION	Grades in the course are based on four tests, quizzes, and worksheets if any. The following grading scale can be used to estimate grades for individual quizzes and exams; however, course grades will be determined from a curve based on point totals, attendance, improvement, effort, attitude, and so on. No make-up exam will be given unless you have a reasonable excuse. No early or late make-up quiz and worksheet will be given for **any reason**. Late assignments will not be accepted. **If you miss one of the four exams, you will be automatically assigned an "F" grade unless you are excused and make it up later.**

10 FALL MATH 220-001 COURSE OUTLINE

	Tests 1-3 100 points each Test 4 150 points Quizzes (in class or online) 10 points each. **Grading Scales** A = 90%-100% A- =87%-89% B+ = 84%-86% B = 81%-83% B- =78%-80% C+ =75%-77% C = 72%-74% C- = 69%-71% D+= 66%-68% D = 63%-65% D- = 60%-62% F=under 60%
CONTENT AND PROBLEMS	The following are sections of chapters we will cover. The problems in each section are for your own practice only. Remember the exam problems are similar to these problems, so practicing more problems will definitely help you get better grade. ***DO THE PROBLEMS***
CHAPTER 1 **Limits and Their Properties**	**1.1 A Preview of Calculus:** 1-11 **1.2 Finding Limits Graphically and Numerically:** 1-26, 59, 60, 63-67 **1.3 Evaluating Limits Analytically:** 1-88, 113-118 **1.4 Continuity and One-Sided Limits:** 1-72, 83-86, 91-94 **1.5 Infinite Limits:** 1-48, 67-70, **Review :** 5-6, 11-49, 51-68, 70
CHAPTER 2 **Differentiations**	**2.1 The Derivative and the Tangent Line Problem:** 1-59,71-86, 91-96, 99-103 **TEST ONE** **2.2 Basic Differentiation Rules and Rates of Change:** 1-66, 73-77, 83-88, 93, 109 - 114 **2.3 The Product and Quotient Rules and Higher-Order Derivatives:** 1-83, 93-102 **2.4 The Chain Rule:** 1-74, 81-100, 111, 112, 120-122 **2.5 Implicit Differentiation:** 1-58 **2.6 Related Rate:** 1-46 **Review Exercise:** 1-39, 41-82, 101-112 **TEST TWO**
CHAPTER 3 **Applications of Differentiation**	**3.1 Extrema on an Interval:** 1-44, 53-58, 60-61, 63-68 **3.2 Rolle's Theorem and the Mean Value Theorem:** 1-36, 39-50, 53-61, 65-85 **3.3 Increasing and Decreasing Functions and the First Derivative Test:** 1-46, 55-72, 95-105 **3.4 Concavity and the Second Derivative Test:** 1-56, 61-63, 76-84 **3.5 Limits at Infinity:** 1-8, 15-34, 39-46, 51-72, 105-106 **3.6 A Summary of Curve Sketching:** 1-34, 47-54, 67-72 **3.7 Optimization Problems:** 3-16, 19-30, 33-36, 39-42, 43-45, 54 **3.8 Differentials:** 1-35, 43-48, 55-58 **Review Exercise:**2-20, 23-28, 33-44, 49-76, 85, 86 **TEST THREE**
CHAPTER 4 **Integration**	**4.1 Antiderivatives and Indefinite Integration:** 1-48, 55-62, 67-74, 79-83, 87-96 **4.2 Area:** 1-62 **4.3 Reimann Sums and Definite Integrals:** 1-58, 63-72, 75, 77 **4.4 The Fundamental Theorem of Calculus:** 5-50, 53-63, 67-73, 75-91, 101-106 **4.5 Integration by Substitution:** 1-38, 43-92, 99-110, 122-134 **4.6 Numerical Integration:**1-33 odd, **Review Exercise:**1-10, 13-88

10 FALL MATH 220-001 COURSE OUTLINE

CHAPTER 5 Logarithmic, Exponential, and Other Transcendental Functions	**5.1 The Natural Logarithmic Function: Differentiation:** 3-34, 39-88, 93-98 **5.2 The Natural Logarithmic Function: Integration:** 1-42, 47-54, 61-64, 67-74, 83-90, 97-102 **5.3 Inverse Functions:** 1-16, 23-44, 47-52, 63-66, 71-90, 95-109 **5.4 Exponential Functions: Differentiation and Integration:** 1-18, 21-28, 33-72, 85-110, 113-116, **5.5 Bases Other Than e and Applications:** 1-30, 35-72, 81-90, 101-106
CHAPTER 6 Differential Equations	**6.1 Slope Fields and Euler's Method:** 1-77, 85-88 **6.2 Differential Equations Growth and Decay:** 1-60, **6.3 Separation of Variables and the Logistic Equation:** 1-58, 67-70, 75-78, 85-88 **TEST FOUR**
STUDY STRATEGIES	❖ Attend all classes and come prepared. Have your homework completed. Bring the text, paper, pen or pencil, and a calculator (scientific or graphing) to each class. ❖ Read the section in the text that is to be covered before class. Make notes about any questions that you have and, if they are not answered during the lecture, ask them at the appropriate time. ❖ Participate in class. As mentioned above, **ask questions**. Also, do not be afraid to answer questions. ❖ Take notes on all definitions, concepts, rules, formulas and examples. After class, read your notes and fill in any gaps, or make notations of any questions that you have. ❖ **DO THE PROBLEMS!!!** You learn mathematics by doing it yourself. Allow at least two hours outside of each class for problems. Remember the methods of solving problems are more important than just getting correct answers. Do not fall behind. ❖ Seek help when needed. Visit your instructor during office hours and come prepared with specific questions; check with school's tutoring service; find a study partner in class; check additional books in the library for more examples if necessary - just do something before the problem becomes insurmountable. ❖ Do not cram for exams. Each chapter in the text contains a chapter review and this study guide contains a practice test at the end of each chapter. (The answers are at the back of the study guide). Work these problems many days before the exam and review any areas of weakness.
EXAM DATES	**1st test: 2nd test: 3rd test: 4th test:** 8-9:40 am, Thur., Dec. 16
REMARK	**The instructor reserves the right to make reasonable changes for the above descriptions.**

INSTRUCTOR'S SCHEDULE

	Monday	Tuesday	Wednesday	Thursday	Friday
8:00-9:00	Math 220-001 Science 136	Math 220-001 Science 136	Math 220-001 Science 136	Math 220-001 Science 136	Math 220-001 Science 136
9:00-10:00	Math 130-001 Science 136	Math 130-001 Science 136	Math 130-001 Science 136	Math 130-001 Science 136	
10:00-11:00	Office Hour	Office Hour	Office Hour	Office Hour	
11:00-12:00	Office Hour	Meeting	Office Hour	Meeting	
12:00-1:00	Independent Study	Independent Study	Independent Study	Independent Study	Independent Study
1:00-2:00					Project Meeting

3

Math 230 – Fall, 2010

Course Information: Math 230 Analytical Geometry and Calculus 2, Section 1, 5 credits
Prerequisites: Math 220
Spring, 2010
Monday - Friday: 9:00 am – 9:50 am STR 236

Robert McCullough
ASC 2042

Office Hours: M 8:30 am – 9:00 am; 12:30 pm – 1:00 pm
T 9:00 am – 9:30 am
W 8:30 am – 9:00 am; 12:30 pm – 1:00 pm
Th 9:00 am – 9:30 am
F 8:30 am – 9:00 am; 12:30 pm – 1:00 pm
Other times by appointment

Phone: 591-5876 (office)
796-3986 (home)

Required Textbooks and Materials: Calculus by Larson, Hostetler and Edwards
Houghton Mifflin, 8th edition

Course Outcomes: At the end of this course, students should be able to:

1. compute derivatives and integrals for common transcendental functions, and analyze their graphs.

2. find indefinite and improper integrals using different integration techniques and apply L'Hopital's rule for indeterminate forms.

3. use various tests to determine series convergence, perform standard operations with convergent power series, and find Taylor series representations.

4. employ techniques from analytic geometry and calculus to work with parametric equations.

5. graph the classic conic sections.

6. convert between polar and rectangular coordinates and graph polar equations.

7. apply the methods from this course to real-world applications they may encounter in the future.

Course Description: This is the second of a three-semester sequence in analytical geometry and calculus. Topics include: applications of integration, integration techniques, infinite series, conic sections, parametric equations and polar coordinates.

Policies: Attendance is optional, will only be used to help determine extreme borderline grades. If you come to class, please try to get to class on time and stay for the entire class. You are responsible for finding out what goes on in class if you are absent, including any changes in test dates.

Unless you are on emergency call, please turn off all cell phones, pagers, etc. while in class.

Grades: 5 tests - 100 points each
1 final - 100 points
The lowest of these six scores will be dropped and the average computed using the remaining five scores. Make up tests will only be given for valid, verifiable reasons. Notification must be received before test is given. Otherwise, the missed test becomes the score that is dropped. ***Be prepared to show your ID when taking tests.***

Grading scale:

100.0 - 92.5	A
92.4 - 90.0	A-
89.9 - 87.5	B+
87.4 - 82.5	B
82.4 - 80.0	B-
79.9 - 77.5	C+
77.4 - 72.5	C
72.4 - 70.0	C-
69.9 - 67.5	D+
67.4 - 62.5	D
62.4 - 60.0	D-
59.9 - 0.0	F

Calculators: A simple scientific calculator may prove useful in this course. No graphing or programmable calculators are allowed.

Course Requirements: Your grade is determined totally be your performance on the tests.

Course Calendar: see attached outline

Optional Information: See enclosed Syllabus Attachment for other policies dealing with incompletes, academic misconduct, etc.

Math 230 – Fall, 2010

Date		Topic	Assignment (odd problems only)	
M	8/30	Calc 1 review	in class	
T	8/31	5.6	p. 377	1-17
W	9/ 1	5.6	p. 378	41-55
Th	9/ 2	5.7	p. 385	1-19
F	9/ 3	5.7	p. 390	21-37
T	9/ 7	7.1	p. 452	1-9
W	9/ 8	7.1	p. 452	17-29
Th	9/ 9	7.2	pp. 463-464	1-27
F	9/10	7.2	pp. 463-464	1-27
M	9/13	7.3	p. 472	1-23
T	9/14	7.3	p. 472	1-23
W	9/15	7.3	p. 472	1-23
Th	9/16	Review	-	
F	9/17	Test 1	-	
M	9/20	7.4	p. 483	1-7, 15-23 (a, b only)
T	9/21	7.4	pp. 484-485	39-43, 45 (set up only)
W	9/22	7.5	p. 493	1-15
Th	9/23	7.6	p. 504	1-11
F	9/24	7.6	p. 504	13-27
M	9/27	8.1	p. 522	1-43
T	9/28	8.1	p. 522	1-39
W	9/29	8.2	p. 531	1-21, 25-35
Th	9/30	8.2	p. 531	1-21, 25-35
F	10/ 1	8.3	p. 540	5-17
M	10/ 4	8.3	pp. 540-541	25-41, 55-63
T	10/ 5	Review	-	
W	10/ 6	Test 2	-	
Th	10/ 7	8.4	p. 549	1-37
F	10/ 8	8.4	p. 549	1-37
M	10/11	8.5	p. 559	1-17
T	10/12	8.5	p. 559	21-27
W	10/13	8.6	p. 565	1-23
Th	10/14	8.7	p. 574	5-35
F	10/15	8.7	p. 574	37-53
M	10/18	8.8	p. 585	5-45
T	10/19	8.8	p. 585	5-45
W	10/20	9.1	pp. 602-603	1-41, 69-81
Th	10/21	9.1	pp. 602-603	1-41, 69-81
F	10/22	9.2	pp. 612-613	1-65

MATH 322.001 (Linear Algebra)
3 credits, fall 2010
MWF 8:00-8:50 a.m. STR 223

Professor Kent Sun, Ph.D.
Office ASC 2031 & PUT 100D

Phone: 591-2579, Fax: 591-2627
Email: kentsun@ferris.edu

Course Description

An introduction to the theory of vector spaces with emphasis on matrix algebra. Topics included are linear transformation, independence, rank, and inverses. This is a mixed-delivery course.

Course Material and Test Schedule

Chapter 1 Linear Equations and Matrices
- 1.1 Linear Systems
- 1.2 Matrices
- 1.3 Dot Product and Matrix Multiplication
- 1.4 Properties of Matrix Operations
- 1.5 Matrix Transformations
- 1.6 Solutions of Linear Systems of Equations
- 1.7 The Inverse of a Matrix

(Exam I)

Chapter 3 Determinants
- 3.1 Definition and Properties
- 3.2 Cofactor Expansion and Applications
- 3.3 Determinants from a Computational Point of View

Chapter 4 Vectors in R^n
- 4.2 n-vectors
- 4.3 Linear Transformations

(Cumulative exam II containing material up to and including chapter 4)

Chapter 6 Real Vector Spaces
- 6.1 Vector Spaces
- 6.2 Subspaces
- 6.3 Linear Independence

(Cumulative exam III containing material up to and including section 6.3)

- 6.4 Basis and Dimension
- 6.5 Homogeneous Systems
- 6.6 The Rank of a Matrix and Applications
- 6.8 Orthonormal Bases in R^n (If time permits)

Chapter 8 Eigenvalues, Eigenvectors, and Diagonalization
- 8.1 Eigenvalues and Eigenvectors
- 8.2 Diagonalization (If time permits)

(A cumulative final exam is scheduled for Wed., December 15th from 8-9:40 a.m.)

Course Objective

To learn the basics concepts in Linear algebra.

Learning Outcomes

1) Matrix Operations: Students will be able to perform elementary arithmetic with matrices, including matrix multiplication, and list the basic properties of these matrix operations.
2) Solving Systems of Linear Equations with Matrices: Students will be able to determine when a system of linear equations is consistent and be able to compute the solution to the system.
3) Inverse Matrices: Students will be able to calculate the inverse of any invertible square matrix.

4) Determinants: Students will be able to demonstrate the connection between determinants and invertible matrices.
5) Evaluating Determinants: Students will be able to evaluate a given determinant by co-factor expansion along any of its rows or columns.
6) Cramer's Rule: Students will be able to solve a system of linear equations, which is amenable to such analysis, by the use of Cramer's Rule.
7) Vectors: Students will be able to perform basic operations on vectors in real n-space, where n is any positive integer.
8) Vector Space: Students will be able to define and explain in detail a vector space as well as its many associated concepts including subspaces, spanning sets, linearly independent sets, bases, dimension, and linear transformations; and to prove elementary theorems involving such concepts.
9) Eigenvalues & Eigenvectors: Students will demonstrate the ability to work with the basic definitions and theorems involving eigenvalues, eigenvectors, and diagonalization (optional).

Prerequisite

C- or better in Math 220 or its equivalent

Textbooks

Required: <u>Introductory Linear Algebra: An Applied First Course</u>, 8th edition, Kolman and Hill; Pearson, Prentice Hall.

You are responsible for reading the textbook and doing the HW problems. In particular, pay close attention to the examples in the textbook. If you have questions about these examples then ask for help.

Office Hours

Monday, Wednesday 9 – 11 a.m. (ASC 2031)
and ~~12:00-3:30 p.m.~~ (Honor Students only, PUT 100D)
11:15 to 2:45 pm.

You may also make an appointment to see me. But please be aware that if you make an appointment to see me outside of my normal office hours and do not show up without canceling ahead of time then afterwards I will only consent to see you during my normal office hours or if I am in my office and not busy.

If more than one student shows up during an office hour then I will take turns answering questions. Therefore, do not wait for me outside my office door if I am with a student but make your presence known. If I need to speak with a student on a one-to-one basis because of a sensitive issue such as grades or advising then I will let you know.

Grading Policy

The course consists of approximately 500 points
Homework is worth 3 points each
(The 3 lowest HW grades are dropped)
Three cumulative exams worth 100 points each
The cumulative final exam worth 150 points

If your answer is wrong, partial credit may be given if correct intermediate steps are shown. However, <u>if your answer is right but the intermediate steps are wrong or nonexistent, full credit and perhaps even partial credit may not be given</u>.

Course Grades

93% to 100%	= A	78% to 80%	= B-	61% to 64%	= D+
87% to 92%	= A-	74% to 77%	= C+	58% to 60%	= D
84% to 86%	= B+	71% to 73%	= C	55% to 57%	= D-
81% to 83%	= B	65% to 70%	= C-	54% and below	= F

HW For Math 322 (Linear Algebra)
Introductory Linear Algebra: An Applied First Course (8th Edition) by Kolman and Hill

"ru" means read and understand. You do not hand in the ru problems.

HW #	Section	Page	HW	Due Date
Chapter 1 Linear Equations and Matrices				
1)	1.1	8	1-17odd, 18, 19, 23, 25, 27, T.4	
2)	1.2	19	1-10, T.1, 3, 7, ru T.2, 5, 6	
3)	1.3	34	1-9odd,10,11,15,19-27odd, 28,31,33,T.1,2,7,ru T.4-6	
4)	1.4	49	2-8,10-13,15, T.6,12ab,18,23a,26,27, ru T.24,29,30	
5)	1.6	85	1-9, 17, 19, 21, 27, 29, 41, 43, 47, T.11,12	
6)	1.7	105	1-13odd, 18, 22-26, T.1,8	
Chapter 3 Determinants				
7)	3.1	192	5,6,9,11,13,15-17,19,22,23, T.3,5-10,14,16	
8)	3.2	207	2-6,15-23odd,T.1,10	
Chapter 4 Vectors in R^n				
9)	4.2	244	1-4,6,7,11-21odd,23-27,29,31,34, T.5,6,9,10,13	
10)	4.3	255	1-4,13,14,17-22,25-30, T.3,4,8-11	
Chapter 6 Real Vector Spaces				
11)	6.1	278	1-4,11-19, T.1,3-5	
12)	6.2	287	1-10,14,16-20,25-27, T.3,6,7	
13)	6.3	301	1,2,4,7,10-13,15, T.1,4,5	
14)	6.4	314	1-4,7-21odd,23-25,28,29	
15)	6.5	327	1ab,2ab,3-13,T.1	
16)	6.6	337	1-17odd,18,21-35odd	
17)	6.8	349	1,2,3-9odd,15,19-21, T.6	
Chapter 8 Eigenvalues, Eigenvectors, and Diagonalization				
18)	8.1	420	1-11odd,14,15	

I reserve the right to make needed and appropriate adjustments in this syllabus.

Appendix B – Faculty Vitae

1. **Name:** Robert Burtch

2. **Education:** MS in Geodetic Science, The Ohio State University, 1983

3. **Academic experience:**
   Ferris State University (1979-present) - Professor (1992), Department Chair (2003-2004), full time

4. **Non-academic experience:** None (all more than 30 years ago)

5. **Certifications or professional registrations:**
   Professional Surveyor Michigan, Certified Photogrammetrist ASPRS

6. **Current membership in professional organizations:**
   ASPRS, ASCE, ION, MSPS, Remote Sensing and Photogrammetric Society (London), ACSM, URISA

7. **Honors and awards:** None

8. **Service activities:**
   College of Engineering Technology Curriculum Committee (2009-2011)

9. **Publications and presentations:**
   Felus, Y.A. and R.C. Burtch, 2009. "On symmetrical three-dimensional datum conversion", GPS Solutions, 13:65-74.

10. **Professional development activities:**
    Attended MSPS Annual Conference (yearly), Mobile Mapping webinar through ASPRS (April 2011)

1. **Name**: Sayed R. Hashimi, PS

2. **Education:** M.S. Geodesy, Purdue University, 1975
   B.S. Computer Information System, Ferris State University, 1984
   B.T. Civil Technology (Surveying Option) Oregon Institute of Technology, 1972
   Associate of Engineering in Surveying Engineering Technology, Oregon Institute of Technology, 1968
   Additionally, have taken two undergraduate and one graduate courses in computer science at Central Michigan University

3. **Academic experience**: Ferris State University, Big Rapids, Michigan
   Sept. 1975 - one year appointment - Rank Technical Instructor
   Sept. 1977 - Reappointment as Technical Instructor
   Sept. 1978 - Promotion to Assistant Professor
   June 1984 - Promotion to Associate Professor
   Jan. 1987 to June 1994, July 1,1995 to January 1997- Program Director, Surveying Engineering, 75% administration, 25% teaching
   August 2000 to August 2004, Teaching 100%
   August 2004 to August 2009, Surveying Engineering Department Chair, 75% release, 25% teaching
   August 2009 to Present, Surveying Engineering Program Coordinator, 25% release, 75% teaching

4. **Non-academic experience:**
   March 1995 to June 25, 1995, Associate/Consultant - McNeely and Lincoln, Assoc., Inc., Novi, MI
   September 1994 to February 1995, President - METCO Land S.E.A. Corp., Clawson, MI
   May 1978 to September 1978, Consulting - Gilbert/Commonwealth Assoc., Inc., Jackson, MI
   June 1976 to August 1977, Field Project Coordinator - Gilbert/Commonwealth Assoc., Inc., Jackson, Michigan
   September 1972 to August 1974, Survey Party Chief - Clarence Blair Associates, New Haven, CT
   September 1969 to September 1970, and March1971 to September 1971, Assistant Survey Party Chief, Clarence Blair Associates, New Haven, CT
   September 1968 – August 1969, Survey Party Chief – Cadastral Survey, Kabul, Afghanistan

5. **Certifications or professional registrations:** Licensed Professional Surveyor, Michigan 1979, #26456

6. **Current membership in professional organizations:**
   American Association of Geodetic Surveyors – AAGS
   Michigan Society of Professional Surveyors – MSPS
   American Society of Civil Engineers - ASCE

7. **Honors and awards:**
   Certificate of Appreciation by the National Council of Examiners for Engineering and Surveying (NCEES) as a consultant on the Committee on Examinations since 1993

Recipient of the NSF $50,000 Instrumentation and Laboratory Improvement (ILI) grant, May, 1989
Appointed by Michigan Governor John Engler to serve on the Board of Licensing for Professional Surveyors, September, 1991
Recipient of a two-year tuition and fee paid scholarship by the U.S. Agency for International Development to attend Oregon Institute of Technology, formerly known as Oregon Technical Institute, September 1966 to September 1968
Graduated second (in a class of 105) from Cadastral Survey High School, March 1966

8. **Service activities (within and outside of the institution) within the last five years:**
Within: Student Judicial Services Committee, three years
COT Assessment/accreditation Committee (two years)
COT Promotions Committee (two years)
COT Sabbatical Leave Committee (two years)

Outside: National Council of Examiners for Engineering and Surveying (NCEES) Subject Matter Expert, Committee on Examination for Land Surveyors, 1993-present, ASCE's ASCE's Geomatics Division, Education Committee, two years
K-12 Charter School Board Vice President – two years, currently serving as Board Treasurer
Macomb Community College Surveying Program Advisory Committee, three years

9. **Publications and presentations from the past five years:**
Presented a paper on "Computer Programming Language Options In Undergraduate Surveying Programs" at the North American Surveying Educators Conference on July 9, 2009, Johnson City, Tennessee
Presented a one-day workshop on Least Squares and Relative Positional Accuracy at the ACSM Annual Convention in St. Louis, MO, on March 10, 2007
Presented a one-day workshop on Relative Positional Accuracy in Lafayette, IN, 11/16/06
Presented a one-day workshop on Relative Positional Accuracy in Angola, IN, 10/19/06

10. **Most recent professional development activities:**
NCEES24 hours CPC (Continuing Prof. Competency), 01/13-15/2011, Clemson, SC
One day workshop on Graphics User Interface in MATLAB, Feb. 2010, Livonia, MI
Attended the American Congress on Surveying and mapping Conference, April 24-28, 2010, Phoenix, AZ
Carlson Surveying Software Workshop, 8/19-20/09, Big Rapids, MI
North American Surveying Educators Conference, 7/8-10/2009, Johnson City, TN
NCEES16 hours CPC (Continuing Prof. Competency), 01/18-19/09, Clemson, SC
NCEES16 hours CPC (Continuing Prof. Competency), 01/19/08, Clemson, SC
Two-day training on Ferris Connect, 01/10/08, Ferris State University
NCEES16 hours CPC (Continuing Prof. Competency), 01/13/07
NCEES16 hours CPC (Continuing Prof. Competency), 06/24/06, Clemson, SC
NCEES16 hours CPC (Continuing Prof. Competency), 01/28/06, Clemson, SC
MATLAB - Fundamentals of Programming Techniques, 06/19/06, two days, Washington, D.C.

1. **Name:** Carl F. Shangraw, PS, CFedS

2. **Degree:** Master of Science, Surveying Engineering, Purdue University, 1993

3. **Academic experience:**
   Ferris State University, Big Rapids, Michigan
   Date of Hire: August 1995, Assistant Professor
   Promotion: August 2001, Associate Professor
   Promotion: August 2006, Professor

4. **Non-academic experience:**
   MDOT, Statewide GPS Survey Leader, 1993-1995
   Moore and Bruggink, Inc.; Director, Survey Department; 1989-1991
   Carl F. Shangraw Land Surveyor; Owner; 1986 – 1989
   Michigan National Guard; Training Officer; 1984-1986
   Moore and Bruggink, Inc.; Professional Surveyor; 1976-1984

5. **Certifications or professional registrations:**
   Professional Surveyor, State of Michigan, 1978 to Present
   Land Surveyor, State of Wisconsin, 1983 to Present
   Certified Federal Surveyor, U.S. Department of the Interior, Bureau of Land Management, 2007 to Present

6. **Current membership in professional organizations:**
   Michigan Society of Professional Surveyors, Wisconsin Society of Land Surveyors, American Society of Engineering Educators, Society of American Military Engineers

7. **Honors and awards:** N/A

8. **Service activities (within and outside of the institution):**

   Within the Institution (current unless otherwise noted):
   Founder and Faculty Advisor, Mary Feindt Chapter of Lambda Sigma
   Faculty Advisor, Burt and Mullett Chapter of ACSM
   Member, College of Engineering Technology Promotion Committee
   Member, College of Engineering Technology Assessment and Accreditation Committee
   Member, College of Engineering Technology Scholarship Committee
   Surveying Engineering Program Scholarship Coordinator
   American Democracy Project (2004-2008)

Outside the Institution:
State of Michigan Professional Surveyors Licensing Board
Original gubernatorial appointment 2002-2006, reappointed 2006-2010
Served as chair from March of 2004 to March of 2010

NCEES Engineering Faculty Licensing Task Force (2008-2010)

Grand Traverse Land Conservancy, Traverse City Michigan: As a class project, currently reviewing legal descriptions on $100 million worth of real estate.

Disability Advocates of Kent County: Organizing student teams to compete in annual Walk and Roll fund raiser.

9. Most important publications and presentations from the past five years:

Carl F. Shangraw, et.al,; *Michigan Law Project*; Presentation made to the Michigan Society of Professional Surveyors; Lansing, Michigan; February, 2010

Yaron Felus and Carl Shangraw; *Mapping Handicapped Accessibility Facilities at Ferris State University*; Presentation made at ESRI Summit, Redlands, CA, 2007

Carl F. Shangraw; *The Global Positioning System*; Presentation given as part of the Certified Surveyor Technician Program; Ferris State University, 2007

Carl F. Shangraw; *Basic Astronomy*; Presentation given as part of the Certified Surveyor Technician Program; Ferris State University, 2007

Greenview v. Pettis; 2009 Mich. App. Lexis 560; Provided expert witness testimony in a boundary dispute on behalf of plaintiffs. Plaintiffs won.

10. Briefly list the most recent professional development activities:
Michigan Society of Professional Surveyors Annual Conferences (2005 through 2011)
Wisconsin Society of Land Surveyors Annual Conference (2011)
National Council of Examiners for Engineers and Surveyors (NCEES)
Annual Conference (2005, 2007, 2009); Board Chairs Assembly (2005, 2007)
CFedS Training Program (2007)
Continuing CFedS Education: *Discrepancies in the Official Record* (2010); *Non-Rectangular Surveys* (2010); *Swamp Land Grants, Omitted Areas and Island Surveys* (2010); *Special Boundary Problems* (2009).

1. **Name:** Khagendra Thapa

2. **Education:**
   Ph.D. in Geodetic Science and Surveying, The Ohio State University, September 1982 - June 1987.
   Master of Science in Geodetic Science and Surveying, The Ohio State University, Sept. 1982 - December 1985.
   Master of Science in Engineering (M.SC.E.), Surveying Engineering, University of New Brunswick, New Brunswick Canada. September, 1978 - May 1980.
   Bachelor of Science (Honors Degree) CNAA, Land Surveying Sciences University of East London, London, England, September, 1975 - July 1978.
   Master of Science in Statistics (incomplete, attended two semesters) Tribhuvan University, Kathmandu, Nepal, July, 1973 - July 1975.
   Bachelor of Science (Physics, Mathematics and Statistics), Tri-Chandra College, Kathmandu, Nepal, June 1971 - June, 1973.

3. **Academic experience:**
   Currently PROFESSOR, Surveying Engineering Dept., Ferris State University
   Professor and Dept. Chair, Surveying Engineering Department, 9/98 to 12/2000
   LECTURER, Institute of Engineering, Tribhuvan University, Kathmandu, Nepal, 9/ 1980 – 9/1982.
   LECTURER, First Regional Training Course for Hydrology Technicians, Sponsored by HM Government of Nepal, UNESCO, and World Meteorological Organization. November 1981 - August 1982.
   RESEARCH AND TEACHING ASSISTANT, Department of Surveying Engineering, University of New Brunswick, September 1978 - May 1980.

4. **Non-academic experience:**
   Worked for Center for Mapping of the Ohio State University for the US Geological Survey Project as a consultant, July-August, 1990
   Worked for Digital Mapping Project, Department of Geodetic Science and Surveying, Ohio State University, 7/8, 1988
   SUPERVISOR - MAPPING LABORATORY, Department of Geodetic Science and Surveying, Ohio State University 1987
   WORKED PART TIME for TAEC Consult P. Ltd. as a consultant, October 1980 - August 1982. Also field work for (5) water supply projects and (1) paper factory
   Geodetic Survey of Canada, Dept. of Energy Mines and Resources, Ottawa Canada July –September, 1980

5. **Certifications or professional registrations**: None

6. **Current membership in professional organizations:**
   American Association of Geodetic Surveyors
   American Congress on Surveying and Mapping selected as Fellow of ACSM-9/2000

Institute of Navigation
American Society for Engineering Education

7. **Honors and awards:**
FSU Distinguished Teacher Award 2008
Received Ralph Moore Berry Education Award from Michigan Society of Professional Surveyors, February, 2008
Received Certificate of Appreciation from the US Dept. of Labor May, 2008
Outstanding Service Award by Association of Nepalese in Midwest America May, 2003
FSU Distinguished Teacher Award Finalist, 2002
Education Outreach Award from IMAGIN, 2002
Ferris State University, Provost Award for Excellence**,** 1997
Distinguished Faculty Award from Michigan Association of Governing Boards (MAGB) For Extraordinary Contributions to Michigan Higher Education, Lansing, MI. 1996
Certificate of Recognition by the Board of Control of Ferris State University, January, 1995 and March, 1996
Construction Department "Spark Plug Award" given by the Dean of the College of Engineering Technology in 1989
Certificate of Commendation given by the National Society for Professional Surveyors

8. **Service activities (within and outside of the institution)**
Chair of the Distinguished Teacher Selection Committee 2009/10
Member of the Distinguished Teacher Selection Committee 2008/09
College of Engineering Technology, Sabbatical Committee, 2008/09
Served as Vice President of the Executive Committee of Senate for 07/08
Served as Vice President of the Executive Committee of Senate for 06/07
Served as Chair of the All University Sabbatical Committee for 06/07
Served as a member of the student life committee 04/06
Commissioner of ABET 2008-11, Evaluator of ABET since 1997

9. **Most important publications and presentations from the past five years**:
Thapa, K. (2007) Proceedings: Twenty First North American Surveying and Mapping Educators Conference, Big Rapids, MI. (editor)

10. **Most recent professional development activities:**
ABET workshop on assessment, Tampa, FL, FEBRUARY, 2011.
Completed FERRIS-CONNECT TRAINNING (for online teaching) which was held on Nov. 27, 29 and Dec, 4 and 6 2007
Four days Long Training on TDS software in December 12- 16, 2006
Week long training on MATLAB in July 2006 in Detroit
One day Training on Trimble Geomatics Office new GPS software at Ferris in August, 2005

Appendix C – Equipment

Please list the major pieces of equipment used by the program in support of instruction.

Equipment Inventory

Complete list of surveying equipment used and maintained by the

Surveying Engineering Department as of May 6, 2011.

EQUIPMENT	QTY	NOTES
Robotic Total Stations	6	Leica TCRP1203+ with CS controller. Consignment.
Robotic Total Stations	4	Trimble S6 Series. Consignment.
GPS with data collector	6	Leica Viva GS10/15. Consignment.
GPS with remote data collector	5	Trimble. Consignment.
Traverse Kits	10	Kit includes following Leica equipment: Case, 2 Carriers, 2 Tribrachs, 2 Prisms
THEODOLITES		
Digital Theodolites	10	Leica T107
Digital Theodolites	2	Leica Builder T100
DKM 1	1	Kern
DKM 2	1	Kern
K+E	1	K&E 20 sec
NT-2s	5	Nikon Mark III Series 360 degrees
T1	1	Wild Degree
T2	7	Wild Old Stlye Degree
T3	6	Wild
T16	5	Wild 3rd Order/20 second
TM-20c	2	Lietz
Vernier Theodolite	1	Dietzgen
Micrometered Theodolite	1	Dietzgen (broken)
Compass	1	Sperti Astro Mark II
Sun Compass	1	Brunson Inst. Co. Universal 0 degree to 90 degree N&S Latitudes
Chronograph	1	
Chronograph Sidereal	1	clock
compass (hand)	1	for plane table
compass engineering	1	
Gunther Chain	1	66 ft.
Geodimeter	1	AGA Model 4B NASM-4B
Electric Distance Meter	1	
Transits	13	K&E, David White Co., Teledyne Gurley
LEVELS		
DNA10	6	Leica Digital Levels
NA730	11	Leica Automatic Levels

Rugby 100	1	Leica
NA2	4	Wild Automatic Level
N3	1	Wild Level
N10	2	Wild
NE-20H	1	Nikon
GK1-A	1	Kern
Ni-2	3	Zeiss
Inverted Image	1	Kern
Dumpy Levels	12	K&E, Gurley, Dietzgen, Teledyne Gurley, Gurley, Buff & Buff
Magnetic Locators	6	Schonstedt model GA 72cd
Prism right angle	1	in black case
Prism reuloff	9	2 of them in black case, 1 in wood box
Prism adaptor	9	4 silver, 5 black
Plumb bobs	18	
Radios - Motorola Mag One BPR40	12	Includes charger base and plug and 2 multi-unit chargers.
Reflectors	7	Wild, Lietz
Level Rods	24	Fiberglass, metal and digital
MISCELLANEOUS EQUIPMENT		
Hand Compass	11	
Hand Levels	7	Several spare
Level Rods	24	Fiberglass, metal and digital
Range Poles	32	8 foot
Tripods	32	
Tape, Steel Drag Tape	9	Plus 20 spare
Tape Survey Rule	12	6' wood
Tape Survey Rule	6	6 metric pocket
Tape 100' Steel	7	Plus 3 empty reels
Tape Cloth	15	100’ and 200’
Alidade Plane Table		
Alidade	4	
Barometer	3	American Paulin System
Sextant	1	David White Co.

Appendix D – Institutional Summary

1. ***The Institution***
   a. *Name and address of the institution*

      Ferris State University
      1201 S. State Street, CSS 201
      Big Rapids, MI 49307-2747

   b. *Name and title of the chief executive officer of the institution*

      David L. Eisler, DMA
      President

   c. *Name and title of the person submitting the self-study report*

      Debbie Dawson, P.E.
      Director, School of CEEMS
      College of Engineering Technology

   d. *Name the organizations by which the institution is now accredited and the dates of the initial and most recent accreditation evaluations*

      HLC Institution ID: **1321**
      Current Accreditation Status: **Accredited**
      Accreditation Date(s): **(1959- .)**
      Commission Participation: **PEAQ PARTICIPANT**
      Participation Notes: **Participating in the Academy for Assessment of Student Learning.**

      Year of Last PEAQ Comprehensive Evaluation: **2010 - 2011**
      Year of Next PEAQ Comprehensive Evaluation: **2020 - 2021**

1. ***Type of Control***
   Description of the type of managerial control of the institution, e.g., private-non-profit, private-other, denominational, state, federal, public-other, etc

   State of Michigan Public Four-Year Institution

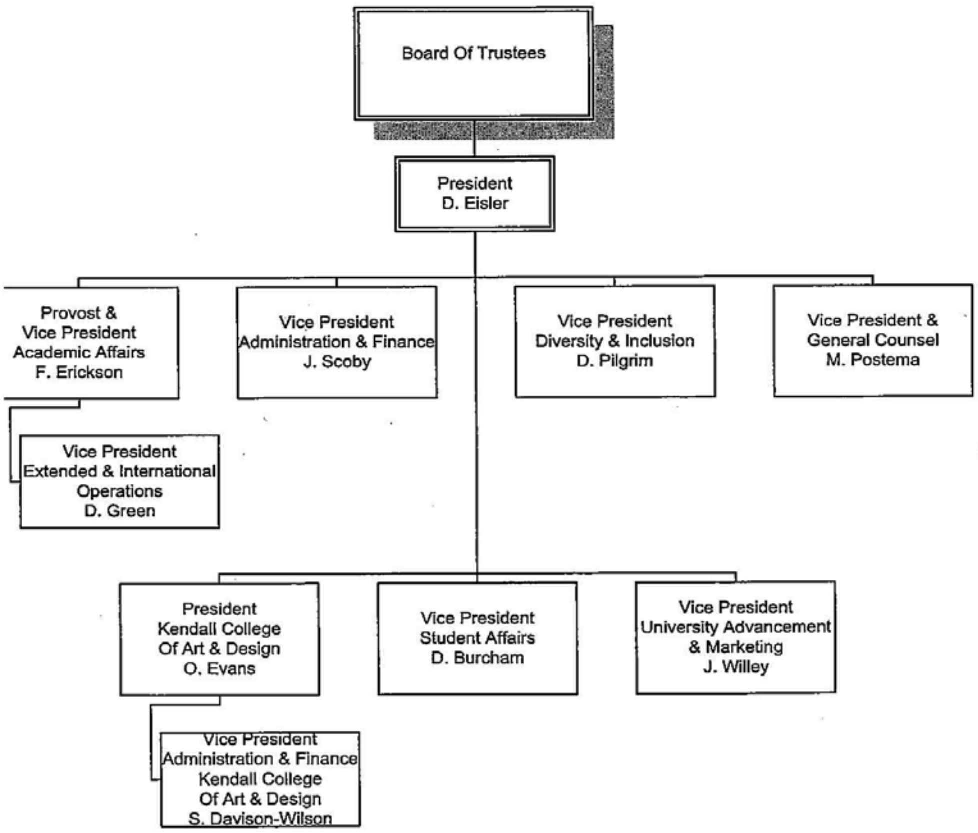
2. ***Educational Unit***

Describe the educational unit in which the program is located including the administrative chain of responsibility from the individual responsible for the program to the chief executive officer of the institution. Include names and titles. An organization chart may be included.

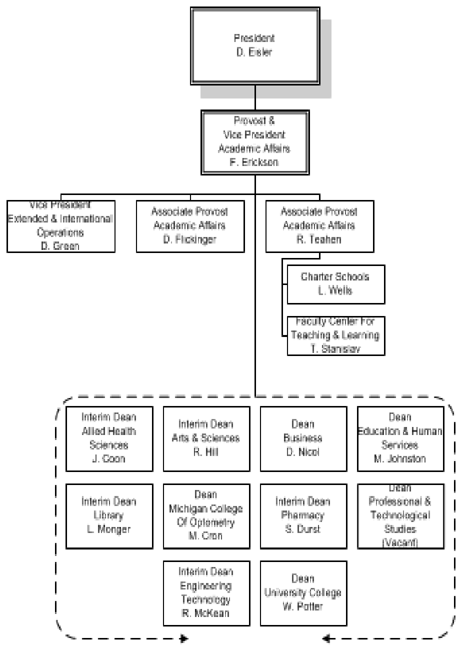
The Program Coordinator, who has1/4 release time for administrative duties, has immediate responsibility for the Surveying Engineering program. The Program Coordinator reports to the Director of the School of CEEMS who reports to the Dean of the College of Engineering Technology who reports to the Vice President of Academic Affairs who reports to the President of Ferris State University who reports to the Board of Trustees – see flow charts below:

FERRIS STATE UNIVERSITY

PRESIDENT'S COUNCIL



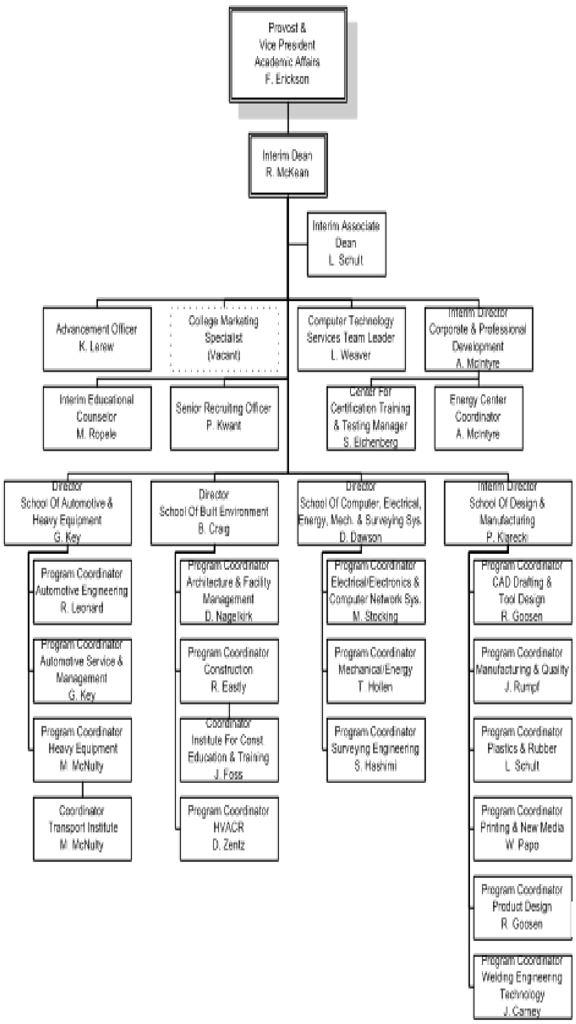
FERRIS STATE UNIVERSITY
ACADEMIC AFFAIRS DIVISION



FERRIS STATE UNIVERSITY

ACADEMIC AFFAIRS DIVISION

COLLEGE OF ENGINEERING TECHNOLOGY



3. ***Academic Support Units***
   List the names and titles of the individuals responsible for each of the units that teach courses required by the program being evaluated, e.g., mathematics, physics, etc.

   Robert Eastly, Program Coordinator, Construction
   David Frank, Department Head, Physical Sciences
   Nathan Garrelts, Department Head, Language and Literature
   Grant Snyder, Department Head, Humanities
   Kirk Weller, Department Head, Mathematics

4. ***Non-academic Support Units***
   List the names and titles of the individuals responsible for each of the units that provide non-academic support to the program being evaluated, e.g., library, computing facilities, placement, tutoring, etc.

   Maude Bigford, Coordinator, Honors Program
   Martin Bledsoe, Director, Public Safety
   Michael Cairns, Associate Vice President, Student Affairs
   Deb Cox, Department Head, Educational Counseling & Disability Services
   James Maat, Director Telecom & Student Technical Services
   Leah Monger, Interim Dean, FLITE
   Piramanayagam Prakasam, Director, International Education
   Kristen Salomonson, Dean, Enrollment Services
   Scott Thede, Manager, Computer Technical Services
   Perk Weisenburger, Director, Atheletics

5. ***Credit Unit***
   It is assumed that one semester or quarter credit normally represents one class hour or three laboratory hours per week. One academic year normally represents at least 28 weeks of classes, exclusive of final examinations. If other standards are used for this program, the differences should be indicated.

   One semester credit represents one lecture hour or one to four contact hours per week. One academic year represents 30 weeks of classes, exclusive of final examinations. All credits are expressed as semester hours.

6. ***Tables***
   Complete the following tables for the program undergoing evaluation

Table D-1. Program Enrollment and Degree Data

Surveying Engineering Program

	Academic Year		Enrollment Year					Total Undergrad	Total Grad	Degrees Awarded			
			1st	2nd	3rd	4th	5th			Associates	Bachelors	Masters	Doctorates
Current Year	10-11	FT	6	5	14	51		76					
		PT											
1	09-10	FT	7	11	23	57		98		15			
		PT									21		
2	08-09	FT	9	21	21	56		107		12			
		PT									16		
3	07-08	FT	17	21	18	62		118		16			
		PT									22		
4	06-07	FT	11	17	25	65		118		13			
		PT									17		

Give official fall term enrollment figures (head count) for the current and preceding four academic years and undergraduate and graduate degrees conferred during each of those years. The "current" year means the academic year preceding the fall visit.

FT--full time
PT--part time

Table D-2. Personnel

Surveying Engineering Program

Year[1]: 2010-2011

	HEAD COUNT		FTE[2]
	FT	PT	
Administrative[3]	1.25	0	
Faculty (tenure-track)	3.75	0	
Other Faculty (excluding student Assistants)	0	0	
Student Teaching Assistants	0	0	
Student Research Assistants	0	0	
Technicians/Specialists	0	1	
Office/Clerical Employees	0	3	
Others[4]			

Report data for the program being evaluated.

[1] Data on this table should be for the fall term immediately preceding the visit. Updated tables for the fall term when the ABET team is visiting are to be prepared and presented to the team when they arrive.

[2] For student teaching assistants, 1 FTE equals 20 hours per week of work (or service). For undergraduate and graduate students, 1 FTE equals 15 semester credit-hours (or 24 quarter credit-hours) per term of institutional course work, meaning all courses — science, humanities and social sciences, etc. For faculty members, 1 FTE equals what your institution defines as a full-time load.

[3] Persons holding joint administrative/faculty positions or other combined assignments should be allocated to each category according to the fraction of the appointment assigned to that category.

[4] Specify any other category considered appropriate, or leave blank.

Signature Attesting to Compliance

By signing below, I attest to the following:

That the Surveying Engineering Program has conducted an honest assessment of compliance and has provided a complete and accurate disclosure of timely information regarding compliance with ABET's *Criteria for Accrediting Engineering Programs* to include the General Criteria and any applicable Program Criteria, and the ABET *Accreditation Policy and Procedure Manual.*

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Dean's Name (As indicated on the RFE)

______________________________ ______________________

Signature **Date**