

ACAP
3/23/17
Agenda Item 5b

Name of Institution
Clemson University

Name of Program (include concentrations, options, and tracks)

Materials Science & Engineering

Program Designation

- | | |
|---|--|
| <input type="checkbox"/> Associate's Degree | <input type="checkbox"/> Master's Degree |
| <input checked="" type="checkbox"/> Bachelor's Degree: 4 Year | <input type="checkbox"/> Specialist |
| <input type="checkbox"/> Bachelor's Degree: 5 Year | <input type="checkbox"/> Doctoral Degree: Research/Scholarship (e.g., Ph.D. and DMA) |
| <input type="checkbox"/> 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 **Fall 2017** CIP Code **14.1801**

Delivery Site(s) **Clemson University Main Campus**

Delivery Mode

- | | |
|--|---|
| <input checked="" type="checkbox"/> Traditional/face-to-face*
*select if less than 50% online | <input type="checkbox"/> Distance Education |
| | <input type="checkbox"/> 100% online |
| | <input type="checkbox"/> Blended (more than 50% online) |
| | <input type="checkbox"/> Other distance education |

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

Marian S. Kennedy
Associate Professor, Department of Materials Science & Engineering
864.656.5349
mskenne@clemson.edu

Institutional Approvals and Dates of Approval

Department of Materials Science & Engineering 4/7/2016
College of Engineering, Computing and Applied Sciences Curriculum Committee
9/16/2016
University Undergraduate Curriculum Committee 10/7/2016
Board of Trustees: 2/3/2017 (Anticipated)

Background Information

Provide a detailed description of the proposed modification, including its nature and purpose and centrality to institutional mission. (1500 characters)

Clemson University has a responsibility to drive innovation and incubate research that addresses national challenges including improving healthcare, energy production and increasing environmental sustainability. Since materials play key roles in addressing these great challenges, the university is dedicated to providing undergraduate and graduate materials engineering programs. The Clemson University Department of Materials Science & Engineering began offering a B.S. degree in Materials Science & Engineering with concentrations in 'Polymeric Materials' or 'Inorganic Materials' in 2011. These concentrations grew out of the merger of the Department of Ceramic & Materials Engineering and the School of Textiles, Fiber & Polymer Science in 2001. After their merger into a single Department of Materials Science & Engineering, the faculty initially still supported undergraduate students matriculating through five undergraduate degree programs until 2011. By 2011, the faculty had streamlined the undergraduate program into a single undergraduate degree program with two concentrations.

This proposal is to merge the two concentration areas (Polymeric Materials and Inorganic Materials) into a single Materials Science & Engineering B.S. curriculum track. Currently, the two concentration areas have different curricular requirements from the first semester of the sophomore year through the senior year. These changes were made based on input from the MSE Undergraduate Standards Committee, Curriculum Advisory Board, faculty and students. These groups based their decisions on a variety of data, including prior ABET and ABET Mock reviews.

List the objectives of the modified program. (1500 characters)

The modification to a single curriculum track will:

- **Ensure all students graduating from the program have the same foundational knowledge**
- **Increase clarity for students, employers and faculty advisors**
- **Simplify review and evaluation process for professional and regional accreditation**
- **Allow the department to offer all students the opportunity to complete a B.S./M.S. program**

Program objectives will continue to closely follow the recommendations of ABET (the program's specialty accreditor), and include:

- **Ability to apply mathematics, science and engineering principles.**
- **Ability to design and conduct experiments, analyze and interpret data.**
- **Ability to function on multidisciplinary teams.**
- **Ability to identify, formulate and solve engineering problems.**
- **Understanding of professional and ethical responsibility.**
- **Ability to communicate effectively.**
- **The broad education necessary to understand the impact of engineering solutions in a global and societal context.**
- **Recognition of the need for and an ability to engage in life-long learning.**
- **Knowledge of contemporary issues.**
- **Ability to use the techniques, skills and modern engineering tools necessary for engineering practice.**

Assessment of Need

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

Feedback from the reviews from both ABET reviews and a subsequent Mock ABET review highlighted both strengths and weakness of our undergraduate degree program. The reviewers highlighted exceptional components of the current curriculum and outlined the benefits of requiring a senior-level individual undergraduate research since this requirement augments the senior capstone course by providing a supervised but independent hands-on research experience.

However, reviewers were concerned about large differences between requirements for each of the concentration tracks (inorganic and polymeric) under a single degree (Materials Science & Engineering). For example, one review stated: "While the curriculum for the inorganic materials concentration is consistent with a program with the modifier of materials, the curriculum for the polymeric materials concentration does not provide a level of instruction in the processing, structure, property, and performance of ceramics, metals, and semiconducting materials to a depth consistent with this the materials program modifier." Using this feedback, along with feedback from the MSE Undergraduate Standards Committee, Curriculum Advisory Board, the MSE faculty and MSE students, the new curriculum was created.

Will the proposed modification impact any existing programs and services at the institution?

Yes

No

If yes, explain. (1000 characters)

The modifications will merge the existing two concentrations into a single track.

Current sophomores, juniors, and seniors within the MSE program will be able to complete a B.S. degree in MSE and will be able to complete a concentration in either the Polymeric Materials or Inorganic Materials. We expect the current sophomores to graduate in May 2019. We have spoken to and emailed our current freshman about the new MSE program we are working to put into place. The current freshmen in General Engineering who select MSE (either concentration) as their major currently have common freshman and sophomore years now. Since the curriculum maps for the first two years (freshman and sophomore years) courses are identical to the proposed MSE curriculum, these students can transition into the proposed program.

None of the courses required in either concentration are being deleted in the merged curriculum. The specialized courses differentiating the two concentrations are being moved as technical electives in the merged curriculum during the senior year. This means that if a student did not want to switch to the merged curriculum, the student would be able to remain in and graduate with either concentration. Assuming that these students will graduate on time, the last student with the option of concentrations in MSE will graduate in May 2020.

List of Similar Programs in South Carolina

There is no other undergraduate program focused on materials engineering within South Carolina.

Program Name	Institution	Similarities	Differences

Description of the Program

Projected New Enrollment						
Year	Fall		Spring		Summer	
	Headcount	Credit Hours	Headcount	Credit Hours	Headcount	Credit Hours
2017	40	600	40	600	0	0
2018	45	675	45	675	0	0
2019	45	675	45	675	0	0
2020	50	750	50	750	0	0
2021	55	825	55	825	0	0

Curriculum

Attach a curriculum sheet identifying the courses required for the program.

See Appendix A

Curriculum Changes

Note: Complete this table only if there are changes to the curriculum.

Courses Eliminated from Program	Courses Added to Program
MSE 3610 (Proc. Of Metals and their Composites, 3cr) Removed relative to both concentrations.	ECE 2070 (Basic Electrical Engineering, 2cr) Added relative to both concentrations.
MSE 4130 (Non-crystalline Materials, 3cr) Deleted relative to Inorganic Materials Concentration only. Now an option for technical elective requirements.	MSE 3100 (Introduction to Metals and Ceramics Engineering, 3cr) Added relative to both concentrations.
MSE 4320 (Manufacturing Processing Processes and Systems, 3cr) Deleted relative to Inorganic Materials Concentration only. Now an option for technical elective requirements.	MSE 3190 (Processing of Materials I, 3cr) Added relative to prior Polymeric Materials Concentration only.
MSE 4410 (Manufacturing Laboratory, 1cr) Deleted relative to Inorganic Materials Concentration only. Now an option for technical elective requirements.	MSE 3260 (Thermodynamics of Materials, 3cr) Added relative to prior Polymeric Materials Concentration only.
MSE 4580 (Surface Phenomena in Materials Science, 3cr) Deleted relative to Polymeric Materials Concentration only. Now an option for technical elective requirements.	STAT 4110 (Statistical Methods for Process Development and Control, 3cr) Added relative to both concentrations.
MSE 4600 (Surface Phenomena Laboratory, 1cr) Deleted relative to Polymeric Materials Concentration only. Now an option for technical elective requirements.	MSE 4810 (Fundamentals of Research, 1cr) Added relative to both concentrations.
MSE 4610 (Polymer & Fiber Science III, 3cr)	MSE 4020 (Solid State Materials, 3cr) Added relative to prior Polymeric Materials Concentration only.

Deleted relative to Polymeric Materials Concentration only. Now an option for technical elective requirements.	
*MSE 4910 (Undergraduate Research, 1cr) Removed 1 of 3 credits for both concentrations.	MSE 3010 (Materials Characterization Laboratory, 2cr) Added relative to both concentrations.
MSE 4570 (Color Science, 3cr) Deleted relative to Polymeric Materials Concentration only. Now an option for technical elective requirements.	MSE 3020 (Materials Characterization Laboratory, 2cr) Added relative to both concentrations.
MSE 4590 (Color Science Laboratory, 1cr) Deleted relative to Polymeric Materials Concentration only. Now an option for technical elective requirements.	Technical Requirement (3cr) Added relative to both concentrations.
MSE 4160 (Electrical Properties of Materials, 3cr) Deleted relative to Inorganic Materials Concentration only. Now an option for technical elective requirements.	Technical Requirement (3cr) Added relative to both concentrations.
MSE 4240 (Optical Materials & their Apps, 3cr) Deleted relative to Inorganic Materials Concentration only. Now an option for technical elective requirements.	Technical Requirement (3cr) Added relative to both concentrations.
MSE 4330, Combustion System & Envir. Emissions, 3cr) Deleted relative to Inorganic Materials Concentration only. Now an option for technical elective requirements.	Technical Requirement (3cr) Added relative to prior Inorganic Materials Concentration only.
CH 3310 (Physical Chemistry I, 3cr) Removed relative to Polymeric Materials Concentration only.	Technical Requirement (3cr) Added relative to prior Inorganic Materials Concentration only.
MSE 3280 (Phase Diagrams for Matl's Proc & Apps, 3cr) Deleted relative to Inorganic Materials Concentration only. Now an option for technical elective requirements.	
MSE 3420 (Structure/Prop Laboratory, 2cr) Deleted relative to Inorganic Materials Concentration only.	
CH 3320 (Physical Chemistry II, 3cr) Removed relative to Polymeric Materials Concentration only.	
MSE 4560 (Polymer & Fiber Sci II, 3cr) Deleted relative to Inorganic Materials Concentration only. Now an option for technical elective requirements.	
MATH 3020 Statistics for Science and Engr. (3cr) OR STAT 2300 Introductory Statistics (3cr) Removed relative to both concentrations	

Faculty

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

There will not be any changes in faculty and/or administrative assignments from implementing the proposed program modification.

Resources

Identify any new library/learning resources, new instructional equipment, and new facilities or modifications to existing facilities needed to support the modified program. (2000 characters)

Current library/learning resources, instructional equipment, and facilities are wholly adequate to support the modified program.

Financial Support

Estimated New Costs by Year						
Category	1 st	2 nd	3 rd	4 th	5 th	Total
Program Administration						
Faculty and Staff Salaries						
Graduate Assistants						
Equipment						
Facilities						
Supplies and Materials						
Library Resources						
Other*						
Total						
Sources of Financing						
Category	1 st	2 nd	3 rd	4 th	5 th	Total
Tuition Funding						
Program-Specific Fees						
State Funding (i.e., Special State Appropriation)*						
Reallocation of Existing Funds*						
Federal Funding*						
Other Funding*						
Total						
Net Total (i.e., Sources of Financing Minus Estimated New Costs)						

*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.

No new resources (personnel, financial, facilities, etc) are needed to accomplish and support the modification.

Evaluation and Assessment

Will any the proposed modification impact the way the program is evaluated and assessed?

Yes

No

If yes, explain. (1000 characters)

Will the proposed modification affect or result in program-specific accreditation?

Yes

No

If yes, explain; if the modification will result in the program seeking program-specific accreditation, provide the institution's plans to seek accreditation, including the expected timeline for accreditation. (500 characters)

These modifications are needed to respond to feedback collected during the current program's accreditation (ABET) process. No new accreditation process will be needed.

Will the proposed modification affect or lead to licensure or certification?

Yes

No

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

Teacher or School Professional Preparation Programs

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

Yes

No

If yes, complete the following components.

Area of Certification

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

Appendix A: Required Courses

The merged B.S. MSE curriculum will require the following classes:

- 3 credit hours - CH 2230 Organic Chemistry I
- 1 - CH 2270 Organic Chemistry Laboratory I
- 3 – CH 2240 Organic Chemistry II
- 1 – CH 2280 Organic Chemistry Laboratory II
- 4 – MATH 2060 Calculus of Several Variables
- 4 – MATH 2080 Intro to Ordinary Differential Equations
- 3 – PHYS 2210 Physics with Calculus II
- 3 – CE 2010 Engineering Mechanics: Statics
- 2 – ENGR 2080 Engineering Graphics and Machine Design
- 3 – MSE 3100 Introduction to Metals and Ceramics
- 1 – MSE 4810 Fundamentals of Research 1
- 2 – MSE 3010 Materials Synthesis and Fabrication Lab
- 3 – MSE 3260 Thermodynamics of Materials
- 3 – STAT 4110 Statistical Methods for Process Dev.
- 3 – MSE 4150 Intro to Polymer Science & Engineering
- 1– MSE 4450 Practice of Materials Engineering
- 3 – IE 3840 Engineering Economic Analysis
- 2 – MSE 3020 Materials Characterization Laboratory
- 3 – MSE 3190 Materials Processing I
- 3 – MSE 3270 Transport Phenomena
- 3 – MSE 4020 Solid State Materials
- 3 – MSE 4220 Mechanical Behavior of Materials
- 2 – MSE 4910 Undergraduate Research
- 2 – ECE 2070 Basic Electrical Engineering
- 15 – Tech Requirement
- 3 – MSE 4070 Senior Capstone Design and Project