New Program Proposal
Bachelor of Science, Industrial Engineering
Francis Marion University

Summary

The Francis Marion University (FMU) requests approval to offer a program leading to the Bachelor of Science degree in Industrial Engineering to be implemented in January 2014. The proposed program is to be offered through traditional instruction in collaboration with Florence-Darlington Technical College (FDTC). FMU currently offers a program leading to the B.S. degree in Engineering Technology with concentrations in Civil Engineering Technology and Electronic Engineering Technology. The following chart outlines the stages for approval of the proposal; the Committee on Academic Affairs and Licensing (CAAL) voted to recommend approval CHE. The full program proposal is attached.

Stages of Consideration	Date	Comments
Program Planning Summary received	7/15/2012	Approval for the program began before implementation of the revised *Policies and Procedures*.
Program Planning Summary considered at ACAP	10/12/2012	SBTCE ACAP representative provided a statement of full support for the program from FDTC.
Program Proposal Received	5/13/2013	Staff suggested edits for revision: inclusion of transfer pathways available on SC TRAC, and clarity to reference to a recurring state appropriation of $400,000 for the program.
Revised Program Proposal Received	6/5/2013	Revisions addressed suggestions from the staff.
ACAP Consideration	6/20/2013	ACAP members highlighted the strength of the program to be offered in collaboration with FDTC and stressed the importance of careful grooming of students for retention, especially that they have adequate math background. ACAP voted to recommend approval of the program.
Program Proposals distributed to CAAL for review	8/21/2013	
Comments received from CAAL Members	8/27/2013	Commissioner Munns asked questions concerning recurring funding from the state and confidence in the projected growth of enrollments. Staff requested that the institution address these issues.
Responses provided to CAAL	9/3/2013	Staff received responses and distributed the information to CAAL.

Stages of Consideration	Date	Comments
CAAL consideration	9/5/2013	Commissioner Munns acknowledged the responses to his previous questions and requested that they be included in the proposal to CHE. CAAL and institution representatives discussed assessment and student learning outcomes. Institution representatives responded that assessment will comply with ABET accreditation and include an Employer Advisory Board. Commissioner Munns suggested removing the provision that no additional unique cost or other special state funding be required or requested. The Committee voted to amend the recommendation to remove the cost and special funding language and voted to recommend approval to CHE.

Recommendation

The Committee on Academic Affairs and Licensing recommends that the Commission approve the program at Francis Marion University and the Southeastern Institute of Manufacturing and Technology (SiMT) at Florence-Darlington Technical College leading to the Bachelor of Science degree in Industrial Engineering to be implemented in January 2014.

Commissioner Munns' Questions and CHE/Institutional Responses Regarding New Academic Degree Program Proposals

Francis Marion University, BS Industrial Engineering

QUESTION: Pg 17 claims $400,000 recurring funding from the state, is it in the current budget? What is the risk and consequence if this does not stay in the budget over the projected 6 years?

INSTITUTIONAL RESPONSE: The General Assembly showed its backing for the BS in Industrial Engineering program by appropriating $400,000 recurring to support the program. These funds are present in the state budget for 2013-2014 and because the funding is recurring will be present in future state budgets as well.

The $400,000 recurring for the BS in Industrial Engineering is part of FMU's overall appropriation, and given the level of support in the General Assembly for this program, it is unlikely that these funds will be cut.

However, in the event the General Assembly at some point during the next six years reduces appropriations to public higher education institutions, then FMU will deal with those cutbacks as we did from 2007 to 2011, when base appropriations were cut by almost 45%. Through careful management, and by means of private fund raising, we were able to cope with the reduced appropriations while continuing to offer our academic programs. Thus the risk and consequences for the BS in Industrial Engineering program will be similar to the risk and consequences for other academic programs, except that there has already been substantial private support for the BS in Industrial Engineering and it seems reasonable to assume that private support will continue to be available because of the importance of the Industrial Engineering program to employers in northeastern South Carolina. Furthermore, the BS in Industrial Engineering program is a high priority for Francis Marion, and thus we anticipate that it will be successful and will be supported by FMU even if there should be cutbacks to state higher education appropriations.

QUESTION: This program plans 40-50 new students in this program alone each year (once the program is up); the past few years have seen only a small growth (2% - 70 students) to the whole school. What confidence do you have in the projected growth, and what is the consequence of not achieving it?

INSTITUTIONAL RESPONSE: With respect to FMU's enrollment growth, it may be useful to look at the period from Fall 2002 through Fall 2012. Total headcount undergraduate enrollment at FMU in Fall 2002 was 2,966. Total headcount undergraduate enrollment in Fall 2012 was 3,780. Thus undergraduate enrollment was 27.4% larger in Fall 2012 than in Fall 2002, and this comparison provides a more complete picture of enrollment growth in recent years.

The Bachelor of Science in Industrial Engineering program is the first full engineering degree program offered by Francis Marion University and the first such program offered in northeastern South Carolina. We are confident that once the program is up and

running, we will be able to attract the projected additional enrollment of 40 to 50 students, which represents an annual increase of only 1% to 1.2% in FMU's total headcount enrollment. The feasibility study for the Industrial Engineering program revealed substantial interest in and support for this program, especially in FMU's service area and among major corporations and employers. Duke Progress Energy, Honda of South Carolina, and Santee Cooper have already provided private funds that will be used for scholarships. We are confident that the availability of those scholarship dollars will make this program extremely attractive to students.

Furthermore, considerable thought and effort is being devoted to the recruitment of new students. We anticipate students enrolling in this program from at least three different sources. The first source will be FMU students (new freshmen, already-enrolled FMU students, and transfers) who decide to major in industrial engineering. Anecdotal evidence suggests that there is a great deal of interest among potential industrial engineering majors. Academic advisors have already met with and corresponded with students who wish to pursue this degree. Prospective students who are interested in engineering--such as the 250 high school students who participate in FMU's AP calculus prep sessions each year--have not always applied to FMU because many of those students were interested in engineering and until now, engineering was not an option. Thus we will focus on recruiting that type of student into the new BS in Industrial Engineering program. Another source of enrollment will be qualified students who have come through the engineering technology program at Florence Darlington Technical College and other technical colleges and who wish to pursue the industrial engineering degree at FMU. A third source of enrollment involves older students, perhaps with an engineering technology degree and background, whose employers desire them to pursue an industrial engineering degree at FMU.

We are planning on recruiting students for the BS in Industrial Engineering program from all of those sources and are confident that we will be successful, just as our baccalaureate nursing program, which began in 2005, has succeeded and grown over time. (In Fall 2005, when FMU launched its nursing program, there were 64 students enrolled in the BSN program. In Fall 2012, there were 230 students enrolled in the BSN program.)

As the foregoing discussion indicates, enrollment in the BS in Industrial Engineering program is not dependent on growth in overall university enrollment, although as the comparison of Fall 2002 enrollment and Fall 2012 enrollment demonstrates, Francis Marion's enrollment has increased by 27.4% during that period. Hypothetically, if during the next few years we do not achieve the average of about 2.5% per year in undergraduate enrollment growth that we experienced between Fall 2002 and Fall 2012, we still anticipate the recruitment of the 40 to 50 additional students for the Industrial Engineering program. In reality, we expect those 40 to 50 additional students who will enroll in the Industrial Engineering program to be part of the annual growth in overall enrollment at Francis Marion University.

Proposing Institution

Francis Marion University

Title of Proposed New Program

Bachelor of Science in Industrial Engineering

Submission Date

May 13, 2013
Revised June 5, 2013

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Dr. Luther Fred Carter, President

Francis Marion University

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A. Classification

Program Title:	Bachelor of Science in Industrial Engineering
Academic Unit:	Department of Physics and Astronomy
Designation, type and level of degree:	New Program Proposal, Four-year Undergraduate Program, Bachelor of Science in Industrial Engineering
Proposed implementation date:	January 2014
CIP code:	14.3501
Site:	Francis Marion University, Florence, SC
Program qualifies for supplemental Palmetto Fellows Scholarship and Life:	Yes
Delivery Mode:	Traditional

B. Institutional Approval

Industrial Engineering Steering Committee	October 9, 2012
Department of Physics and Astronomy	October 9, 2012
Academic Affairs Committee	November 1, 2012
Faculty Senate	November 13, 2012
General Faculty	November 27, 2012
Board of Trustees	March 1, 2013
President	May 13, 2013

C. Purpose

Francis Marion University requests approval of a Bachelor of Science in Industrial Engineering degree. Students in the Industrial Engineering program will use classroom and laboratory facilities on the FMU campus and will use engineering classroom and laboratory facilities at the Southeastern Institute of Manufacturing and Technology (SiMT) on the campus of Florence Darlington Technical College (FDTC). A Memorandum of Agreement with Florence Darlington Technical College regarding the use of the SiMT facilities has been signed and is attached to this program proposal. Furthermore, FMU has retained the service of Dr. Patrick Koelling, a consultant from the Industrial Engineering program at Virginia Tech, to assist in the development and design of the program. Dr. Koelling is Associate Professor of Industrial Engineering at the Virginia Polytechnic Institute and State University and an expert on Accrediting Board for Engineering and Technology (ABET) accreditation.

Industrial engineering is concerned with the design, improvement, and installation of integrated systems of people, materials, information, equipment and energy. It draws upon specialized knowledge and skill in the mathematical, physical, and social sciences together with the principles and methods of engineering analysis and design, to specify, predict, and evaluate the results to be obtained from such systems (Institute of Industrial Engineers official definition).

The program intends to attract students from northeastern South Carolina who are interested in industrial engineering and desire to stay in northeastern South Carolina. Businesses and industries located in this region have expressed difficulty in recruiting employees who hold degrees in industrial engineering.

The program will incorporate quantitative systems design and management that can be applied to a broad range of industry and business enterprises. The purposes of this proposed major program are to:

1. address the persistent demand for industrial engineers in this region
2. provide continuing education opportunities for locally employed engineers
3. enhance opportunities for Pee Dee high school students
4. promote economic development in the Pee Dee region by:
    a. recruiting industries to this area
    b. retaining and expanding local industries
    c. addressing the high unemployment levels in the Pee Dee

In addition to the purposes described above, the objectives for this degree program include:

1. Provide students with a strong liberal arts background as part of their engineering degree program
2. Provide students with a professional degree leading to employment directly after graduation
3. Grow the opportunities for students attending FMU
4. Encourage women and underrepresented minorities into STEM fields
5. Foster improved relationships between industry partners and FMU
6. Improve coordination of FMU and the technical college system

D. Justification

D.1 Employability of Graduates: A well-educated workforce is necessary to attract industry to the Pee Dee region where unemployment is higher than the state average. Government and industry leaders have repeatedly urged FMU to offer an engineering degree program. Industrial engineering graduates are employable in a large variety of positions, ranging from non-profits, to hospitals, to large manufacturing plants. According to the Bureau of Labor Statistics Occupational Handbook [1], an industrial engineer "focus[es] on how to get the work done most efficiently, balancing many factors – such as time, number of workers needed, actions workers need to take, achieving the end with no errors, technology that is available, workers' safety, environmental concerns, and cost."

The BLS Occupational Handbook predicts a 6% growth rate from 2010 to 2020 with a national median pay of $76,100 per year. According to salary.com the median pay in South Carolina is typically below this average, yet consistent across the state. Starting salaries (Level I) are listed below for Industrial Engineers:

Augusta – $49,898	Columbia – $52,228
Florence – $50,637	Greenville – $53,706
Sumter – $51,546	Charleston – $54,672
Spartanburg – $51,887	Rock Hill – $55,979

A further search of recent job postings on Careerbuilder.com (April 2, 2013) for industrial engineering jobs in SC yielded 174 postings within the last 30 days. For a systems engineer 471 postings were found. The proposed industrial engineering program will help to address this shortage in the state and the Pee Dee region.

In addition, FMU conducted a survey of 200 local companies and local government agencies and has produced the following data from 41 responses to date:

1. 21 of the 41 employ industrial engineers.
2. 5 of the 21 who employ industrial engineers (IEs) attempt to hire engineers on a regular basis, offering up to 30 positions annually.
3. Respondents noted problems in hiring and retaining IEs and other engineers because of a shortage of engineers in the region and difficulty in getting engineers to relocate to the Pee Dee area.
4. 26 of the 41 reported that they would be willing to provide internships or provide opportunities for senior design projects for FMU undergraduates.
5. 17 of the 41 project an increasing demand for engineers.
6. 17 of the 41 would be willing to have their employees study industrial engineering at FMU.
7. 7 of the 41 volunteered to serve on an advisory board.

The survey of employers produced the following anecdote that captures the need for industrial engineers in the Pee Dee region. The human resources manager of an automotive parts manufacturer with a production facility located in Mullins, SC, phoned specifically to explain that he was excited to learn that FMU was considering an industrial engineering program. However, for his company, the initiative came too late. The company is closing its operations in South Carolina with one of the primary reasons being the lack of industrial engineers. The closure of the facility in Mullins will eliminate jobs in Marion County, which in December 2012 had an unemployment rate of 17.2% (the highest in the state of South Carolina) [2].

D.2 Congruence with Mission: The mission of FMU is to "…serve the Pee Dee region . . .", ". . . to make available excellent educational programs for the people of the region and the state . . .", and "to foster the economic development of the region…." This proposed program is directly aligned to the mission of the University in its goals to educate students in the Pee Dee and meet the needs of local business and industry. This program will also serve as a way for FMU to encourage the development of new industry and the expansion of existing industry in the area.

D.3 Relationship to Related Programs Within the Institution: The proposed program does not duplicate any of the existing programs currently offered by the university. FMU offers a robust pre-engineering curriculum and a baccalaureate degree in engineering technology with concentrations in civil and electronic engineering through cooperative arrangements with South Carolina technical colleges.

The curriculum for the proposed industrial engineering program shares a common foundation with mathematics and physics. In addition, with respect to physics, the industrial engineering program will provide a broader application of physics principles in an engineering program.

The School of Business courses are also strongly correlated to some of the proposed engineering ones while still maintaining meaningful differences. In the first few years of this proposed program, faculty in the School of Business will offer courses as needed as a mixed enrollment option with appropriate assignments for those in the engineering sections.

D.4 Related Programs – SC and NC: According to the Accrediting Board for Engineering and Technology (ABET) list of accredited programs, there are 97 industrial engineering baccalaureate programs in the United States. There is only one such program in South Carolina and two in North Carolina.

There is no engineering program in the Pee Dee region and the only Bachelor of Science in Industrial Engineering program in South Carolina is offered by Clemson University, 211 miles away. In North Carolina only North Carolina State University in Raleigh (147 miles), and North Carolina Agricultural and Technical State University in Greensboro (150 miles) offer industrial engineering. A list is provided below:

University	Location	Miles	Degree Program
Clemson University	Clemson, SC	211	Industrial Engineering
North Carolina State University	Raleigh, NC	147	Industrial Engineering
North Carolina Agricultural and Technical State University	Greensboro, NC	150	Industrial Engineering

D.5 Similar Programs – Private, SREB ACM, & Proprietary: There are institutions in South Carolina that offer pre-engineering curricula, but these programs require students to transfer to another institution to complete the desired degree or transfer to an institution outside of the borders of South Carolina. A search of the Southern Regional Education Board's program listing for the Academic Common Market yielded no industrial engineering programs. No proprietary institution was found to offer an industrial engineering program at the baccalaureate level.

E. Admission Criteria

Prospective students will follow the normal admission policy set by the University [3]. Once enrolled at the University, students will be classified as industrial engineering majors, but must make a formal application for admission to the industrial engineering program. Admission to the industrial engineering program is a prerequisite for enrollment in ENGR 220 and ENGR 355 and those courses that require ENGR 220 and ENGR 355 as prerequisites. Students are encouraged to apply for admission at the end of three semesters of full-time study as a lower division student, provided that all requirements for admission to the program have been met. Admission to the industrial engineering program will require the following:

1. Successful completion of the following courses: Physics 200, 201, and 202; Mathematics 201 and 202; and Engineering 101, 201, and 301. The grades earned in these courses must average at least a 2.0 GPA.
2. Earned credit in a minimum of 40 undergraduate credit hours with a cumulative GPA of at least 2.0.

F. Enrollment

Table A – Projected Total Enrollment

PROJECTED TOTAL ENROLLMENT						
YEAR	FALL		SPRING		SUMMER	
	Headcount	Credit Hours	Headcount	Credit Hours	Headcount	Credit Hours
2013 – 2014	0	0	30	450	0	0
2014 – 2015	70	1050	70	1050	0	0
2015 – 2016	95	1425	95	1425	0	0
2016 – 2017	125	1875	125	1875	0	0
2017 – 2018	140	2100	140	2100	0	0

Assumptions for the calculation:

1. the program is a four-year program;
2. thirty students from other programs within the institution will switch to Industrial Engineering in Spring 2014;
3. forty students new to the institution will enroll in the program each fall increasing to 50 by the fifth year; and
4. students will take a full academic load.

To develop our estimations for the initial cohort, we reviewed Clemson University's student profile as well as our received applications. Clemson University's 2012 Profile [4] for their Industrial Engineering major:

Freshmen	Sophomore	Junior	Senior	Total
0	49	80	113	242

FMU's application pool for those interested in engineering and physics for Fall 2013 as of May 10:

Electronics Engineering Technology (EET)	Civil Engineering Technology (CET)	Dual-Degree	Physics	Total
39	56	5	31	131

G. Curriculum

The proposed program will require a minimum of 122 hours at Francis Marion University, which will include the engineering curriculum as well as the University's general education requirements. The curriculum outlined below was developed by Dr. Patrick Koelling, an approved ABET consultant from Virginia Polytechnic Institute and State University hired by FMU. The curriculum is designed to be completed in four years.

G.1 Sample Curriculum Plan:

Freshman			
Fall semester	*Hrs*	*Spring semester*	*Hrs*
Calculus I, Math 201	*3*	*Calculus II, Math 202*	*3*
Technical Physics, Phys 200	*4*	*Technical Physics, Phys 201*	*4*
General Chemistry, Chem 101	*4*	*Composition III, Eng 200*	*3*
Composition II, Eng 112	*3*	*Introduction to IE ENGR 101*	*3*
		Engineering Graphics (CAD) ENGR 201	*3*
Total semester hours	*14*	*Total semester hours*	*16*
Sophomore			
Fall semester	*Hrs*	*Spring semester*	*Hrs*
Calculus III, Math 203	*3*	*Linear Algebra, Math 304*	*3*
Technical Physics, Phys 202	*4*	*Multivariable Calculus, Math 306*	*3*
Literature (any)	*3*	*Intro to Microeconomics Econ 203*	*3*
Computational Methods, Phys 220	*3*	*Materials Engineering ENGR 220*	*3*
Mechanics, ENGR 301	*3*	*Production & Operations Man., ENGR 355*	*3*
Total semester hours	*16*	*Total semester hours*	*15*
Junior			
Fall semester	*Hrs*	*Spring semester*	*Hrs*
Intro to Macroeconomics Econ 204	*3*	*Speech, Spco 101*	*3*
History (any)	*3*	*Art/Music/Theatre Appreciation 101*	*3*
Electronics, ENGR 310	*4*	*Biology (any)*	*4*
Workplace Data A&A ENGR 320	*3*	*Engineering Economy ENGR 330*	*3*
Manufacturing Processes ENGR 350	*4*	*Operations Research ENGR 373*	*3*
Total semester hours	*17*	*Total semester hours*	*16*
Senior			
Fall semester	*Hrs*	*Spring semester*	*Hrs*
Political Science, Pol 101	*3*	*Humanities Elective*	*3*
Business Writing, Eng 305	*3*	*Quality Control, ENGR 356*	*3*
Human Factors Engr., ENGR 420	*3*	*Facility Design, ENGR 470*	*3*
Supply Chain Design, ENGR 467	*3*	*Senior Design, ENGR 480*	*4*
Production planning, ENGR 468	*3*		
Total semester hours	*15*	*Total semester hours*	*13*
		TOTAL PROGRAM	*122*

G.2 New Industrial Engineering Courses:

ENGR 101 Introduction to Engineering (3) (Prerequisite/Corequisite: Math 201) S. Introduction to the Industrial Engineering (IE) profession, applications of IE principles and approaches, integrated systems approach to problem solving, overall goals and components of the IE degree program, career opportunities, development of engineering work skills, oral and written communication skills, and the importance of professionalism, ethics, contemporary challenges, and lifelong learning.

ENGR 201 Engineering Graphics (3) S. This course introduces the student to the operation of a Computer Aided Drafting (CAD) system, with an emphasis on the design component, using AutoCAD as the computing tool. The course includes interaction with a CAD station to produce technical drawings. Students will independently learn to produce drawings using AutoCAD and will learn the value of CAD and design in both industrial and service environments.

ENGR 220 Materials Engineering (3) (Prerequisites: PHYS 201 and CHEM 101 and admission to the Industrial Engineering Program) S. This course is designed to introduce the students to the structures and properties of metals, ceramics, polymers, and composites. In addition, students will gain an understanding of the processing and design limitations of these materials, as well as being introduced to new classes of materials being developed to meet the ever-expanding range of material requirements. Use in manufacturing is emphasized.

ENGR 301 Engineering Mechanics (3) (Prerequisites: PHYS 201 and MATH 202) F. An introduction to statics and dynamics. Topics include static equilibrium of particles, rigid bodies, and trusses; rotational motion; torque; moment of inertia; Newton's Laws of Motion; linear and angular momentum methods; work and energy methods; kinematics of particles and rigid bodies; applications of vector analysis; and structural analysis of joints and trusses.

ENGR 310 Electronics and Instrumentation (4:3-3) (Prerequisites: PHYS 202 and PHYS 220) F. This class provides an introduction to analog and digital electronics with specific application to instrumentation used in scientific and engineering applications. Topics include analog signal processing, power supplies, sensors (theory and interpretation of sensor data), and microcontrollers with heavy emphasis on design projects to achieve practical results and give insights on troubleshooting electronic equipment used in the workplace. Credit cannot be received for both ENGR 310 and PHYS 310.

ENGR 320 Workplace Data Acquisition and Analysis (3) (Prerequisites: 101 and 355; prerequisites/corequisites: MATH 202 and PHYS 220) F. Methods for assessing the performance of both individuals and groups within a system. Data acquisition techniques include basic industrial engineering tools such as work analysis, work sampling, and work measurement, as well as automated procedures. Data storage and retrieval techniques are introduced. Variation in data, including an introduction to probability and statistics for proper analysis of data.

ENGR 330 Engineering Economy (3) (Prerequisites: 101, 355 and MATH 201) F. Concepts and techniques of analysis for evaluating the value of products/services, projects, and systems in relation to their cost. Economic and cost concepts, calculating economic equivalence, comparison of alternatives, purchase versus lease decisions, financial risk evaluation, cash flow sensitivity analysis, and after-tax analysis.

ENGR 350 Manufacturing Processes (4:3-3) (Prerequisites: 220, 301 and MATH 202) F. An overview of manufacturing processes primarily for metals and alloys, focusing on fabrication and joining processes. Emphasis will be placed on process capabilities and limitations, with calculation of process parameters for select processes. Also includes topics in additive manufacturing, heat treatment, product design and process planning, design-for-manufacture/assembly, numerical control, and inspection. The laboratory experience will provide manual and computer-aided process techniques, including assembly, machining, casting, welding, sheet metal forming, powder metallurgy, and inspection.

ENGR 355 Production and Operations Management (3) (Prerequisites: 101 and 201 and admission to the Industrial Engineering Program) S. Study of the production and operations component of companies. Topics include capacity and location planning, inventory management, scheduling of jobs and projects, and quality assurance and control. Use of quantitative methods. Credit cannot be received for both ENGR 355 and MGT 355.

ENGR 356 Quality Control (3) (Prerequisite: 355) S. A study of engineering philosophy, practices and analytical processes implemented in quality planning and administration of products and services. Topics include corporate culture, quality design, human factors and motivation, quality auditing, service quality,

quality assurance, quality circles, and conformance to design. Credit cannot be received for both ENGR 356 and MGT 356.

ENGR 373 Operations Research (3) (Prerequisite: 355) S. Applications of hypothesis testing, simple linear regression, and multiple linear regression. Coverage of the mathematical structure, solution procedures, and application of basic management science models, including linear programming, network modeling and simulation. Study of project management methods and techniques. Computer software is used to solve problems. Credit cannot be received for both ENGR 373 and MGT 373.

ENGR 420 Human Factors Engineering (3) (Prerequisites: 320, 373 and MATH 201) F. A survey of human factors engineering emphasizing the systems approach to workplace and machine design. Discussion of basic human factors research and design methods, visual processes and design methods, selection of statistical techniques for application to human factors data, visual and auditory processes, display and control design, and effects of environmental stressors on humans.

ENGR 467 Supply Chain Design (3) (Prerequisite: 355) F. Supply chain design is concerned with the activities performed from initial raw materials to the finished product. The course examines the analytical modeling of various aspects of a supply chain including product flows, information flows, and the relationships among supply chain participants. Credit cannot be received for both ENGR 467 and MGT 467.

ENGR 468 Production Planning (3) (Prerequisite: 355) F. This course provides an in-depth study of the full spectrum of activities of production managers. Topics covered include forecasting, independent demand inventory management, just-in-time inventory management, materials requirement planning, capacity planning, production activity control, and master production scheduling. Emphasis will be given to the use of personal computers to support decision making. Credit cannot be received for both ENGR 468 and MGT 468.

ENGR 470 Facility Design (3) (Prerequisites: 320 and 373) S. Theory and concepts involved in model formulation for design and analysis of facility plans. Includes facility layout, facility location and material handling system design. Application of quantitative tools and techniques for flow analysis, layout planning, and automated material handling system design.

ENGR 480 Senior Design (4) (Prerequisites: 420 and 468; prerequisites/corequisites: 356 and 470) S. The capstone design sequence for industrial engineering majors. Survey of methods, tools and techniques used to plan, communicate, manage and control projects and work on teams. Students work in teams to develop a proposal for, and implement, an industrial engineering design project for an actual manufacturing or service industry client.

H. Assessment

Francis Marion University plans for three different levels of assessment of the Industrial Engineering program.

H.1 ABET Assessment Requirements: Assessment Measures will be developed and adaptive to be appropriate for the learning goals and will include application of rubrics to specific assignments, graded reports, labs or projects, employer and alumni surveys, company feedback on internships and senior design projects, oral and written presentations, exams or specific test questions and others as determined necessary.

ABET assesses a program on the basis of meeting the following goals:

1. An ability to apply knowledge of mathematics, science, and engineering.
2. An ability to design and conduct experiments as well as to analyze and interpret data.
3. 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.
4. An ability to function on multidisciplinary teams.
5. An ability to identify, formulate and solve engineering problems.
6. An understanding of professional and ethical responsibility.
7. An ability to communicate effectively.
8. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and societal context.
9. Recognition of the need for and an ability to engage in life-long learning.
10. Knowledge of contemporary issues.
11. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Table 1 below shows where the concepts are introduced (I), built upon (B) and, ultimately, tested (T).

Table 1 – Engineering Program Assessment

Course/Learning Goal		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Calculus I	Math 201	I										
Technical Physics	Phys 200	I	I									
General Chemistry	Chem 101	I	I									
Calculus II	Math 202	B										
Technical Physics	Phys 201	B	B									
Introduction to IE	ENGR 101	I		I	I	I	I	I	I	I	I	I
Engineering Graphics (CAD)	ENGR 201	I		B				T				B
Calculus III	Math 203	B										
Technical Physics	Phys 202	B	B									
Computational Methods	Phys 220	B	B									B
Mechanics	ENGR 301	B										
Linear Algebra	Math 304	B										
Multivariate Calculus	Math 306	B										
Engr. Science-Materials	ENGR 220	B		B		B			B			B
Production & Operations Man.	ENGR 355	B		B		B	B				B	B
Electronics	ENGR 310	B	T			B						B
Workplace Data A&A	ENGR 320	B	T	B		B						B
Manufacturing Processes	ENGR 350	B	T	B		B	B				B	B
Engineering Economy	ENGR 330	B		B		B			B		B	B
Operations Research	ENGR 373	B	T	B		B						B
Human Factors Engr	ENGR 420	B		B		B	B		B		B	B
Supply Chain Design	ENGR 467	B		B		B					B	B
Production planning	ENGR 468	B		B		B					B	B
Quality Control	ENGR 356	B		B		B					B	B
Facility Design	ENGR 470	B		B		B			B		B	B
Senior Design	ENGR 480	T	T	T	T	T	T	T	T	T	T	T

H.2 Programmatic Assessment: ABET stated that the program educational objectives should be consistent with the missions of the institution, the needs of the program's various consistencies and the criteria listed in part H.1 of this document and assessed against these criteria. As a regional institution, Francis Marion University seeks to graduate industrial engineers that meet the needs of the Pee Dee. To this end we will do the following:

a) Establish a board of advisors who will meet regularly to assess current trends in the fields and the needs of local employers.
b) Ask advisors of senior projects, internships, class projects and other practical applications for feedback on the strengths and weaknesses of our students and any gaps they have noted in their abilities.
c) Regularly survey employers where the students have been placed in order to seek feedback on the strengths and weaknesses of our alumni and any gaps they have noted in their abilities as well as future needs, trends and other considerations to be incorporated into the program.
d) Regularly survey alumni to seek feedback on any gaps they have noted in their abilities and current or upcoming trends that should be watched.
e) In addition, due note will be taken of alumni career paths, graduate school opportunities and achieving of the Professional Engineering certification as an independent verification of our program.
f) Keep abreast of information provided by ABET and the Institute of Industrial Engineers for changes necessary to be incorporated into the program.
g) Systematically review all facilities, labs, equipment and other products and services in the Industrial Engineering program to assure they are meeting industry standards.
h) ABET requires faculty to be sufficient in number and have competencies to cover all of the curricular areas of the program as well as advising, counseling, professional activities and the like. This will be a component of hiring decisions as well as tenure and promotion.
i) ABET requires adequate institutional support not only recruiting and retention of faculty and staff but also for adequate infrastructure, laboratories, equipment and library resources. This will be periodically reviewed and all suggestions forwarded to administration for budget purposes.

H.3 Assessment Driven Changes:

a) The program will systematically review all the above on an annual basis and changes as needed will be incorporated into curriculum, faculty, and other program components.
b) Tenure and promotion decisions will be based in part upon the faculty's fit in the program and the achievement of the goals of the program.
c) Additionally, ABET accreditation will be sought as soon as possible. The ABET six-year renewal cycle will provide an independent assessment of the program.

I. Faculty

Table B– Faculty List

List Staff by Rank (e.g. Professor #1, Professor #2, Associate Professor #1, etc.)	Highest Degree Earned	Field of Study	Teaching in Field (Yes/No)
Professor #1 (Coordinator)	PhD	Industrial Engineering	Yes
Professor #2	PhD	Physics	Yes
Associate Professor #1	PhD	Nuclear Engineering	Yes
Associate Professor #2	PhD	Information Technology	Yes
Assistant Professor #1	PhD	Industrial Engineering	Yes

I.2 New Faculty: Two new tenure-track faculty will be hired for the program: a coordinator and one additional faculty member. The coordinator will be hired on a nine-month contract with a nine credit hour per semester teaching assignment and the other time used for administration duties. The program coordinator will be responsible for:

- Reporting to the department chair
- Coordinating usage of SiMT facilities
- Recruiting students
- Progression monitoring
- Evaluating program outcomes
- Self-study for ABET accreditation
- Reporting about program progress to the department chair

I.3 Existing Faculty: Existing faculty in the department of physics and astronomy will teach ENGR 301 and ENGR 310. Only ENGR 310 will be offered as a mixed enrollment course with PHYS 310. Existing faculty in the School of Business will teach ENGR 355, 356, 373, 467, and 468 as mixed enrollment sections with the corresponding MGT courses. These mixed enrollment sections will not change the load of the faculty members assigned to these courses. Once the numbers of students in the Industrial Engineering program are large enough to support their own sections they will no longer be offered as mixed enrollment.

I.4 Faculty Development: Professional development funds are available through the university at a rate of $2,500 per year per faculty member with preference given to support of scholarly presentations. Other opportunities for staff development exist internally in the University and within the Department of Physics and Astronomy. Faculty members are also encouraged to seek grant support for research especially during summer months.

I.5 Full-time Equivalent Definition: The fulltime teaching equivalency (FTE) at Francis Marion for:

- Tenured and Tenure-track faculty is a 3-4 annual teaching load with four contact courses in either the Fall or Spring semester and three contact courses in the other semester.
- Non-tenure track (term contract) is a 4-4 annual teaching load with four contact courses each semester.

I.6 Involvement of FDTC faculty under the supervision of FMU faculty in the FMU Industrial Engineering Major: Students in the Francis Marion Industrial Engineering Program will be able to utilize the excellent facilities at SiMT. The Computer Aided Design class, (ENGR 201), will initially be taught in the labs at SiMT which already have the computer hardware and the AutoCAD and SolidWorks software. The laboratory component of the Manufacturing Processes class, (ENGR 350), will also utilize the SiMT capabilities for 3-D printing, machining, inspecting with coordinate measurement machines, and computer numerical control (CNC) machines. The Introduction to Engineering (ENGR 101) and Materials Engineering (ENGR 220) courses will also benefit from the extensive labs and equipment at SiMT. The expertise of FDTC faculty will be utilized in the instruction of students in labs which will be part of courses taught by FMU Industrial Engineering faculty. Qualifications of the FDTC faculty are provided in Appendix I.

I.7 Unit Administration, Faculty, and Staff Support:

Table C – Unit Administration, Faculty & Staff Support

UNIT ADMINISTRATION, FACULTY, AND STAFF SUPPORT FOR ENGINEERING PROGRAM						
YEAR	**NEW**		**EXISTING**		**TOTAL**	
	Headcount	FTE	Headcount	FTE	Headcount	FTE
Administration						
2013 – 14	1	1			1	1
2014 – 15			1	1	1	1
2015 – 16			1	1	1	1
2016 – 17			1	1	1	1
2017 – 18			1	1	1	1
Faculty						
2013 – 14	1	1	3	3	4	4
2014 – 15			4	4	4	4
2015 – 16			4	4	4	4
2016 – 17			4	4	4	4
2017 – 18			4	4	4	4
Staff						
2013 – 14			2	0.8	2	0.8
2014 – 15			2	0.8	2	0.8
2015 – 16			2	0.8	2	0.8
2016 – 17	1	1	2	0.8	3	1.8
2017 – 18			3	1.8	3	1.8

J. Physical Plant

The McNair Science Building and Leatherman Science Facility both will provide space for the industrial engineering program. There are adequate classroom and seminar rooms to support the program. Students have access to a computer lab for classes and informal meetings. The Rogers Library also provides study rooms that students may use for individual or small group study. Students have access to a break area in the Rogers Library which they can have respite between classes and activities. Offices for the additional faculty are available in the McNair Science Building. The Department of Physics and Astronomy has a workshop equipped with a band saw, lathe, drill press, and radial arm saw. The workshop is available to students to use under the supervision of a faculty member or building maintenance supervisor.

The Southeastern Institute of Manufacturing and Technology (SiMT) located at Florence Darlington Technical College (FDTC) will provide additional physical plant for the program to use. Facilities at SiMT include lecture rooms, laboratories, and 2 AutoCAD labs which will be available to the University on Tuesday/Thursday each week. FDTC and FMU have signed a Memorandum of Understanding to allow the University access to these additional facilities. A copy of the MOU is included with the proposal.

No additional physical plant modifications at the University are required at this time. In the future if a separate laboratory is requested by the faculty in the Industrial Engineering program there is one classroom that can be easily converted. Financing of this conversion will come from department funds, grant support, or private dollars raised by the University.

K. Equipment

To support the industrial engineering program the University plans to acquire the following items over the next three years:

1. 3D printer –$100,000
2. AutoCAD licenses for the Computational Physics laboratory – $23,400
3. Hitachi Starboard electronic smart-board – $5,000
4. Large format printer – $4,000
5. Precision Measuring Equipment – $5,000
6. Microsoft Visio Professional – $8,700
7. Ergonomic Laboratory Equipment – $40,000

Additionally in Year 4 the computer laboratory in the department will need to be refreshed with new computers and updated software. Replacement of damaged or worn equipment for the program will begin in Year 5.

L. Library Resources

L.1 Current Holdings: The current holdings of industrial engineering materials of the James A. Rogers Library and Cauthen Educational Media Center consists of 214 printed materials, one project medium, and 16 eBooks. The library has access to general and science databases (Science Direct, Academic Search Complete, and Inspec) and business databases (Lexis-Nexis, Mergent Online, Standard & Poor's NetAdvantage, and Value Line Investment Survey).

Recently (March 2013) the library has acquired access to the Springer eBook database. This will provide students with access to over 6,000 engineering books.

L.2 New Acquisitions: To support the industrial engineering program additional database access will be required. The database Engineering Village will provide access to CRC handbooks as well as engineering articles. Access to this database will cost $25,064 per year. EngNetBase will provide additional CRC

handbooks and encyclopedias. This access will cost $24,917 per year. Electronic access to Knovel handbooks will cost $21,387 per year.

Additional library holdings to support the Industrial Engineering program will be acquired at a rate of $1,000 per year for the first five years. Acquisitions after that point will come through the normal procedure followed by the Rogers Library staff.

L.3 PASCAL: PASCAL allows access to business related databases such as Business Source Premier and Regional Business News. PASCAL also includes borrowing privileges of 196 print & microform items with the subject heading "industrial engineering."

M. Accreditation, Approval, Licensure, or Certification

M.1 Accreditation: The industrial engineering program will be subject to accreditation from the Accrediting Board for Engineering and Technology (ABET). Preparing for the accreditation review by ABET will begin the first semester courses are offered in the major.

The ABET accreditation process [5] will take 18 months to complete and application can be made once the first class receives degrees in May 2017. As the University does not have any ABET accredited programs, one year before the site visit the University will need to undergo a Readiness Review. The accreditation process will involve the following steps:

1. One year prior to on-site visit – Readiness Review
2. 9 months prior to on-site visit – Request for Evaluation submitted
3. 6 months prior to on-site visit – Self-study reports due
4. 2-3 months after on-site visit – ABET releases a Draft Statement
5. 3-4 months after on-site visit – University response submitted
6. July 2018 – ABET Commission meets
7. August 2018 – ABET releases a Final Statement

M.2 Licensure: A graduate of the industrial engineering program can apply for a Professional Engineer (PE) license. According to the National Society of Professional Engineers [6], the requirements for the PE license are:

1. Earn a four-year degree at an accredited engineering program
2. Pass a Fundamentals of Engineering exam
3. Complete four years of work under the guidance of a PE
4. Pass the Principles and Practice of Engineering exam

Graduates of the first class at the University in 2017 will be able to complete the PE license requirements after 2021. ABET accreditation will be retroactively given to all graduates of the industrial engineering program.

N. Articulation

N.1 Associate-level to Baccalaureate: Not an associate-level program.

N.2 Entry from two-year institutions: The industrial engineering program will be offered in cooperation with Florence Darlington Technical College. Accordingly, interested students from FDTC will be encouraged to transfer into FMU's industrial engineering program. These students will be advised about course selection and about program requirements. Certain prerequisite courses in mathematics and physics that are not offered by FDTC will be required. FMU and FDTC will establish an articulation agreement that defines the transfer pathway into the industrial engineering program.

In addition, students can transfer from other two-year programs into the University. A student wishing to pursue industrial engineering will need the prerequisite courses in mathematics and physics that are not offered at most of the technical colleges in South Carolina. The program will be added to SC TRAC to provide assistance for students wishing to transfer to FMU.

N.3 Terminal degree: The proposed program is not considered a terminal degree. Graduates will have the option of entering the workforce right away or continuing on to a graduate program to earn an M.S. or Ph.D.

N.4 MOUs: Francis Marion University will offer the program under a Memorandum of Agreement with Florence Darlington Technical College (FDTC). Students in the industrial engineering program at FMU will use engineering and classroom laboratory facilities at the FDTC Southeastern Institute of Manufacturing and Technology (SiMT) campus. A signed MOU between FMU and FDTC is attached to this proposal.

O. Estimated Costs and Sources of Financing

In estimating the costs for the industrial engineering program the University assumes students in Table A are predominately in-state students to calculate tuition and fees. The program will be housed in the Department of Physics and Astronomy. Monies will be internally allocated to the industrial engineering program from the general revenue of the University. Salary monies for three FDTC faculty members have been included in the calculations. Salary monies for faculty needed to support the additional sections of general education and other supporting classes have been included using the curriculum outline provided in this document.

The University has been successful in raising private donations to support the industrial engineering program. We anticipate continued philanthropic support from the region.

As of this date a recurring state appropriation of $400,000 is contained in both the House and Senate version of the appropriation act to assist in sustaining the program. We anticipate this will be in the 2013-2014 state budget.

Table D – Estimated Costs and Sources of Financing by Year

ESTIMATED COSTS BY YEAR						
CATEGORY	**1st**	**2nd**	**3rd**	**4th**	**5th**	**TOTALS**
Program Administration	$125,100	$128,853	$132,719	$136,700	$140,801	$664,173
ENGR Faculty Salaries	$122,598	$126,276	$135,373	$139,434	$143,617	$667,298
Other Faculty	$128,465	$293,630	$378,110	$440,715	$453,937	$1,694,857
Graduate Assistants	0	0	0	0	0	0
Clerical/Support Personnel	$42,034	$43,295	$44,593	$95, 971	$98, 850	$324,743
Supplies and Materials	$30,000	$30,000	$40,000	$40,000	$50,000	$190,000
Library Resources	$72,368	$72,368	$72,368	$72,368	$72,368	$361,840
Equipment	$146,100	$40,000	$40,000	$100,000	$90,000	$416,100
Facilities	0	0	0	0	0	0
Other (Identify)	0	0	0	0	0	0
TOTALS	$666,665	$734,422	$843,163	$1,025,188	$1,049,573	$4,319,011
SOURCES OF FINANCING BY YEAR						
Tuition Funding	$126,825	$591,850	$803,225	$1,056,875	$1,183,700	$3,762,475
Program-Specific Fees	0	0	0	0	0	0
State Funding	$400,000	$400,000	$400,000	$400,000	$400,000	$2,000,000
Reallocation of Existing Funds	0	0	0	0	0	0
Federal Funding	0	0	0	0	0	0
TOTALS	$526,825	$991,850	$1,203,225	$1,456,875	$1,583,700	$5,762,475

P. References

1. Bureau of Labor Statistics, U.S. Department of Labor, *Occupational Outlook Handbook, 2012-13 Edition*, Industrial Engineers, on the Internet at http://www.bls.gov/ooh/architecture-and-engineering/industrial-engineers.htm (visited March 4, 2013).
2. South Carolina Department of Employment and Workforce, *South Carolina Employment Situation*, *December 2012*, on the Internet at http://dew.sc.gov/documents/lmi-monthly-trends/December_2012.pdf (visited March 4, 2013).
3. Francis Marion University 2012-2013 Academic Catalog, on the Internet at http://www.fmarion.edu/academics/Catalogs (visited March 04, 2013).
4. Clemson University 2012 Profile, on the Internet at http://www.clemson.edu/oirweb1/FB/factBook/CUfactbook.cgi?conf_file_name=FBS_LevelMajor&tabbness=2&colapp=4 (retrieved March 14, 2013).
5. Accrediting Board for Engineering and Technology, *Accreditation Timeline*, on the Internet at http://www.abet.org/accreditation-timeline/ (visited February 26, 2013).
6. National Society of Professional Engineers, *Licensure*, on the Internet at http://www.nspe.org/Licensure/WhatisaPE/index.html (visited March 4, 2013).

APPENDIX I

Qualifications for Florence Darlington Technical College faculty at the SiMT facility are provided below.

List Staff by Rank (e.g. Professor #1, Professor #2, Associate Professor #1, etc.)	**Highest Degree Earned**	**Field of Study**
Department Head	MS	Civil Engineering
Engineering Tech Instructor	MS	Mechanical Engineering
Engineering Tech Instructor	MS	Computer Engineering
Engineering Tech Instructor	MS	Design Science
Engineering Tech Instructor	BS	Electrical Engineering