New Program Proposal
Bachelor of Science in Mechanical Engineering
Francis Marion University

Executive Summary

Francis Marion University requests approval to offer the program leading to the Bachelor of Science in Mechanical Engineering, to be implemented in January 2020 through traditional delivery. The following chart outlines the stages of approval for the proposal. The Advisory Committee on Academic Programs (ACAP) voted to recommend approval. The full program proposal and support documents are attached.

Stages of Consideration	Date	Comments
Program Proposal Received	10/02/18	Not Applicable
ACAP Consideration	11/29/18	Representatives from Francis Marion University (FMU) introduced the proposal, citing the recent reception of accreditation from ABET for Industrial Engineering and the great need for the program in the area. Nine companies surveyed expressed interest in Mechanical Engineering and internship opportunities the program could provide, especially due to trouble with recruitment and retaining employees. FMU representatives stated equipment and courses overlap with existing programs with only two (2) new faculty and some space renovation needed for the proposed program. There is also support from a company to provide equipment needed for the program. Members of the Advisory Committee on Academic Programs (ACAP) discussed the proposal, inquiring about the target audience of the survey conducted and building facilities. FMU representatives cited the nine different companies that expressed interest in having graduates and supporting the program, the external support from other companies, and the need for moderate space renovation. FMU was also extended commendations during discussion for a compelling proposal. After remaining discussion, ACAP voted to approve the program proposal. Staff transmitted remaining questions for additional clarity.
Comments and suggestions from CHE staff sent to the institution	12/04/18	Staff requested the proposal be revised to include information provided at ACAP about industry support of the proposed program, determination of the need for program completers to hire, and faculty cost. An update on Institutional approval dates was also requested.
Revised Program Proposal Received	12/21/18 1/2/19	The revised proposal satisfactorily addressed request for updates.

Recommendation

The staff recommends the Committee on Academic Affairs and Licensing approve the program approve the program leading to Bachelor of Science in Mechanical Engineering to be implemented in January 2020.

Francis Marion University Student and Program Data

Undergraduate In-/Out-of-State Enrollment, Fall 2017	3,296 (95.26%)/164(4.74%)
Number of Approved Programs in 10 Yrs. (FY 2009- 2018)	12
Number of Terminated Programs in 10 Yrs. (FY 2009- 2018)	2

Industry Related Occupational Wages and Projections in South Carolina, 2016 – 2026*

Occupational Field[1]	2016 Median Income[2]	2016 Estimated Employment[3]	2026 Projected Employment	Total 2016-2026 Employment Change	2016-2026 Annual Avg. Percent Change	Total Percent Change
Architecture and Engineering	$71,370	39,528	45,055	5,527	1.32%	17.98%

[1] "Occupational Field" represents the closest related occupation category that includes the occupations aligned with the program proposal.
[2] SC Department of Employment & Workforce (DEW), Labor Market Information. (2018). Occupational Employment and Wage Rates (OES) for All Major Groups in South Carolina in 2016 [Data file]. Retrieved from https://jobs.scworks.org/vosnet/lmi/default.aspx?pu=1
[3] SC Department of Employment & Workforce (DEW), Labor Market Information. (2018). Occupational Projections (Long-term) for Multiple Occupations in South Carolina in 2016-2026 [Data file]. Retrieved from https://jobs.scworks.org/vosnet/lmi/default.aspx?pu=1
* Data downloaded October 8, 2018; Most recent data available.

NEW PROGRAM PROPOSAL FORM

Name of Institution: Francis Marion University

Name of Program (include degree designation and all concentrations, options, or tracks):
Bachelor of Science in Mechanical Engineering

Program Designation:

- ☐ Associate's Degree
- ☐ Master's Degree
- ✓ Bachelor's Degree: 4 Year
- ☐ Specialist
- ☐ Bachelor's Degree: 5 Year
- ☐ Doctoral Degree: Research/Scholarship (e.g., Ph.D. and DMA)
- ☐ Doctoral Degree: Professional Practice (e.g., Ed.D., D.N.P., J.D., Pharm.D., and M.D.)

Consider the program for supplemental Palmetto Fellows and LIFE Scholarship awards?

- ✓ Yes
- ☐ No

Proposed Date of Implementation: January 2020

CIP Code: 14.1901

Delivery Site(s): Francis Marion University – main campus

Delivery Mode:

- ✓ Traditional/face-to-face
  *select if less than 25% online
- ☐ Distance Education
  - ☐ 100% online
  - ☐ Blended/hybrid (50% or more online)
  - ☐ Blended/hybrid (25-49% online)
  - ☐ Other distance education (explain if selected)

Program Contact Information (name, title, telephone number, and email address):

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Institutional Approvals and Dates of Approval (include department through Provost/Chief Academic Officer, President, and Board of Trustees approval):

Department approval – August 20, 2018
Faculty Academic Affairs Committee approval – September 6, 2018
Faculty Senate approval – September 20, 2018
General Faculty approval – October 11, 2018
Provost approval – October 12, 2018

President approval – October 12, 2018
Board of Trustees approval – November 15, 2018

Background Information

State the nature and purpose of the proposed program, including target audience, centrality to institutional mission, and relation to the strategic plan.

Francis Marion University is proposing a new Bachelor of Science degree in mechanical engineering. Mechanical engineering involves applying the physics of motion (force, energy, and kinematics) to design equipment, devices, and machines. Mechanical engineers work in a variety of design and manufacturing industries, including aerospace, automotive, construction, energy, and robotics. The target audience for the program is South Carolina undergraduate students.

The South Carolina Commission on Higher Education (CHE) officially approved Francis Marion University's Bachelor of Science in Industrial Engineering degree on October 3, 2013. The first graduates of the industrial engineering program received their degrees in May 2017. In August 2018, ABET informed FMU of the successful accreditation of the industrial engineering program. Industrial engineering students and graduates have been in high demand by regional employers. To date, all FMU industrial engineering students have been employed upon graduation with the lone exception being a student who received funding to pursue graduate studies in industrial engineering at Clemson. Given the success of the industrial engineering program and the response of regional South Carolina employers, the university decided to explore expanding the engineering offerings on campus. A feasibility study that included communication with regional employers reached the conclusion that mechanical engineering was the next logical offering at FMU.

The FMU faculty and Board of Trustees approved a strategic plan in 2012. This mechanical engineering proposal relates to three objectives in this plan. They are:

- Objective I – Maintain and expand quality academic programs and maintain academic accreditation as indicators of program quality.
- Objective III – Continue to build an excellent faculty
- Objective VII – Increase student enrollment and retention.

If approved, the proposed mechanical engineering program will result in an expansion of quality academic programs and ABET accreditation will be pursued. The university will bring the same approach to hiring new engineering faculty that has created an excellent FMU faculty. Finally, as described later in this proposal, it is anticipated that the new program will result in a net increase in student enrollment.

The mission statement for Francis Marion University states, in part, that "its purpose is threefold: to provide students with an excellent education, stimulate inquiry and research, and serve the Pee Dee region and the state of South Carolina. Francis Marion University adheres to the primary purpose of its establishment: to make available excellent educational programs for the people of the region and the state." The proposed mechanical engineering program is motivated entirely by a desire to adhere to these purposes.

For many South Carolina students, especially those living within economically-disadvantaged areas, such as FMU's service region, a residential college experience at one of the state's larger universities remains a financial impossibility. As a result, deserving students simply do not have access to the mechanical engineering programs that they desire and that would provide

appreciable career opportunities. These students, especially those from the Pee Dee region, would be particularly well served by a local, affordable mechanical engineering program.

The unemployment rate of the Pee Dee region remains higher than the state average and household earnings remain below the state average. For many years, Francis Marion University has worked to address these dynamics by creating academic programs that meet specific workplace needs and allow graduates to earn substantial wages. The university's recent programs in industrial engineering and healthcare administration are two examples of FMU's commitment to improving the economic development of our region while providing valuable opportunities for our students.

Assessment of Need

Provide an assessment of the need for the program for the institution, the state, the region, and beyond, if applicable.

Available data indicate that mechanical engineering is a high-interest field of study for many South Carolina students. Table 1 details the number of South Carolina high school students by high school graduation year who indicated a probable major in mechanical and industrial engineering when they took the ACT. Approximately 200 students in each of the classes of 2016 and 2017 indicated a probable major of mechanical engineering. Only 15 such students indicated a probable major of Industrial Engineering. This ratio of more than 10 to 1 suggests that popularity of mechanical engineering amongst South Carolina high school students is higher than industrial engineering. This suggests that mechanical engineering enrollment at FMU will be higher than industrial engineering.

Table 1. Number of South Carolina High School students by their graduation year who indicated either Mechanical or Industrial Engineering as a probable major when they took the ACT. Students are grouped by ACT test score (score on the Math test for the Class of 2016 and 2017).

SC High School Senior Class Year	ACT Math Score	Indicated Probable Major in Mechanical Engineering	Indicated Probable Major in Industrial Engineering
2016	23-25	85	3
	26-28	63	7
	29-31	32	2
	32-34	15	3
	TOTAL (23-34)	**195**	**15**
2017	23-25	88	6
	26-28	68	3
	29-31	34	4
	32-34	15	0
	TOTAL (23-34)	**205**	**13**

The proposed mechanical engineering program will advance the university's important work. Mechanical engineers--who "design, develop, build and test mechanical and thermal sensors and devices, including tools, engines, and machines"—play a central role in helping South Carolina, especially its underserved regions, attract new industry (Bureau of Labor Statistics Occupational Handbook). Equally important, engineers earn considerable compensation. According to the Bureau of Labor Statistics, South Carolina currently employs 3,420-6,950 mechanical engineers, who earn a mean wage of $86,080-92,290 per year. These figures compare favorably with the national average of $84,190 (Bureau of Labor Statistics Occupational Handbook). Salary.com reports that entry-level salaries for mechanical engineers (ME1s) are equally impressive, as shown in Table 2 for the data of five municipalities within the FMU service region.

Table 2. Entry-level salaries for mechanical engineers in the Pee Dee region.

Municipality	Salary
Florence	$58,854
Marion	$58,462
Dillon	$58,396
Darlington	$58,854
Bishopville	$58,396

Not only are these salaries well above the area averages; they are also remarkably consistent between larger, more prosperous communities, such as Florence, and smaller, poorer communities, such as Bishopville.

Equally important, mechanical engineering is a profession positioned for steady growth in the coming years. The Bureau of Labor Statistics anticipates a 9% increase in the demand for mechanical engineers between 2016-2026, which is comparable to the average expected growth for all professions. According to the CHE's study, Occupational Outlook for Various Programs of Study (2016), engineering in South Carolina is "expected to grow 10.9% through 2022" (p. 31).

Although the CHE study notes that "the number of civil and mechanical engineers is about balanced between openings and graduates" (p.31), it also acknowledges that "Depending on the percentage of STEM graduates in particular fields who find jobs in non-STEM occupations, there may be additional shortages, particularly among civil and mechanical engineers" (p.35). Equally important, the CHE report fails to account for South Carolina graduates finding out of state employment, particularly important when one considers the number of out of state enrollees at South Carolina engineering institutions. The report also fails to consider regional supply and demand. The employer survey conducted as part of this report provides evidence that such issues exist.

Transfer and Articulation

Identify any special articulation agreements for the proposed program. Provide the articulation agreement or Memorandum of Agreement/Understanding.

Not applicable.

Employment Opportunities

Table 3. Mechanical engineering jobs and job growth

Occupation	State		National		Data Type and Source
	Expected Number of Jobs	Employment Projection	Expected Number of Jobs	Employment Projection	
Mechanical Engineering	3,420 to 6,950	~10% growth	288,800 in 2016, expected to grow to 314,100 by 2026	9% over next 10 years	Bureau of Labor Statistics and SC CHE Occupational Outlook for Various Programs of Study

Supporting Evidence of Anticipated Employment Opportunities

Provide supporting evidence of anticipated employment opportunities for graduates.

To assess the demand for mechanical engineers in regional constituencies, surveys were administered to two groups in the Pee Dee: employers and practicing engineers. Nine employers and ten practicing engineers responded to the survey. The employers are summarized in Table 4 and in total employ a minimum of 50 mechanical engineers. Note that regional demand is greater than this number as it only represents those responding to the survey.

GE Healthcare manufactures MRI magnets and recently expanded to include the production of PET-MRI systems as well as supporting a local warehouse. Groupe Beneteau is a manufacturer of luxury yachts. Honda of South Carolina produces all terrain vehicles. Nan Ya Plastics's facility in Lake City produces polyester filament, fiber, and chip (resin) for the textile and bottle/sheet industries. Sam Carbis Solutions Group produces safety solutions for manufacturing facilities. Schaeffler Group has two facilities in Cheraw and produces precision automotive parts. Sonoco in Hartsville produces packing products and solutions. Wyman Gordon designs and manufactures complex metal components for the aerospace industry.

Table 4. Employers responding to survey
GE Healthcare
Groupe Beneteau
Honda of South Carolina
Nan Ya Plastics
Ruiz Foods
Sam Carbis Solutions Group

Schaeffler Group – Cheraw, SC
Sonoco
Wyman Gordon

Eight of the nine employers (89%) indicated difficulty in hiring mechanical engineers with 5 (56%) further experiencing issues in retaining mechanical engineers. Table 5 provides the responses employers provided when asked to elaborate on these challenges.

Table 5. If your company has difficulty hiring and/or retaining mechanical engineers, please elaborate
There is a small pool of candidates and we are struggling to compete with larger employer.
The local talent pool for recent grads is minimal. We have resorted to hiring remote mechanical engineers because of the local talent gap.
Relocating someone can be an issue in hiring/finding them
When looking for candidates, people from outside this area are not interested in relocating here.
Most new hires are not local to area, and move on after 2-3 years for larger cities. Engineers we retain for longer periods are local to the area.
Location

All employers (9 of 9) indicated an interest in hiring mechanical engineering graduates from Francis Marion University. Practicing engineers indicated with unanimity (10 of 10) that there is a current need for mechanical engineers in and around the Pee Dee and anticipate that need continuing to grow. Finally, both employers and practicing engineers indicated a willingness to support a new mechanical engineering program at FMU (providing coops/internships and serving on an advisory board).

Description of the Program

Table 6. Projected enrollment (CHE format)

Projected Enrollment			
Year	Fall Headcount	Spring Headcount	Summer Headcount
2019-2020	N/A	20	
2020-2021	35	35	
2021-2022	50	50	
2022-2023	75	75	
2023-2024	100	100	

Explain how the enrollment projections were calculated.

Enrollment at Clemson University indicates an approximate 2:1 ratio in the number of students enrolling in mechanical vs. industrial engineering. It is worth noting that this ratio has been consistently decreasing in favor of industrial engineering over the last five years despite both majors growing in popularity. This ratio, combined with historical enrollments in the FMU Department of Physics & Engineering, has been used to project enrollments in a potential FMU

mechanical engineering program, as well as its impact on existing program enrollment. Upon the arrival of industrial engineering at FMU, enrollments in dual engineering and physics decreased and took about 6 years to recover. Note that engineering technology enrollment was not impacted by industrial engineering and is therefore not projected to be negatively impacted with the arrival of mechanical.

Besides the general institutional admission requirements, are there any separate or additional admission requirements for the proposed program? If yes, explain.

☐ Yes

✓ No

The curriculum on the following pages was developed by faculty at FMU. As part of the curriculum development process, the faculty and administration consulted with Dr. William Wepfer. Dr. Wepfer recently retired as the longtime chair of the Woodruff School of Mechanical Engineering at Georgia Tech. Dr. Wepfer is a Fellow in the American Society of Mechanical Engineers and in 2014-15 served as Chair of the Engineering Accreditation Commission for the Accreditation Board for Engineering and Technology (ABET). Dr. Wepfer encouraged us to leverage existing FMU resources in developing our program. FMU faculty also incorporated feedback from regional industry partners in designing the original curriculum to meet their engineering needs.

Curriculum

New Courses

List and provide course descriptions for new courses.

ENGR 250 **Mechanics of Materials** (3 credit hours) (prerequisite: ENGR 301) Spring. The course covers determination of stresses, deflections, and stability of deformable bodies with an introduction to finite elemental analysis. By successfully completing this course, students will be able to identify, formulate, and solve problems related to the effect of forces on deformable bodies. An emphasis will be placed on the behavior of beams and columns.

ENGR 370 **Fluid Mechanics** (3 credit hours) (Prerequisite: ENGR 250, Mathematics 301, Mathematics 306, Physics 200) Spring. The course introduces the concepts and applications of fluid mechanics and dimensional analysis with an emphasis on fluid behavior, internal and external flows, analysis of engineering applications of incompressible pipe systems, and external aerodynamics.

ENGR 400 **Thermodynamics and Heat and Mass Transfer** (4 credit hours) (Prerequisites: ENGR 250, 370, Physics 200, Mathematics 301) Spring. The course covers applications of the laws of thermodynamics to closed and open systems. Topics include steady one-dimensional conduction, lumped parameter analysis, convection, radiation, and diffusion.

ENGR 401 **Design of Mechanisms** (3 credit hours) (Prerequisites: ENGR 201, 250, Mathematics 301) Fall. The course focuses on the function, classification, position, velocity, and acceleration of multi-element mechanical linkages. Furthermore, the course discusses design methods and practical information about common mechanisms and mechanism components. By successfully completing this course, students will be able to identify and analyze various mechanical linkage mechanisms, including four-bar mechanisms, gears, gear trains, and cams.

ENGR 402 **System Dynamics and Controls** (3 credit hours) (Prerequisites: ENGR 250, 310, Mathematics 301) Spring. The course covers dynamic modeling and simulation of systems with mechanical, 6 hydraulic, thermal, and/or electrical elements. Topics include frequency response analysis, stability, and feedback control design of dynamic systems.

ENGR 411 **Design for Manufacturing and Assembly** (3 credit hours) (Prerequisites: ENGR 350 Prerequisite/corequisite: ENGR 401) Fall. The course is based on concurrent engineering techniques to link product design to modern manufacturing and assembly process design. The course will also introduce students to modern manufacturing and assembly process design techniques used to reduce costs. By successfully completing this course, students will be able to: design new products while considering manufacturing and/or assembly processes; redesign existing products to reduce product realization costs; analyze manufacturing and assembly systems to determine inefficiencies; and apply several other Design for X principles.

ENGR 482 **Mechanical Engineering Senior Design** (4 credit hours) (Prerequisites: ENGR 370, 411) Spring. This course serves as the capstone design experience for mechanical engineering students. The course involves the design and development of solutions to real-world mechanical engineering problems. Students will demonstrate the ability to work in teams and solve problems, which include multiple realistic constraints and require the application of engineering standards and codes.

Total Credit Hours Required: 123
New: 23

Table 10. Curriculum for FMU Mechanical Engineering

Curriculum by Year					
Course Name	**Credit Hours**	**Course Name**	**Credit Hours**	**Course Name**	**Credit Hours**
Year 1					
Fall		**Spring**		**Summer**	
PHYS 200 – Technical Physics I	4	ENGR 101 – Introduction to Engineering	3		
MATH 201 – Calculus I	3	ENGR 201 – Engineering Graphics	3		
CHEM 101 – General Chemistry I	4	PHYS 201 – Technical Physics II	4		
ENGL 101 – Analysis and Argument	3	MATH 202 – Calculus II	3		
		ENGL 102 – Rhetoric, Genre, and Reesearch	3		
Total Semester Hours	14	Total Semester Hours	16	Total Semester Hours	
Year 2					
Fall		**Spring**		**Summer**	
ENGR 301 – Engineering Mechanics	3	ENGR 220 – Engineering Materials	3		
PHYS 202 – Technical Physics III	4	ENGR 250 – Mechanics of Materials	3		
PHYS 220 – Computational Methods for Physics and Engineering	3	MATH 301 – Ordinary Differential Equations	3		
MATH 203 – Calculus III	3	ECON 203 – Introduction to Microeconomics	3		
Literature elective	3	History elective	3		
Total Semester Hours	16	Total Semester Hours	15	Total Semester Hours	

Course Name	Credit Hours	Course Name	Credit Hours	Course Name	Credit Hours
Year 3					
Fall		**Spring**		**Summer**	
ENGR 310 – Electronics and Instrumentation	4	ENGR 330 – Engineering Economy	3		
ENGR 320 – Statistics for Engineers	3	ENGR 370 – Fluid Mechanics	3		
ENGR 350 – Manufacturing Processes	4	Biology elective	4		
MATH 306 – Multivariable Calculus	3	SPCO 101 – Basics of Oral Communication	3		
ECON 204 – Introduction to Macroeconomics	3	Fine arts elective	3		
Total Semester Hours	17	Total Semester Hours	16	Total Semester Hours	
Year 4					
Fall		**Spring**		**Summer**	
ENGR 401 – Design of Mechanisms	3	ENGR 400 – Thermodynamics and Heat & Mass Transfer	4		
ENGR 411 – Design for Manufacturing and Assembly	3	ENGR 402 – System Dynamics and Controls	3		
ENGR 468 – Production Planning	3	ENGR 482 – Mechanical Engineering Senior Design	4		
ENGL 318 – Technical Communication	3	Humanities elective	3		
POLI 101 or 103 – Political Science	3				
Total Semester Hours	15	Total Semester Hours	14	Total Semester Hours	
Year 5					
Fall		**Spring**		**Summer**	
Total Semester Hours		Total Semester Hours		Total Semester Hours	

Similar Programs in South Carolina offered by Public and Independent Institutions

Identify the similar programs offered and describe the similarities and differences for each program.

Table 11. Similar programs in South Carolina

Program Name and Designation	Total Credit Hours	Institution	Similarities	Differences
B.S. in Mechanical Engineering	135	The Citadel	• FMU and The Citadel's ME programs cover fundamental topics in Mechanical Engineering such as Engineering Mechanics and Thermodynamics. • Both programs include technical communication in their respective curricula. • Both programs emphasize the need for hands-on experiences.	• Most FMU students are local to the Pee Dee region and pursue local employment opportunities. FMU-ME curriculum is geared towards helping students achieve this goal. • FMU-ME will offer unique options to students due to the close integration with the FMU-IE curriculum. Specifically, courses such as Production Planning, and Engineering Economy. The Citadel's ME curriculum is more closely tied to Civil Engineering. • While the Citadel's ME curriculum integrates many Physical Education and Leadership courses, the FMU-ME curriculum focusses on fulfilling the needs of local industries with a design and manufacturing focus. • The FMU-ME students will have a unique opportunity to collaborate with FMU-IE students on projects.

B.S. in Mechanical Engineering	125	Clemson University	• FMU and Clemson University's ME programs cover fundamental topics in Mechanical Engineering such as Engineering Mechanics and Thermodynamics. • Both programs include technical communication in their respective curricula. • Both programs emphasize the need for hands-on experiences. • Both programs offer a course focused on design for manufacturing and assembly. • Both universities provide opportunities for collaboration between IE students and ME students.	• Most FMU students are local to the Pee Dee region and pursue local employment opportunities. FMU-ME curriculum is geared towards helping students achieve this goal. • FMU-ME will offer unique options to students due to the close integration with the FMU-IE curriculum. Specifically, courses such as Production Planning, and Engineering Economy. These options are not available to Clemson University ME students (within the ME curriculum).
B.S. in Mechanical Engineering	126	University of South Carolina	• FMU and University of South Carolina's ME programs cover fundamental topics in Mechanical Engineering such as Engineering Mechanics and Thermodynamics. • Both programs emphasize the need for hands-on experiences. • Both programs offer a course focused on design for manufacturing and assembly.	• Most FMU students are local to the Pee Dee region and pursue local employment opportunities. FMU-ME curriculum is geared towards helping students achieve this goal. • FMU-ME will offer unique options to students due to the close integration with the FMU-IE curriculum. Specifically, courses such as Production Planning, and Engineering Economy. These options are not available to University of

				South Carolina ME students (within the ME curriculum). • FMU-ME students will also learn technical communication through a formal course in the curriculum. This is unavailable to USC-ME students. • The FMU-ME students will have a unique opportunity to collaborate with FMU-IE students on projects.

Faculty

Table 12. Summary of current and future faculty supporting FMU engineering courses

Rank and Full- or Part-time	Courses Taught for the Program	Academic Degrees and Coursework Relevant to Courses Taught, Including Institution and Major	Other Qualifications and Relevant Professional Experience (e.g., licensures, certifications, years in industry, etc.)
Assistant Professor, Full-time	ENGR 201, 220, 301, 350, 401, 411, 480, 482	B.Eng. Mechanical Engineering M.S. Mechanical Engineering Ph.D. Mechanical Engineering	
Assistant Professor, Full-time	ENGR 101, 355, 420, 468, 470	B.S. Industrial Engineering M.S. Health Systems Ph.D., Industrial Engineering	
Assistant Professor, Full-time	ENGR 320, 330, 356, 373, 467	B.S. Mathematics M.S. Mathematics Ph.D., Industrial and Systems Engineering	
Assistant Professor, Full-time (arrives August 2020)	ENGR 101, 301, 370, 400, 482	Ph.D. Mechanical Engineering	
Assistant Professor, Full-time (arrives August 2021)	ENGR 201, 220, 301, 310, 350, 402	Ph.D. Mechanical or Industrial Engineering	
Professor, Full-time in department (part-time contributions to ENGR)	ENGR 310	B.S. Health Physics M.S. Health Physics Ph.D. Nuclear Engineering	

Total FTE needed to support the proposed program: Two
Faculty: Two, new full-time engineering faculty
Staff: No new staff is anticipated as a result of the mechanical engineering program addition.
Administration: No new administrative personnel are needed to add this program

Faculty, Staff, and Administrative Personnel

Discuss the Faculty, Staff, and Administrative Personnel needs of the program.

Currently, three full-time faculty members support the industrial engineering degree program. Additional faculty in the Department of Physics and Engineering support courses such as Electronics (ENGR 310.) Due to the significant overlap between industrial and mechanical engineering, mechanical engineering can be added with the addition of two new engineering faculty.

The Department of Physics and Engineering already has a laboratory manager on staff and shares an administrative assistant with the Department of Chemistry. No new staff is anticipated as a result of the mechanical engineering program addition.

Upon creation of the program, a mechanical engineering faculty member will be appointed as Coordinator of the program. This faculty member will receive one course release per year. No other administrative changes are needed.

Resources

Library and Learning Resources

Explain how current library/learning collections, databases, resources, and services specific to the discipline, including those provided by PASCAL, can support the proposed program. Identify additional library resources needed.

The 77,000 square foot James A. Rogers Library contains 475 seats and is open 85.5 hours a week and students, faculty and staff are provided 24/7 online access to electronic resources. The library houses a collection of over 398,000 print volumes, 274 of which are in the Mechanical Engineering subject area, 550 print subscriptions, 377,000 volumes of microforms, and 142 electronic databases to access information from almost anywhere. In addition, the library provides electronic access to over 340,000 accessible e-books (710 in the Mechanical Engineering subject area), and 35,000 accessible e-journals, many in full text format.

In addition, a plethora of other resources are available via our electronic databases. With a keyword search for "mechanical engineering" via EBSCO Discovery, there were 4,417,971 hits. These sources include the following databases:

Academic Search Complete
Applied Science and Technology
Business Source Premier
eBook Central
Professional Development Collection
Science Reference Center
Science Direct
Inspec
JStor
PASCAL ebooks
Engineering Source
IBISWorld
Ingenta

Student Support Services

Explain how current academic support services will support the proposed program. Identify new services needed and provide any estimated costs associated with these services.

Center for Academic Success and Advisement (CASA).

The Center for Academic Success and Advisement (CASA) offers students a one-stop resource for assistance with advising questions, academic support, and career services. CASA, located in Founders Hall 220, is home to Advisement, the Career Development Office, the Tutoring Center, as well as the Writing Center (located downstairs in FH 114-C). CASA provides a variety of services designed to help students thrive during their time at Francis Marion University. CASA advisors work closely with first-year students to ease the transition from high school to university life. In year two, students are assigned an academic advisor in their major.

Writing Center

The FMU Writing Center is available to help all students improve their writing abilities and acquire the skills needed to succeed at writing tasks in academic and professional communities. English Department faculty consultants and trained student consultants provide one-on-one assistance on a wide range of writing tasks and projects, including research papers for all disciplines, literary analyses, creative writing, lab reports, resumes, business letters, and graduate school applications.
The writing center is also available to students online for assistance and tutoring.

Career Development Center

The Career Development Office, located in CASA (Founders Hall 220), provides a comprehensive, educational approach to career development and preparation. Career services and programs are available for all FMU students and alumni. Students are encouraged to begin using the Career Development Office during their first year of enrollment. Staff members are available to meet with students exploring their skills and interests as they decide upon their majors and plans for specific career fields.

Tutoring Center

The FMU Tutoring Center provides all students with learning assistance for a variety of subjects, including math, sciences, social sciences, and humanities courses. Located in CASA (Founders Hall 220), the Tutoring Center is staffed by faculty members and trained peer tutors. Students are welcome to meet with tutors to review course content, practice problem solving skills, and discuss study strategies.

Computer and Technology Services

FMU's Campus Technology office provides information, technology resources and services for instructional and research missions of the University. The department provides digital content, access to that content, and guidance for its use through public computer laboratories and support in the Stanton Academic Computer Center and facilities in the John K. Cauthen Educational Media Center. All currently enrolled students are provided a SwampFox Mail email account. The SwampFox Emergency Alert System has been adopted by FMU in order to quickly notify students via SMS text messaging (standard text messaging rates apply) and email in the event of an imminent campus emergency. The campus is covered by Wi-Fi access.

Counseling and Testing Center

Counseling and Testing is responsible for meeting the personal counseling needs of FMU students. Professional counselors are available to help with personal, relationship, and/or emotional issues (with referrals made to community agencies as needed). The office also coordinates the advanced placement testing program and administers several standardized

tests used by graduate and professional schools. Counseling and Testing serves as the focal point of academic services for students with disabilities.

Student Health Services
FMU is committed to providing professional and cost-effective health care for its students through Student Health Services. The goal of Student Health Services is to promote and maintain the health of students by providing preventive services, health education, acute and chronic medical care, and referral assistance so that students can best meet their educational objectives. There are no fees for services rendered in Student Health.

Physical Resources/Facilities
Identify the physical facilities needed to support the program and the institution's plan for meeting the requirements.

Francis Marion University has existing physical space located in McNair Science Building (MSB) and Leatherman Science Facility (LSF) to support the proposed program. Laboratory space is scheduled for renovation to fit the specific needs for Mechanical Engineering

Equipment
Identify new instructional equipment needed for the proposed program.

Equipment
Free and Forced Convection
Boyle's Law
Rotating Fatigue Tester
Bernoulli's Principle
Digital Hydraulic Bench
Energy Transfer Calorimeter
Heat Engine Cycles
Specific Heat
Computer-Based Thermal Expansion
Heat Conduction

Note: The Duke Energy Foundation has committed grant funds ($50,000) to cover cost of this equipment.

Impact on Existing Programs

Will the proposed program impact existing degree programs or services at the institution (e.g., course offerings or enrollment)? If yes, explain.

✓Yes

☐No

As discussed previously, early enrollment is expected to impact enrollment in other similar programs. We have a basis for estimating the short term enrollment impact based on what transpired when the industrial engineering program began at FMU. Similarly, the recovery of that enrollment in existing programs is expected to take place over a 6 year period. Therefore, the long-term impact is expected to be a net growth in enrollment in these programs. Not accounted for is any potential net benefit to other programs as FMU becomes more widely known for its engineering programs.

The University has developed a plan for renovating existing, under-utilized classroom and laboratory space to provide the required space for the mechanical engineering program. The plan involves conversion of a computer lab which was formerly a laboratory into a mechanical engineering laboratory, conversion of an underutilized classroom into a combined classroom and computer lab, moving a computer cluster to an unused small classroom and converting its current home to two faculty offices. Renovation of an existing classroom will facilitate use in engineering and other classes. This space will be shared with existing programs in industrial engineering and physics. The costs associated with these changes to existing spaces are reflected in the budget in Year 1 under the Facilities, Equipment, Supplies, and Materials section.

As described earlier, two new faculty hires (one in August 2020 and a second in August 2021) are planned as part of this proposal. The total number of engineering faculty will then be five. The total number of faculty in the department will then be fourteen. The faculty will be able to handle the advising load throughout program growth. This load is eased by freshman advising taking place in the Center for Academic Success and Advisement.

Financial Support

Sources of Financing for the Program by Year												
	1st		2nd		3rd		4th		5th		Grand Total	
Category	**New**	**Total**	**New**	**Total**	**New**	**Total**	**New**	**Total**	**New**	**Total**	**New**	**Total**
Tuition Funding	165,000	165,000	577,500	577,500	825,000	825,000	1,237,500	1,237,500	1,485,000	1,485,000	4,290,000	4,290,000
Program-Specific Fees												
Special State Appropriation												
Reallocation of Existing Funds	187,300	187,300									187,300	187,300
Federal, Grant, or Other Funding	50,000	50,000									50,000	50,000
Total	402,300	402,300	577,500	577,500	825,000	825,000	1,237,500	1,237,500	1,485,000	1,485,000	4,577,300	4,577,300
Estimated Costs Associated with Implementing the Program by Year												
	1st		2nd		3rd		4th		5th		Grand Total	
Category	**New**	**Total**	**New**	**Total**	**New**	**Total**	**New**	**Total**	**New**	**Total**	**New**	**Total**
Program Administration and Faculty/Staff Salaries		79,252	196,392	354,897	196,392	407,732	196,392	434,149	196,392	434,149	785,568	1,710,179
Facilities, Equipment, Supplies, and Materials	247,300	251,783	10,000	18,966	10,000	21,954	10,000	23,448	10,000	23,448	287,300	339,599
Library Resources		5,548		11,095		14,794		16,643		16,643		64,723
Other (Indirect Departmental Cost Spread)		48,344		96,688		128,917		145,032		145,032		564,013
Total	247,300	384,927	206,392	481,645	206,392	573,397	206,392	619,272	206,392	619,272	1,072,868	2,678,513
Net Total (Sources of Financing Minus Estimated Costs)	155,000	17,373	371,108	95,855	618,608	251,603	1,031,108	618,228	1,278,608	865,728	3,504,432	1,898,787

Note: New costs - costs incurred solely as a result of implementing this program. Total costs - new costs; program's share of costs of existing resources used to support the program; and any other costs redirected to the program.

Budget Justification

Provide an explanation for all costs and sources of financing identified in the Financial Support table. Include an analysis of cost-effectiveness and return on investment and address any impacts to tuition, other programs, services, facilities, and the institution overall.

The Mechanical Engineering program will become self-sustaining in the second year of the program with the addition of its second cohort of students. Large facilities renovation, equipment, and staff needed for start-up are the primary factor for the loss in year 1. . Renovations will take place to create office space for new faculty and redesigned lab and classroom spaces for the mechanical engineering program. Planned facilities' renovations will cost approximately $187,300 and will be paid for from capital reserve. New equipment has been identified (page 16) and will cost approximately $50,000.

Overall, the expansion of programs will yield increases in total enrollment for the Department of Physics and Engineering, which will allow other departmental programs to spread overhead over a large base of students. Our Total Cost column reflects the departmental indirect spread that will be felt by the program as a result of the increase in enrollment. Overall, the new program revenue will far exceed the new program cost investment in the first five years and will also improve the profit margin of other engineering and physics majors by the spreading of department indirect costs across a larger enrollment base.

As described earlier, costs associated with the new mechanical engineering program are relatively low due to the significant curricular support provided by existing programs in industrial engineering, physics, and mathematics. Facility costs are also relatively low since existing space exists which will only require renovation. This renovated space will support the new mechanical engineering program, but will also support existing engineering and physics programs.

Evaluation and Assessment

As described later in this proposal, the mechanical engineering program will pursue accreditation with ABET. ABET has a strictly defined assessment and continuous improvement process. We have adopted ABET's approach for the section below. Alignment of outcomes to objectives takes place in Table 15. And assessment of outcomes to specific outcomes is detailed in Table 16.

ABET's Program Educational Objectives are statements of expected accomplishments of mechanical engineering graduates within 3 to 5 years of graduation. Student Learning Outcomes line up with Program Educational Objectives. Student Learning Outcomes are then assessed as part of the continuous improvement process described in the next section.

For example, Objective (a) involves graduates being able to obtain graduate degrees. The student outcomes which align with this objective are 1, 6, and 7. The proposed program will offer courses which help students develop skills involving the identification, formulation, and solution to complex engineering problems by applying principles of engineering, science, and mathematics. These skills will prepare students for their future engineering profession and for graduate study.

Table 14. Program Educational Objectives and Student Outcomes

Program Objectives	**Student Learning Outcomes Aligned to Program Objectives**	**Methods of Assessment**
Graduates of the program will be able to: a. Obtain an advanced degree (e.g. MS, MBA, PhD) at an accredited institution b. Spearhead/lead an industrial project or research initiative c. Organize or significantly support structured community outreach/education efforts and activities d. Acquire skills/knowledge through certification in areas not on the ME degree plan	The program must have documented student outcomes that support the program educational objectives. Attainment of these outcomes prepared graduates to enter the professional practice of engineering. 1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics 2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors 3. an ability to communicate effectively with a range of audiences 4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the	Methods of assessment are described in the text below.

	impact of engineering solutions in global, economic, environmental, and societal contexts 5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives 6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions 7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies	

Table 15. Alignment of Student Outcomes to Program Educational Objectives

			Student Outcomes							
			1	2	3	4	5	6	7	Total
Program Educational Objectives (PEOs)	Obtain Advanced Degree from Accredited Institution	a	**X**					**X**	**X**	**3**
	Lead Industrial Project/ Research	b	**X**	**X**	**X**	**X**	**X**	**X**		**6**
	Organize or Engage in Community Outreach Efforts	c		**X**	**X**	**X**	**X**			**4**
	Acquire skills/knowledge through certification in areas not in the ME curriculum	d			**X**	**X**		**X**	**X**	**4**

Explain how the proposed program, including all program objectives, will be evaluated, along with plans to track employment. Describe how assessment data will be used.

Table 16 gives the mapping of Student Outcomes to courses and the illustration of measurement through the four-year curriculum. The measurement of student outcomes is structured to ensure that no individual course or semester is unbalanced due to expected measures. Apart from the Senior Design class (ENGR

482), all courses that have been identified for Student Outcome measurement will focus on two or three outcomes. All Student Outcomes are measured at least twice during the 4-year curriculum.

The measurement of Student Outcomes is evenly distributed amongst faculty members, courses, and semesters. Additionally, the timeline of measurement enables the faculty to get a clear picture of student outcome performance through the four-year curriculum. Assessments of each outcome are performed before and after the introduction of pertinent instruction in the courses.

Table 16. Mechanical Engineering Student Outcome Assessment by Course

Semester/Year	***ENGR Course Number***	***Course Name***	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***Total***
Sp 1	101	Intro to Engineering			X	X			X	3
Sp 1	201	Eng Graphics		X		X				2
Fa 2	301	Mechanics	X							1
Sp 2	220	Eng Materials				X		X		2
Sp 2	250	Mech. of Materials	X							1
Fa 3	310	Electronics								0
Fa 3	320	Data Analytics			X		X	X		3
Fa 3	350	Manuf Processes	X						X	2
Sp 3	330	Eng Econ				X				1
Sp 3	370	Fluid Mechanics	X	X						2
Fa 4	401	Design of Mechanisms		X		X				2
Fa 4	411	DFMA		X		X		X		3
Fa 4	468	Prod Planning								0
Sp 4	400	Thermo/Heat & Mass Transfer	X					X		2
Sp 4	402	System Dynamics & Controls	X			X	X			3
Sp 4	482	ME Senior Design	X	X	X			X	X	5

A centralized database has been developed for the engineering programs to manage the questions, exercises and/or projects used to assess Student Outcomes. The questions in the database are selected by faculty and represent an appropriate measure for the outcomes to be measured in their respective course(s).

When it is time to administer a Student Outcome assessment for a given course, the instructor of the course uses the centralized question database to select a set of assessment questions, exercises, and/or projects in each of the measured student outcomes. These questions can then be embedded within graded course assignments without the knowledge of students, at the discretion of the instructor.

The program faculty then meets once per year to discuss the results of the assessments and determine possible course improvements when desired.

Accreditation and Licensure/Certification

Will the institution seek program-specific accreditation (e.g., CAEP, ABET, NASM, etc.)? If yes, describe the institution's plans to seek accreditation, including the expected timeline.

✓Yes

☐No

Francis Marion's B.S. in Industrial Engineering program received accreditation from the American Board of Engineering and Technology (ABET) in 2018. We will pursue ABET accreditation of the proposed B.S. in Mechanical Engineering. With a January 2020 start date, the first students will graduate in May 2022 with a second graduating cohort in May 2023. We would submit a Self-Study Report to ABET in July 2023 in advance of a site visit in Fall 2023 with an ABET accreditation decision made in July 2024. Note that this timeline aligns with the next general ABET review of the now accredited Industrial Engineering program.

Will the proposed program lead to licensure or certification? If yes, identify the licensure or certification.

✓Yes

☐No

Students would be eligible to pursue a Professional Engineer license.

Explain how the program will prepare students for this licensure or certification.

Students receiving bachelor's degrees from ABET accredited engineering programs are eligible for licensure as a Professional Engineer.

If the program is an Educator Preparation Program, does the proposed certification area require national recognition from a Specialized Professional Association (SPA)? If yes, describe the institution's plans to seek national recognition, including the expected timeline.

☐Yes

✓No