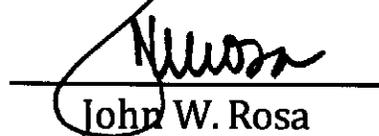


The Citadel
School of Engineering
REQUESTING TO OFFER A NEW DEGREE PROGRAM
Bachelors of Science Degree

in

**Mechanical
Engineering**

Submitted to the South Carolina Commission on Higher Education
August 1, 2012


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Program Planning Summary

Classification:

Program Title : Mechanical Engineering

Academic Unit: School of Engineering

Designation: : Bachelors of Science in Mechanical Engineering (BSME), 4-year program

136 credit hours including military science and physical education requirements

Proposed date of implementation: Aug 2013

CIP code from the current USDOE's Classification of Instructional Programs:
14.1901

Identification of Program as New or Modification: New

Site: On-site four-year day degree program as well as two-year evening degree completion program located at the Low Country Graduate Center for transfer students. Both traditional delivery.

Program qualifies for supplemental Palmetto Fellows Scholarship and LIFE Scholarship awards: Yes X No:

Justification:

The Bachelors of Science in Mechanical Engineering is intended to meet the expressed needs of South Carolina industries. Nationally, Mechanical Engineering is broken out as a separate category by the Department of Labor which shows growth in hiring of mechanical engineers from 212,000 in 2002 to 320,000 in 2011, and includes a 6% growth from 2010. Additionally it shows that Mechanical Engineers are the second most hired group of engineers after civil and before electrical engineers.

The engineering related job market in the Charleston area has exploded in recent years, including drastic increase in the need for Mechanical Engineers. Two large employers in the area, Boeing and SPAWAR Systems Center Atlantic, require literally thousands of engineers. Other large employers include automotive, manufacturing, medical device manufacturers, power generation, and processing. The Bachelors of Science in Mechanical Engineering is being developed at the request of a number of these South Carolina companies, particularly those based in Charleston. The desire to hire local talent and educate an existing workforce drives the need for a local undergraduate Mechanical Engineering program to complement the available civil and electrical engineering programs. A recent survey of mechanical engineering job postings found positions in health care, aviation, defense applications, power systems, telecommunications, automotive, manufacturing, testing, data centers, and many others. This

diversity means that employment as a mechanical engineer is more robust than other more narrowly focused engineering specialties.

The need for mechanical engineers will continue to grow and currently the US is not producing enough as we are seeing an increase in manufacturing and design returning to the US, to include the greater Charleston area. Engineering problem solving is in increased demand and mechanical engineers are a necessary and diverse core engineering skill set that are primarily focused on manufacturing processes and professional services. In this manner they bridge the gap between civil engineering needs and electrical engineering needs. Products will become increasingly complex with increased demand for sustainability that can only be answered through use of innovative processes that consider the human condition while being produced in less time.

The Bachelors of Science in Mechanical Engineering is an interdisciplinary degree. It includes electives that could be taken from Civil and Electrical Engineering as well as Chemistry, Biology, and Physics which are available at The Citadel. The overlap into Psychology should not be overlooked as the research into the human condition associated with products and manufacturing processes are explored.

Anticipated program demand:

The number of students taking evening engineering courses at The Citadel has increased dramatically in the last few years. For example, the electrical engineering numbers have more than doubled from 15 electrical engineering students to 38 students. Trident Technical College has an average of 10-15 students completing the Associates of Science in Mechanical Engineering each year. The arrival of Boeing and their survey of employee educational needs estimate nearly 1000 employees needing undergraduate degree completion, many in mechanical engineering. Many current civil and electrical engineering cadets (estimate 15) have expressed a desire to take mechanical engineering, but the overarching desire to attend the Citadel over shadows the desire to study mechanical engineering and forces them to study civil or electrical engineering. Additionally, there are a number of potential cadets (estimated 10-15 per year) who decide to attend either VMI or Norwich which do have mechanical engineering programs.

| Projected Total Enrollment | | | | | | |
|----------------------------|--------------------------|-----------------|--------------------------|-----------------|-----------|-----------------|
| Year | Fall | | Spring | | Summer | |
| | Headcount Day Evening | Credit hours | Headcount Day Evening | Credit Hours | Headcount | Credit Hours |
| 2013-2014 | 10; 20 | 440 | 10; 20 | 430 | 15 | 135 |
| 2014-2015 | 27; 43 | 1027 | 27; 43 | 1022 | 30 | 270 |
| 2015-2016 | 48; 50 | 1480 | 48; 50 | 1494 | 35 | 315 |
| 2016-2017 | 89; 55 | 2248 | 89; 55 | 2289 | 37 | 333 |
| 2017-2018 | 134; 59 | 3028 | 134; 59 | 3150 | 40 | 360 |

| Estimated New Enrollment | | | | | | |
|--------------------------|-------------------|--------------|-------------------|--------------|-----------|--------------|
| Year | Fall | | Spring | | Summer | |
| | Headcount Evening | Credit hours | Headcount Evening | Credit Hours | Headcount | Credit Hours |
| 2013-2014 | 20 | 260 | 20 | 240 | 16 | 96 |
| 2014-2015 | 43 | 325 | 43 | 1032 | 20 | 180 |
| 2015-2016 | 50 | 628 | 50 | 1200 | 25 | 225 |
| 2016-2017 | 55 | 690 | 55 | 1320 | 26 | 234 |
| 2017-2018 | 59 | 740 | 59 | 1416 | 27 | 243 |

Assumptions for the tables:

- A) New students will enter the program in the fall semester;
- B) There will be some attrition between academic years;

Program duplication:

There are no Bachelors of Science in Mechanical Engineering programs in the Low Country of South Carolina. There are BSME programs at Clemson University and The University of South Carolina, but no opportunity for local students in the heavily populated area of Charleston to attend a Mechanical Engineering program without leaving the area as well as no opportunity for local employees to complete their education in Mechanical Engineering. Trident Technical College has an Associate's of Science degree in Mechanical Engineering as well as Associate's degrees in Civil and Electrical Engineering. Many students in the Civil and Mechanical Engineering Associate programs at Trident Technical College matriculate into The Citadel's evening undergraduate Civil and Electrical Engineering programs. A number of the lower level courses that are required within a Mechanical Engineering program exist within the foundational courses in Civil and Electrical Engineering.

Data in 2011 on engineering students in select engineering programs at The Citadel, University of South Carolina, and Clemson University:

| Total Undergraduate Students for Select Engineering Programs | Total In Engineering | Civil | Electric al | Mechanical |
|--|----------------------|-------|-------------|------------|
| The Citadel | 289 | 188 | 101 | none |
| The University of South Carolina | 1051 | 159 | 100 | 210 |
| Clemson University | 1849 | 605 | 386 | 785 |
| Undergraduate Degrees Awarded | | | | |
| The Citadel | 83 | 52 | 31 | None |
| The University of South Carolina | 235 | 45 | 31 | 64 |
| Clemson University | 721 | 154 | 82 | 142 |

Other institutions:

Trident Technical College has an Associates of Science in Mechanical Engineering with many students taking their courses in the evening. The Citadel already has a Trident Technical College partnership with 2+2 articulation agreements for the Civil and Electrical Engineering degrees. A full time evening undergraduate Mechanical Engineering program in the Charleston area will assist students from across the state and nation to continue taking Mechanical Engineering courses while completing a CO-OP with local companies. This will not only increase student skills while working, but increase the ability of timely graduation for more engineering students who choose to do a CO-OP in the Charleston area.

Cost:

The funding for the program will be through evening tuition, foundation support and space reallocation. The expected evening student enrollments in each course will generate the tuition revenue to cover the cost of faculty salary after the initial year of each hire such that after year five the program will have sufficient evening tuition revenue to cover the faculty cost. The College will support start-up of the program during the first five years to include equipment and office furniture and computers.

| ESTIMATED COSTS BY YEAR | | | | | |
|----------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| CATEGORY | 1 ST | 2 ND | 3 RD | 4 TH | 5 TH |
| Program Administration | | | | | |
| Faculty Salaries | 170k | 310k | 465k | 535k | 535k |
| Graduate Assistants | 8k | 8k | 16k | 16k | 16k |
| Clerical/Support Personnel | 25k | 25k | 25k | 25k | 25k |
| Supplies and Materials | 10k | 20k | 20k | 20k | 20k |
| Library Resources | 10k | 5k | 3k | 2k | 2k |
| Equipment | 300k | 100k | 100k | 100k | |
| Facilities | | | | | |
| Other (Identify) | | | | | |

Proposed Curriculum:

The proposal calls for the curriculum to have five main focus areas to meet the needs of the local industry in South Carolina (See Attachment A - Draft Curriculum):

- Manufacturing
- Materials
- Mechatronics
- Power
- Aeronautics
- Other (thru course work in other programs such as Biomechanical, HVAC, Systems, Management, etc.



Department of Mechanical Engineering
Bachelor of Science in Mechanical Engineering
2013-2014 Curriculum

Freshman Year

Freshman—First Semester (Fall)

| | | |
|----------|--|---|
| HIST | Western or World Civilizations | 3 |
| ENGL 101 | Composition and Literature I | 3 |
| MATH 131 | Analytic Geometry and Calculus I | 4 |
| CHEM 151 | General Chemistry I | 3 |
| CHEM 161 | General Chemistry I Laboratory | 1 |
| CIT 101 | First Year Seminar | 1 |
| RPED 250 | Required Physical Education | 2 |
| MECH 101 | Introduction to Mechanical Engineering | 1 |

Semester Credit Hours 18

Freshman—Second Semester (Spring)

| | | |
|----------|------------------------------------|---|
| MECH 102 | Engineering CAD/Computing | 2 |
| ENGL 102 | Composition and Literature II | 3 |
| MATH 132 | Analytic Geometry and Calculus II | 4 |
| CHEM 152 | General Chemistry II | 3 |
| CHEM 162 | General Chemistry II Laboratory | 1 |
| PHYS 221 | Physics with Calculus I | 3 |
| PHYS 271 | Physics with Calculus I Laboratory | 1 |
| RPED 251 | Required Physical Education | 2 |

Semester Credit Hours 19

Sophomore Year

Sophomore—First Semester (Fall)

| | | |
|----------|-------------------------------------|---|
| ENGL 201 | Major British Writers | 3 |
| ELEC 201 | Electric Circuit Analysis I | 3 |
| CIVL 202 | Statics | 3 |
| MATH 231 | Analytic Geometry and Calculus III | 4 |
| PHYS 222 | Physics with Calculus II | 3 |
| PHYS 272 | Physics with Calculus II Laboratory | 1 |
| LDRS 201 | Sophomore Seminar | 1 |

Semester Credit Hours 18

Sophomore—Second Semester (Spring)

| | | |
|------------|---------------------------------|---|
| ENGL | American or World Literature | 3 |
| ELEC 202/4 | Electric Circuits II/Laboratory | 4 |
| CIVL 301 | Dynamics | 3 |
| MATH 234 | Applied Mathematics I | 4 |
| CIVL 304 | Mechanics of Materials | 3 |
| CIVL 307 | Materials Laboratory | 1 |
| RPED | Required Physical Education | 0 |

Semester Credit Hours 18

Junior Year

Junior—First Semester (Fall)

| | | |
|----------|--------------------------------------|---|
| MECH | Thermodynamics w/ lab | 3 |
| MECH | Fluid Mechanics w/lab | 3 |
| MATH 335 | Applied Mathematics II | 3 |
| MENG | Measurements & Instrumentation w/lab | 4 |
| MENG | Introduction to Design | 3 |
| RPED | Required Physical Education | 0 |

Semester Credit Hours 16

Junior—Second Semester (Spring)

| | | |
|------|----------------------------------|---|
| MENG | Modeling/Analysis of Dynamic Sys | 3 |
| MENG | Engineering Materials w/lab | 3 |
| MENG | Manufacturing/Machine Design | 3 |
| MENG | Heat Transfer | 3 |
| () | Technical Elective | 3 |
| HIST | Western or World Civilizations | 3 |

Semester Credit Hours 18

Senior Year

Senior—First Semester (Fall)

| | | |
|------|-----------------------------------|---|
| MENG | Control Systems | 3 |
| MENG | Mechanical Engineering Sys Design | 3 |
| MENG | ME Option I | 3 |
| MENG | Senior Design I | 2 |
| MECH | Mechatronics | 3 |

Semester Credit Hours 14

Senior—Second Semester (Spring)

| | | |
|------|--------------------------------|---|
| () | Social Science Core Course | 3 |
| MENG | Mechanical Elective | 3 |
| MENG | ME Option II | 3 |
| MENG | Senior Design II | 3 |
| () | Adv. Humanities/Social Science | 3 |

Semester Credit Hours 15

Total Program Credit Hours: 136

Basic ROTC during each semester of freshman and sophomore years, Advanced ROTC each semester junior and senior year.



Department of Mechanical Engineering
Bachelor of Science in Mechanical Engineering
2013-2014 Curriculum

Electives

| Course | Hrs |
|---|-----|
| MENG XXX ME Independent Study | 3 |
| MENG XXX Robotics Engineering | 3 |
| MENG XXX Finite Elements for Engineering Appl | 3 |
| MENG XXX Advanced Heat Transfer | 3 |
| MENG XXX Air Conditioning | 3 |
| MENG XXX Special Topics in ME | 3 |

Manufacturing Engineering (Choose 2)

| Course | Hrs |
|---|-----|
| MENG XXX Advanced Manufacturing Processes and their Application | 3 |
| MENG XXX Manufacturing Design | 3 |

Composites (Choose 2)

| Course | Hrs |
|-----------------------------|-----|
| MECH XXX Advanced Materials | 3 |
| MECH XXX Composite Design | 3 |

Power and Energy (Choose 2)

| Course | Hrs |
|-------------------------------------|-----|
| MENG XXX Mass and Energy Balance | 3 |
| ELEC XXX Electrical Power Systems | 3 |
| MENG XXX Energy Conversions Systems | 3 |
| MENG XXX Mechanical Power Plants | 3 |
| PHYS XXX Nuclear Reactor Analysis | 3 |
| MENG XXX Renewable Energy | 3 |

Aeronautical Systems (choose 2)

| Course | Hrs |
|---|-----|
| MENG XXX Introduction to Applied Aerodynamics | 3 |
| MENG XXX Aircraft Performance and Statics Stability | 3 |
| MENG XXX Propulsion Systems | 3 |

Mechatronics (choose 2)

| Course | Hrs |
|-------------------------------------|-----|
| ELEC 311 Digital Logic and Circuits | 3 |
| MECH XXX Advanced Mechatronics | 3 |

Students are required to take two courses in one of the five Option areas: Power and Energy, Manufacturing, Aeronautical, Composites, and Mechatronics.

Others: Biological Systems, Engineering Management, Automotive

7/3/2012

Estimated Revenue - Mechanical Engineering Major (New Students)

| Year | Fall | Spring | Summer | Total |
|-------|---------|---------|---------|---------|
| FY 14 | 107,400 | 99,200 | 40,000 | 246,600 |
| FY 15 | 134,970 | 424,840 | 74,600 | 634,410 |
| FY 16 | 259,480 | 494,000 | 93,250 | 846,730 |
| FY 17 | 285,100 | 543,400 | 96,980 | 925,480 |
| FY 18 | 305,760 | 582,920 | 100,710 | 989,390 |

Assumptions:

All students are SC residents; using FY 13 undergraduate credit hour fee