

ACAP  
9/10/2015  
Agenda Item 3d

Name of Institution  
The Citadel

Name of Program (include concentrations, options, and tracks)  
Master of Science Degree 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.)

Does the program qualify for supplemental Palmetto Fellows and LIFE Scholarship awards?  
 Yes  
 No

Proposed Date of Implementation  
Aug 2016

CIP Code  
14.1901

Delivery Site(s)  
Courses offered on-site and/or at the Low Country Graduate Center

Delivery Mode

- Traditional/face-to-face\*  
\*select if less than 50% online
- Distance Education  
 100% online  
 Blended (more than 50% online)  
 Other distance education

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

Dr. Ronald Welch  
Dean of Engineering  
843-953-6588  
[ronald.welch@citadel.edu](mailto:ronald.welch@citadel.edu)

Institutional Approvals and Dates of Approval

Graduate Curriculum Committee: 17 Feb 2015  
Academic Board: 24 Feb 2015  
President: 10 April 2015

### **Background Information**

State the nature and purpose of the proposed program, including target audience and centrality to institutional mission. (1500 characters)

The MSME is intended to meet the expressed needs of South Carolina industries, especially Charleston based companies. Nationally, Mechanical Engineering is broken out as a separate category by the Department of Labor which 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 a dramatic increase in the need for Mechanical Engineers. Employers include health care, aviation, defense applications, power systems, telecommunications, automotive, manufacturing, testing, data centers, and many others. The MSME supports The Citadel's LEAD 2018 Objective 2 (academic programs of distinction), Objective 4 (expand enrollment in The Citadel Graduate College), and Objective 8 (provide outreach to the region and serve as a resource in its economic development) and is being developed at the request of a number of Charleston based companies. The desire to hire local talent and educate an existing workforce drives the need for a local graduate ME program to complement an existing undergraduate engineering program. Our ability to offer graduate courses within The Citadel MSME is complementary to any other graduate courses being offered in the lowcountry in providing graduate engineering education. 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.

List the program objectives. (2000 characters)

Student outcomes describe what students are expected to know and be able to do by the time of graduation. These relate to the skills, knowledge, and behaviors that students acquire as they progress through the program. Graduates of the Master of Science degree program in Mechanical Engineering will, by the time of graduation:

- **Outcome 1:** Demonstrate breadth of knowledge in complimentary areas of mechanical engineering that promotes an awareness of and skill in interdisciplinary problem solving.
- **Outcome 2:** Demonstrate a depth of knowledge in a chosen focus area of mechanical engineering that allows the student to apply innovative techniques to solve problems.
- **Outcome 3:** Demonstrate knowledge in methods of advanced analysis appropriate for professional use when solving problems.
- **Outcome 4:** Demonstrate knowledge of contemporary issues in their chosen focus area.
- **Outcome 5:** Demonstrate the skills relevant to graduate level work to include the ability to formulate problems, synthesize and integrate information, work collaboratively, and to communicate effectively.
- **Outcome 6:** Demonstrate preparation for successful careers in industry or continued graduate work and an ethic for lifelong learning.

### **Assessment of Need**

Provide an assessment of the need for the program for the institution, the state, the region, and beyond, if applicable. (1500 characters)

The number of students taking engineering courses at The Citadel has increased dramatically over the last few years. For example, the number of undergraduate engineering students within the Corps of Cadets has grown from 318 in 2012 to 379 students in 2014. The number of evening students has grown from 65 to 85 students. All of this growth is prior to the inclusion of the mechanical engineering undergraduate cadet and evening students who began to attend in fall 2014 (90 new students). The number of enrollments in our MS in Project Management has grown from 95 in 2011 to over 350 in 2013-2014. Many of the evening students in Project Management have asked when will we begin to offer more technical masters level courses and degrees. The arrival of Boeing and their survey of employee educational needs estimate nearly 1000 employees needing undergraduate degree completion, many in engineering. However, recent discussions with key leaders and news releases at Boeing and other companies in the Lowcountry have noted a desire for their current workforce to complete certificates that will show immediate skill attainment as well as master's level technical degrees.

There are few key technical areas / skills this program will ensure anyone with a MSME who wants to work locally will either "have" or "be exposed" to:

Technical Skills / Competencies-

- 1) Advanced Analytic Tools- "product design & mfgs" needing analysis tools and specialized training skills such as: 3D Modeling w/ Finite Element Analysis (FEA), Computational Fluid Dynamics (CFD) and system simulations. More and more of the product design at companies is going to 100% "model based definition"
- 2) Design for Manufacturability and/or Assembly & Advanced Quality Management- Probably over 75% of the companies we are supporting in the Lowcountry area are "manufacturers" and we need MEs with basic Design for Manufacturing / Design for Assembly (DFM/DFA) and QA skills and/or knowledge. Just "exposing" the student to these topics in one course may be the way to go. A multi-subject course that covers DFM, DFA, Lean Mfg, and other advanced quality topics (Six Sigma & design of experiments / Analysis of Variance (DOE/ANOVA), failure modes and effects analysis (FMEA), etc).
- 3) Advanced Materials Science / Engineering- Composites is a must have but we need to address all the other industries' needs that support "metals" (advanced metallurgy class and lab possibly, corrosion, heat treating, etc).
- 4) Machine design or automated manufacturing systems / equipment design- basic robotics course (overview only or maybe a lab), and require exposure to programming
- 5) Product Development and/or Systems Engineering skills / competencies- product development "stage-gate" or life cycle models and the systems engineering "V" model to manage large complex product or system designs. This could go under "management" but can be technical.

The Charleston Regional Competitiveness Center forecasts there will be a 16.4% growth (7200 new jobs) in the engineering field in the area by 2018. This information follows closely to the Department of Labor statistics that show a 12 month growth rate for construction in South Carolina as 7.2% while in Charleston it was 16.2%, growth rate for manufacturing in South Carolina as 2.0% while in Charleston it was 25.4%, and the growth rate for trade, transportation, and utilities in South Carolina as 2.5% while in Charleston it was 3.1%. Many other areas were growing at a faster rate in Charleston than the state as a whole.

### Employment Opportunities

Is specific employment/workforce data available to support the proposed program?

Yes

No

If yes, complete the table and the component that follows the table on page 4. If no, complete the single narrative response component on page 5 beginning with "Provide supporting evidence."

<b>Employment Opportunities</b>			
<b>Occupation</b>	<b>Expected Number of Jobs</b>	<b>Employment Projection</b>	<b>Data Source</b>

Provide additional information regarding anticipated employment opportunities for graduates. (1000 characters)

Provide supporting evidence of anticipated employment opportunities for graduates, including a statement that clearly articulates what the program prepares graduates to do, any documented citations that suggests a correlation between this program and future employment, and other relevant information. Please cite specific resources, as appropriate. (3000 characters)

**Note: Only complete this if the Employment Opportunities table and the section that follows the table on page 4 have not previously been completed.**

There is not specific employment data beyond the fact that there is documented growth of current and new companies providing engineering support and/or products for the rapidly expanding manufacturing hub here in the Lowcountry. One example; Boeing has expanded its workforce to 7500 employees within the last year (many desiring additional skills through graduate certificates and MS degrees) and is currently bringing in a design center, a research center, and expanding the plant footprint. This only scratches the surface of the numerous newspaper articles noting companies moving production of required aeronautical parts to decrease the shipping costs from Washington State. Each of these companies require an engineering team to support design and production. The future deepening of the harbor heightens the desire for more companies to locate their production efforts here in the Lowcountry such as Continental Tire, Daimler (1300 jobs), etc. Charleston County is the only county in the US that manufactures planes, boats, and now automobiles. Most of the students that will be taking the courses within the MSME and its associated certificates will be existing mid-level employees with Lowcountry companies working to improve their current skill set. Some local industries need advanced degrees in their workforce and offer flexible work hours and pay for the employees' degrees / certificates. The availability of the Mechanical Engineering advance degree and/or certificates is a huge benefit for local employees, military, and veterans who are unable to travel to the nearest graduate level campus. The MSME is a logical, natural progression for the local 2+2 program.

The argument within the State House for many years is the need for a comprehensive university in the Lowcountry to be able to offer those already here the ability to obtain PhD level degrees. To support the long-term goal to offer engineering PhD's in the lowcountry, The Citadel is positioned with its all PhD faculty team to offer an MSME degree. The new mechanical engineering graduate program will closely resemble course offerings at Clemson University and USC to ensure ease of transfer for students desiring to transfer for a MS Thesis option or PhD.. An MSME degree at The Citadel will support the needs of local students unable to fully attend Clemson or USC for an MS degree, courses needed by PhD students conducting research in the lowcountry, employees of local companies, and the current students already taking a BSME at The Citadel whether as a cadet or an evening student.

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

- Yes  
 No

If yes, explain. (500 characters)

n/a

**List of Similar Programs in South Carolina**

<b>Program Name</b>	<b>Institution</b>	<b>Similarities</b>	<b>Differences</b>
MSME	Clemson University	Offering of courses in composites, mechatronics, manufacturing, aeronautics, power and energy	The Citadel MSME will only be a no thesis MS degree, only requires 6 ME courses and the other 4 courses can be Technical (ME, CE, EE, other) or non-technical (accounting, business, leadership, project management, etc.)
MSME	The University of South Carolina	Offering of courses in composites, mechatronics, manufacturing, aeronautics, power and energy	The Citadel MSME will only be a no thesis MS degree, only requires 6 ME courses and the other 4 courses can be Technical (ME, CE, EE, other) or non-technical (accounting, business, leadership, project management, etc.)

**Notes:**

There are no Masters of Science in Mechanical Engineering programs in the Low Country of South Carolina. There are MSME programs at Clemson University and The University of South Carolina, but limited opportunity for local students in the heavily populated area of Charleston to attend face-to-face a Mechanical Engineering program without leaving the area as well as limited opportunity for local employees to further their education face-to-face in Mechanical Engineering. The Citadel has a Bachelor of Science in Mechanical Engineering. Trident Technical College has an Associate in Science, Mechanical Engineering Transfer. Many students in the Associate in Science, Mechanical Engineering Transfer program at Trident Technical College matriculate into The Citadel's evening undergraduate Mechanical Engineering program. Many of these students desire to continue living in the Lowcountry and eventually obtain a MSME degree face-to-face.

**Description of the Program**

<b>Projected Enrollment</b>						
<b>Year</b>	<b>Fall</b>		<b>Spring</b>		<b>Summer</b>	
	Headcount	Credit Hours	Headcount	Credit Hours	Headcount	Credit Hours
2016-2017	5	45	5	45	3	15
2017-2018	12	108	12	108	6	18
2018-2019	19	171	19	171	10	30
2019-2020	29	261	29	261	15	45
2020-2021	39	351	39	351	20	60

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

Yes

No

If yes, explain. (1000 characters)  
n/a

Are there any special articulation agreements for the proposed program?

Yes

No

If yes, identify. (1000 characters)  
n/a

### Curriculum

Select one of the following charts to complete: Curriculum by Year **or** Curriculum by Category

<b>Curriculum by Category*</b>			
<b>Composites</b>	<b>Credit hours</b>	<b>Aeronautical</b> (Recommended sequence is MECH 611, 670, 771, and 772)	<b>Credit Hours</b>
MECH 604: Advanced Mechanics of Materials	3	MECH 631: Advanced Engineering Mathematics	3
MECH 605: Materials and Process Selection	3	MECH 611: Advanced Fluid Mechanics	3
MECH 606: Fatigue and Fracture	3	MECH 670: Applied Aerodynamics	3
MECH 702: Theory of Elasticity	3	MECH 771: Compressible Flow	3
MECH 703: Theory of Plasticity Note: Recommend MECH 702 before 703	3	MECH 772: Computational Methods in Thermal Sciences	3
MECH 708: Mechanics of Composite Materials	3		
<b>Manufacturing</b> (Courses can be taken in any sequence)		<b>Power and Energy</b> (Courses can be taken in any sequence)	
MECH 625: Computer-Aided Design and Analysis	3	MECH 615: Applied Heat Transfer	3
MECH 635: Computer-Aided Design and Analysis Laboratory	0	MECH 617: Advanced Topics in Renewable Energy Systems	3
MECH 640: Manufacturing Process and Design	3	MECH 618: Energy Sources, Technology, and Policy	3
MECH 645: Machine Design	3	MECH 619: Power Systems Engineering	3
MECH 660: Advanced Design	3		
<b>Mechatronics</b> (Courses can be taken in any sequence except MECH 755)			
MECH 650: Modeling, Analysis, and Control Systems	3		
MECH 655: Advanced Mechatronics	3		
MECH 750: Introduction to Modern Control Engineering	3		
MECH 755: Nonlinear Control Engineering	3		

\* Add category titles to the table (e.g., major, core, general education, concentration, electives, etc.)



Total Credit Hours Required 30

**Course Descriptions for New Courses**

<b>Course Name</b>	<b>Description</b>
MECH 604: Advanced Mechanics of Materials	Advanced topics in mechanics of materials, including three-dimensional stress and strain transformations, torsion of non-circular prismatic bars, shear center, unsymmetrical bending, curved beams, flat plates, elastic strain energy, and theories of failure and application to machine and structural design. <i>Prerequisites:</i> CIVL 304 or consent of program director.
MECH 605: Materials and Process Selection	Engineering application of materials. Material, shape, and process selection for mechanical designs based on function, constraints, objectives, and free variables. Materials and the environment. <i>Prerequisites:</i> CIVL 304 or consent of program director.
MECH 606: Fatigue and Fracture	Stationary crack under static loading, energy balance, crack initiation and growth, dynamic crack growth, and fatigue of metals, ceramics, polymers, and composites. <i>Prerequisite:</i> MECH 304 Engineering Materials or equivalent.
MECH 702: Theory of Elasticity	Plane stress and plane strain; two-dimensional problems in rectangular and polar coordinates; strain energy methods; complex variables in two-dimensional problems; the general equations of three-dimensional elasticity. <i>Prerequisites:</i> MECH 604 (Advanced Mechanics of Materials) or consent of program director.
MECH 703: Theory of Plasticity	Stress and strain tensors; elastic stress-strain relations, criteria of yielding; plastic stress-strain relations; elastoplastic problems of spheres and cylinders; the plane elastoplastic problem; the slip-line field. <i>Prerequisites:</i> MECH 604 (Advanced Mechanics of Materials) or consent of program director.
MECH 708: Mechanics of Composite Materials	Analysis of stress, strain, and strength of fiber reinforced composite laminates and structures. Topics include laminated plate theory, stress analysis of orthotropic plates, damage mechanisms, fatigue, impact, thermal and environmental effects. <i>Prerequisite:</i> MECH 604 (Advanced Mechanics of Materials) or consent of program director.
MECH 631: Advanced Engineering Mathematics	Classification and solution of partial differential equations; includes linear superposition, separation of variables, Fourier and Laplace transform methods, Green's functions, similarity solution, and spectral methods; introduction to solution of nonlinear partial differential equations, including both exact and approximate techniques, with a strong emphasis on physical systems. <i>Prerequisite:</i> MATH 335 (or equivalent undergraduate Applied Mathematics II course) or consent of program director.
MECH 611: Advanced Fluid Mechanics	Advanced Fluid Mechanics is a continuation of concepts presented in a typical undergraduate course in fluid mechanics. The course introduces vector, tensor, and indicial notation. Topics in incompressible fluid dynamics are explored at depth including viscous flows, the Navier-Stokes

	equations, and boundary layer theory. Basic concepts in turbulent flow are also covered. <i>Prerequisites:</i> MATH 231 and MECH 311 or consent of program director.
MECH 670: Applied Aerodynamics	Applied Aerodynamics introduces the basic theories for analyzing the aerodynamic forces on a vehicle in flight. Topics include incompressible flow over airfoils and finite wings, laminar and turbulent boundary layers in airfoil analysis, and boundary layer transition. <i>Prerequisites:</i> MATH 231 and MECH 311 or consent of program director.
MECH 771: Compressible Flow	Compressible Flow combines aspects of classical thermodynamics and equilibrium mixtures with compressible fluid flow. Chemical thermodynamics and real gases are explored. One-dimensional flows through nozzles and diffusers are analyzed. Normal and oblique shock relations, Prandtl-Meyer flow, and method of characteristics are also introduced. <i>Prerequisites:</i> MATH 231 and MECH 611 or consent of program director.
MECH 772: Computational Methods in Thermal Sciences	Computational Methods in Thermal Sciences is an introduction to the field of Computational Fluid Dynamics (CFD). Finite difference methods for the solution of fluid dynamics and heat transfer problems are utilized. Students will gain a general understanding of numerical methods, computer programming, and fluid dynamics and heat transfer through project-based assignments. Finite volume methods are also introduced. <i>Prerequisites:</i> MATH 231, MECH 611, MATLAB experience or consent of program director.
MECH 625: Computer-Aided Design and Analysis	Geometric and solid modeling, finite element analysis, optimization, rapid prototyping. Emphasizes practical utilization of computer-based design tools. <i>Prerequisites:</i> MECH102 and MECH 325 or consent of program director. <i>Corequisite:</i> MECH 635.
MECH 635: Computer-Aided Design and Analysis Laboratory	Non-credit laboratory to accompany MECH 625. <i>Corequisite:</i> MECH 625.
MECH 640: Manufacturing Process and Design	Selection and analysis of manufacturing processes. Product and process design for automated manufacturing. Economic analysis of manufacturing. Automated manufacturing, knowledge-based systems, and flexible product manufacture. <i>Prerequisites:</i> MECH 340 or consent of program director.
MECH 645: Machine Design	Selection, design, assembly, and analysis of common machine elements including springs, shafts, gears, clutches, brakes, and bearings. Computer-based methods of optimization employed when appropriate. <i>Prerequisites:</i> MECH 345 or consent of program director.
MECH 660: Advanced Design	Creative decision-making processes for design. In-depth study of design in mechanical engineering. Quality functions, robust design, axiomatic design, and design for assembly.
MECH 615: Applied Heat Transfer	Fundamentals of conduction, convective heat transfer, diffusive and convective mass transfer, heat-exchanger design; tradeoff associated with heat transfer systems, workable and optimal system. <i>Prerequisites:</i> MECH 415 or consent of program director.
MECH 617: Advanced Topics in Renewable Energy Systems	Advanced topics in renewable energy sources to include solar heating and cooling, wind resource characteristics and assessments; wind turbine technologies (fixed and variable-speed turbines);

	wind power transmission; integration and interconnection issues; and photovoltaic energy. Surveys the life cycle cost and present value to evaluate systems. Same as MECH 417 but includes graduate student project / report. <i>Prerequisites:</i> MECH 415 or consent of program director.
MECH 618: Energy Sources, Technology, and Policy	Multidisciplinary overview of energy technologies, fuels, environmental impacts, and public policies. Quantitative engineering analysis in energy, including the differences among fuels and energy technologies, the electricity sector, liquid fuels, conventional fuels, renewable fuels, impacts on the environment, basics of atmospheric chemistry, and water use for power plant cooling. Energy policy and the societal aspects of energy, such as culture, economics, war, and international affairs, are covered. <i>Prerequisites:</i> MECH 415 or consent of program director.
MECH 619: Power Systems Engineering	Physical features, operational characteristics, and analytical models for major electric power systems and components; advanced techniques for solving large power networks; load flow, symmetrical components, short circuit analysis. <i>Prerequisites:</i> MECH 415 or consent of program director.
MECH 650: Modeling, Analysis, and Control Systems	Methods for analytical modeling, analysis, prediction, and control of linear, stationary time series of multidisciplinary dynamic systems, including mechanical, electrical, electro-mechanical, hydraulic and pneumatic systems; includes examples of advanced research in nonstationary time-series modeling and applications in manufacturing and other areas. Students complete a project on a topic of their choice. <i>Prerequisite:</i> MECH 350 and MECH 450 or consent of program director.
MECH 655: Advanced Mechatronics	Integrated use of mechanical, electrical, and computer systems for information processing and control of machines and devices. System modeling, electro- mechanics, sensors and actuators, basic electronics design, signal processing and conditioning, noise and its abatement, grounding and shielding, filters, and system interfacing techniques. <i>Prerequisite:</i> MECH 350 and MECH 450 or consent of program director.
MECH 750: Introduction to Modern Control Engineering	State variable methods, eigenvalues, and response modes; controllability, observability, and stability; calculus of variations; optimal control; control of regulator and tracking servomechanisms; Hamilton-Jacobi, dynamic programming; deterministic observers, Kalman filter; discrete and continuous time. <i>Prerequisite:</i> MECH 350 and MECH 450 or consent of program director.
MECH 755: Nonlinear Control Engineering	Characteristics of nonlinear systems; State space formulation; stability criteria; Liapunov functions; describing functions; signal stabilization; Popov and circle criteria for design; adaptive control-systems. <i>Prerequisite:</i> MECH 350 and MECH 650 or consent of program director.

The new mechanical engineering graduate program will closely resemble course offerings at Clemson University and USC to ensure ease of transfer for students desiring to transfer for a MS Thesis option or PhD. A comparison of the degree with those at Clemson University and the University of South Carolina is provided below in Table 1. The Citadel MSME will require 30 credit hours where 18 credit hours will be technical while 12 credit hours can be non-technical (finance, accounting, leadership, program management,

ACAP  
9/10/2015  
Agenda Item 3d

etc.). As shown in Table 1, there will be the opportunity to complete individual graduate certificates in five main focus areas to meet the needs of the local industry in South Carolina: Manufacturing, Materials, Mechatronics, Power and Energy, and Aeronautics.

Table 1: MS Mechanical Engineering Comparison to Other Institutions

	<b>Citadel</b>	<b>Clemson</b>		<b>USC</b>	
	MS Non Thesis	MS Thesis	MS Non Thesis	MS Thesis	ME Non Thesis
Total Hrs	30	30	33	30	30
Core / Focus Area	Comp. – 12 Aero – 12 Manf – 12 Pwr&En – 12 Mechatron – 12	Eng Mech –12 TherFluid – 15 Dynamics – 9 DsgnManf -9	Eng Mech –12 TherFluid – 15 Dynamics – 9 DsgnManf -9	12	12
Other Tech	6 minimum	0 → 6 (50% min tech)	0 → 9 (50% min tech)	advisor	advisor
Other	12 maximum	15	15	advisor	advisor

Citadel MS in Mechanical Engineering:

- 30 credit hours, non-thesis
- Require at least 6 courses (18 hours) in technical classes
- 4 courses (12 hours) in technical or non-technical classes (Mechanical, Electrical, Civil, Program Management, Business)

Example Course Plan:

If a student, for example, has a focus in Composites, he/she must take the 4 Composite courses. The remaining technical courses must be a minimum combination of 2 from the Other Technical Courses (from available focus areas such as Aero). The Other 4 courses can be from non-technical (Business, Leadership, Program Management) or from technical programs (Mechanical, Electrical, or Civil). See example in Table 2, below.

ACAP  
 9/10/2015  
 Agenda Item 3d

Table 2: Sample Course Plan for Composite Focus in MS ME Program

	Course # and Title	30 Credit Hours
MS ME Focus Area (Composites)	MECH 604: Advanced Mechanics of Materials	3
	MECH 606: Fatigue and Fracture	3
	MECH 702: Theory of Elasticity	3
	MECH 708: Mechanics of Composite Materials	3
Other Tech Courses	MECH 605: Advanced Engineering Mathematics	3
	MECH 670: Applied Aerodynamics	3
Other Courses	PMGT 650: Overview of Technical Project Mgmt	3
	PMGT 651: Tech Project Planning and Scheduling	3
	PMGT 652: Applications in Quality Management	3
	PMGT 653: Technical Project Support and Operations	3

**Faculty**

<b>Faculty and Administrative Personnel</b>				
<b>Rank</b>	<b>Full- or Part-time</b>	<b>Courses Taught or To be Taught, Including Term, Course Number &amp; Title, Credit Hours</b>	<b>Academic Degrees and Coursework Relevant to Courses Taught, Including Institution and Major</b>	<b>Other Qualifications and Comments (i.e., explain role and/or changes in assignment)</b>
*Professor	Full-time	To be hired		
Associate Professor	Full-time	MECH 650 MECH 655 MECH 750 MECH 755	PhD, MSE: ME Univ TX at Austin; Model & Simul, Sys Dynamics, Cntrl Sys Dsgn, Veh Sys Dyn, Mechatronics	PE EIT
Associate Professor	Full-time	MECH 604 MECH 605 MECH 606 MECH 702 MECH 703 MECH 708	PhD, University of New Orleans: Plasticity, Elasticity, Aerospace Composites, Advanced Composite Materials, Fracture Mechanics ; ME, Poznan University of Technology: Solid-state Physics, Production Technology	
Assistant Professor	Full-time	MECH 625 MECH 635 MECH 640 MECH 645 MECH 660	PhD, ME Georgia Tech; Computer Aided Design, Mfg Processes and Systems, Mfg Systems, Micro Mfg, Eng Economy, Fracture Mechanics, Structural Vibrations	
Assistant Professor	Full-time	MECH 631 MECH 611 MECH 670 MECH 771 MECH 772	MS, MAE Univ or Virginia; Comp Flow, Fluid Mech, Adv Engr Math, Num Methods, CFD, Conduction, Convection, Radiation, Stat Mech, Non-Eq. Thermo, Combustion	FE
*Assistant Professor	Full-time	MECH 615 MECH 617 MECH 618 MECH 619	Howison, MS, MAE – UVA; Conduction, Convection, Radiation, Combustion Rabb, PhD, ME – UT Austin; Radiation Heat Transfer, Combustion, Sys Dynamics	
*Assistant Professor	Full-time	To be hired		

ACAP  
9/10/2015  
Agenda Item 3d

*Assistant Professor	Full-time	To be hired		
-------------------------	-----------	-------------	--	--

Note: Individuals should be listed with program supervisor positions listed first. Identify any new faculty with an asterisk next to their rank.



Total FTE needed to support the proposed program (i.e., the total FTE devoted just to the new program for all faculty, staff, and program administrators):

Faculty	1	Staff	0	Administration	0
---------	---	-------	---	----------------	---

### **Faculty /Administrative Personnel Changes**

Provide a brief explanation of any additional institutional changes in faculty and/or administrative assignment that may result from implementing the proposed program. (1000 characters)

Faculty are required to teach a full load – 12 credit hours each semester. Each faculty member may consult one day per week and can gain teaching release time for successful research proposals. Additionally, The Citadel has a foundation grant that provides funding (\$2500 each area/year) in the following three areas: research seed funding, result presentations at conferences, and/or participate in faculty development opportunities. The new MSME program will start with current faculty teaching courses as an add pay in the summer while leveraging the ability for students to take up to 4 non-technical courses already being offered throughout the year. As the demand increases beyond the ability for faculty to cover courses with add pay, faculty positions will be requested or reallocated. Current estimates would allow the program to cover 6 graduate courses per semester when the full complement of faculty are hired based on the BSME program approved 3 October 2013 and one additional FTE faculty member. The staff and administration positions supporting the BSME will also support the MSME program.

### **Library and Learning Resources**

Identify current library/learning collections, resources, and services necessary to support the proposed program and any additional library resources needed. (1000 characters)

The 2011 Standards for College Libraries does not address Mechanical Engineering specifically beyond recommending that a comparison of our holdings should occur with a group of peer institutions. The Citadel's holdings were compared with those of Clemson and USC (PASCAL members), VMI, UT-Chattanooga, Western Carolina, and University of North Florida. The Citadel library catalog holdings are small for mechanical engineering; however, the current ebook package, Academic Complete from ebrary, yields 3,521 hits from the same phrase search. These ebooks are available from on and off campus to currently-enrolled students.

The top 5 U.S. journals in mechanical engineering are *IEEE/ASME Transactions on Mechatronics* (access *IEEE*), *Precision Engineering* (access *ScienceDirect*), *Journal of Fluids and Structures* (access *ScienceDirect*), *Journal of Sound and Vibration* (access *ScienceDirect*), *Tribology Letters* (access *ScienceDirect*), and *Tribology International* (access *ScienceDirect*). The Citadel has access to all of them.

The new BSME program has purchased a print version of the entire ASTM package. We expect many fully employed students will be using company resources to complete assignments. The Citadel currently spends approximately \$40,000 per year on engineering.

ACAP  
9/10/2015  
Agenda Item 3d

### **Student Support Services**

Identify academic support services needed for the proposed program and any additional estimated costs associated with these services. (500 characters)

The Citadel currently has strong student support services for existing undergraduate programs, graduate programs and veterans. These same services would provide support for the evening students who would be taking courses within the MSME degree or associated certificates. It is expected that a majority of the students will be either full time employed or completing research degrees through Clemson's Restoration Institute.

### **Physical Resources**

Identify any new instructional equipment needed for the proposed program. (500 characters)

The equipment being purchased as part of the new BSME program as well as the equipment used within the BSCE and BSEE programs will support any physical demonstrations needed within MSME level courses. Since the MSME degree requires only 10 courses and no thesis, the lab equipment needs will be limited to support for showing theoretical concepts within a given course. The five focus areas: composites, mechatronics, manufacturing, aeronautics, and power and energy are the same as the five focus areas within the BSME and associated equipment being purchased.

Will any extraordinary physical facilities be needed to support the proposed program?

Yes

No

Identify the physical facilities needed to support the program and the institution's plan for meeting the requirements, including new facilities or modifications to existing facilities. (1000 characters)

ACAP  
9/10/2015  
Agenda Item 3d

n/a

### Financial Support

Estimated New Costs by Year						
Category	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>	5 <sup>th</sup>	Total
Program Administration	0	0	0	0	0	0
Faculty and Staff Salaries	6,000	12,000	105,000	105,000	117,000	345,000
Graduate Assistants	0	0	0	0	0	0
Equipment	0	0	0	0	0	0
Facilities	0	0	0	0	0	0
Supplies and materials	500	500	500	500	500	2500
Library Resources	0	0	0	0	0	0
Other*	0	0	0	0	0	0
<b>Total</b>	6,500	12,500	105,500	105,500	117,500	347,500
Sources of Financing						
Category	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>	5 <sup>th</sup>	Total
Tuition Funding	19,500	45,000	72,000	109,500	147,000	393,000
Program-Specific Fees	0	0	0	0	0	0
State Funding (i.e., Special State Appropriation)*	0	0	0	0	0	0
Reallocation of Existing Funds*	0	0	0	0	0	0
Federal Funding*	0	0	0	0	0	0
Other Funding*	0	0	0	0	0	0
<b>Total</b>	19,500	45,000	72,000	109,500	147,000	393,000
<b>Net Total</b> (i.e., Estimated New Costs Minus Sources of Financing)	13,000	32,500	(33,500)	4,000	29,500	45,500

\*Provide an explanation for these costs and sources of financing in the budget justification.

### **Budget Justification**

Provide a brief explanation for the other new costs and any special sources of financing (state funding, reallocation of existing funds, federal funding, or other funding) identified in the Financial Support table. (1000 characters)

**Note: Institutions need to complete this budget justification *only* if any other new costs, state funding, reallocation of existing funds, federal funding, or other funding are included in the Financial Support table.**

n/a

### **Evaluation and Assessment**

**Programmatic Assessment:** Provide an outline of how the proposed program will be evaluated, including any plans to track employment. Identify assessment tools or software used in the evaluation. Explain how assessment data will be used. (3000 characters)

The Citadel is accredited by the Commission on Colleges of the Southern Association of Colleges and Schools. The undergraduate engineering programs are accredited by ABET (ME will request initial accreditation in June 2016). The MS in Project Management has requested accreditation through the Project Management Institute Global Accreditation Center. The MSME program will track accomplishment of Program Outcomes through the Taskstream software. All programs within the School of Engineering track employment or employment changes after completion of each degree. The MSME will track employment data in a similar way, but will also track from where students are initiating their MSME (full-time employment, research, full-time schooling by continuing their education after a BSME, etc.).

**Student Learning Assessment**

<b>Expected Student Learning Outcomes</b>	<b>Methods of/Criteria for Assessment</b>
Demonstrate breadth of knowledge in complimentary areas of mechanical engineering that promotes an awareness of and skill in interdisciplinary problem solving	Exams, design projects
Demonstrate a depth of knowledge in a chosen focus area of mechanical engineering that allows the student to apply innovative techniques to solve problems	Exams, design projects and certificates
Demonstrate knowledge in methods of advanced analysis appropriate for professional use when solving problems	Exams, design projects, homework
Demonstrate knowledge of contemporary issues in their chosen focus area	Papers, presentations
Demonstrate the skills relevant to graduate level work to include the ability to formulate problems, synthesize and integrate information, work collaboratively, and to communicate effectively	Exams, design projects, homework, presentations
Demonstrate preparation for successful careers in industry or continued graduate work and an ethic for lifelong learning	Surveys, work placement tracking and certificates

Will the proposed program seek program-specific accreditation?

Yes

No

If yes, provide the institution's plans to seek accreditation, including the expected timeline for accreditation. (500 characters)

n/a

Will the proposed program lead to licensure or certification?

Yes

No

If yes, explain how the program will prepare students for licensure or certification. (500 characters)

n/a

### **Teacher or School Professional Preparation Programs**

Is the proposed program a teacher or school professional preparation program?

Yes

No

If yes, complete the following components.

Area of Certification

n/a

Please attach a document addressing the South Carolina Department of Education Requirements and SPA or Other National Specialized and/or Professional Association Standards.