

CLEMSON UNIVERSITY

BIOMEDICAL ENGINEERING

Masters of Engineering (M.Engr.)

February 15, 2013

David B. Helms, Provost, In James F. Barker

**James F. Barker, FAIA
President**

Contact Information

Dr. Debra B. Jackson
302 Sikes Hall
Clemson, SC 29631
dbj@clermson.edu
864-656-4592

Program Contact

Dr. Ken Webb
Clemson University
kwebb@clermson.edu
864-656-7603

Academic Unit: Department of Bioengineering, College of Engineering and Science

Name of Program: Biomedical Engineering

Name of Degree: M.Engr.

CIP Code: 14.0501

Implementation Date: January 2014

Number of Credit Hours: 30

Program Length: one calendar year

Methodology (traditional, online, blended): Traditional

Qualifies for supplemental state scholarships: N/A

Site: Main Campus and CUBEInC (Clemson University Bioengineering Innovation Campus) at 200 Patewood Drive, Building C, Suite 400

Justification of need for the proposed program:

The proposed M. Eng. degree program offers intensive, focused training in the professional practice of biomedical engineering. It is targeted toward students planning to pursue industrial careers and is designed to be completed within one calendar year. Industry demand for post-baccalaureate training remains high, while reductions in federal research support have reduced the availability of assistantships for traditional M.S.-seeking students.

In response, the biomedical engineering field has witnessed a rapid growth of one-year professional Master's degree programs to efficiently deliver maximum value to predominantly tuition-paying students. Such programs have recently been introduced at top national Universities such as Cornell, as well as our peer institutions within the ACC such as Georgia Tech. In addition, this degree program is designed to support economic development in the healthcare field, contributing to the advancement of a knowledge-based economy in South Carolina. We have recently observed strong growth in the relocation or opening of new facilities by healthcare companies in the State, as well as the formation of new start-up businesses. Kiyatec and Sensortech are two examples of established healthcare companies founded by Clemson bioengineering alumni, with several additional startups in progress by both faculty and our new B. S. graduates.

Relationship of the proposed program to existing programs at the proposing institution:

The 30 credit hours M.Engr. in Biomedical Engineering degree program has been developed by the bioengineering faculty to meet the needs of students who desire to embrace a biomedical engineering industrial career in product and technology development or other related focus.

Based on industrial career interest, students will be advised to select courses among an approved list of existing graduate level courses with the majority offered by the department of bioengineering. Currently, the department of bioengineering offers a total of 36 graduate level courses. Advising will be managed by the Bioengineering Graduate Committee along with the graduate student services program coordinator and the recently hired director of bioengineering professional development.

Assessment of extent to which the proposed program duplicates existing programs in the state:

There is no similar program at a public or private university in South Carolina. Both Clemson University and the University of South Carolina offer Master of Science (M.S.) degrees in Bioengineering/ Biomedical Engineering but do not offer a professional degree for the practice of biomedical engineering at the advanced level. The M.S. degree is a research focused advanced degree intended to prepare students for a research career. The new M.Engr. program will provide an integrated education and internship experience preparing students for product and technology development. It is considered a professional terminal degree.

Anticipated program demand and productivity:

Based on a poll of the Clemson bioengineering graduating seniors (BS) in the past two years, at least 12 students would have enrolled annually in the M.Engr. degree in biomedical engineering, if offered. The Department of Bioengineering is working closely with SCBIO and its members to assure that the curriculum that will be delivered through this professional degree will meet their needs. Therefore, we anticipate that in year one, 12 students will enroll, followed by a 50% increase annually for a cap of 45 students enrolled annually and a graduation rate of 39-42 annually.

Employment Opportunities for Graduates

According to the Bureau of Labor Statistics (1), employment of biomedical engineers is projected to grow by 62 percent from 2010 to 2020, much faster than the average for all occupations. However, because it is a small occupation, the fast growth will result in only about 9,700 new jobs over the 10-year period. The aging baby-boom generation is expected to increase demand for biomedical devices and procedures, such as hip and knee replacements, because this generation seeks to maintain its healthy and active lifestyle. Additionally, as the public has become aware of medical advances, increasing numbers of people are seeking biomedical advances for themselves from their physicians. Professional biomedical engineers will likely experience more demand for their services because of the breadth of activities they engage in, made possible by the diverse nature of their training.

Brief Description of the Curriculum:

The proposed curriculum consists of 30 total credit hours including

Mandatory courses:

BioE 800-Seminar

BioE 813-Industrial Bioengineering

BioE 814-Medical Device Commercialization
BioE 850-Mentoring Undergraduates

Recommended Core:

BioE 801-Biomaterials
BioE 820-Biomechanics
BioE 635-Computer Modeling Multiphysics Modeling

Choice of technical electives including

BioE 612-Orthopaedic Engineering
BioE 623-Cardiovascular Engineering
BioE 631-Medical Imaging
BioE 640-Biotechnology for Bioengineers
BioE 671-Biophotonics
BioE 802-Biocompatibility
BioE 811-Sterilization and Cleaning Engineering for Medical Devices
BioE 815-Design, Manufacturing, and Validation Methods for Reusable Medical Devices
BioE 846-Biomedical Basis for Engineered Replacement
BioE 847-Transport Processes in Bioengineering
BioE 870-Bioinstrumentation
BioE 890-Internship

The department of bioengineering is committed to exposing students to fundamentals of biomedical engineering facts, principles, theories, and applied knowledge. The department will educate M.Engr. students to become proficient in biomedical technology development and understand and solve needs associated with clinical practice. Three program goals will be developed along with student learning outcomes and metrics mapped to each goal.

Assessment Plan for the program:

Assessment of this new degree program will include a program assessment plan and reporting using WEAVE online. All students will also be required to submit an ePortfolio containing artifacts demonstrating competency in biomedical engineering design, oral/written communication, industrial practices, and mentoring/leadership. This e-portfolio will be evaluated by the assessment committee following a review by a sub-committee of the departmental industrial advisory board who are practicing bioengineers in the biomedical industry. The Master of Engineering (M.Engr.) Program in Biomedical Engineering is a professional degree program for students who are focused on a career in industry in the health care, medical device, or bioinstrumentation areas. The curriculum ensures that students preparing for a career in the health care sector gain fundamental technology leadership skills important to biomedical engineers. Students in the M.Engr, degree program receive exposure to issues related to product development, project management, innovation, and commercialization. Students are also required to focus their technical training by completing advanced biomedical engineering coursework. The program is designed to be completed by full-time students in one academic year.

Articulation and Inter-institutional Cooperation:

This program will be exclusively taught at Clemson University. While we have not examined the possibilities of collaboration, we would certainly welcome collaboration. We have initiated an e-mail conversation about the proposed program with the University of South Carolina-Columbia.

Total new costs associated with implementing the proposed program:

The cost of implementation of the M. Engr. degree is \$30,000. Based on the current faculty and administration of the existing bioengineering degrees (BS, MS, and PhD), many resources are in place for the proposed curriculum implementation. An additional \$10,000 for administrative oversight and advising of students, and an addition of \$20,000 for biomedical commercialization courses each semester are anticipated. The student tuition will cover the costs of implementation.