

South Carolina State University

*Program Planning Summary*

**Master of Science Degree in Bioengineering Sciences**

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Submission Date



Dr. Cynthia Warrick, Interim President

Program Contact:

Dr. Judith Salley  
300 College Street NE  
P.O. Box 7212  
Orangeburg, SC 29117  
803.536.8513  
djdsalley@scsu.edu

**Classification**

This Program Planning Summary is for a Master's Degree Program in Bioengineering Sciences at South Carolina State University. This is a 33-semester-hour program. The proposed date of implementation for the program is Fall 2013. As a Science, Technology, Engineering, and Mathematics (STEM) program, it qualifies for supplemental Palmetto Fellows Scholarship and LIFE Scholarship awards. The program will be delivered in a hybrid fashion with some courses delivered in the traditional face-to-face method and some courses offered online.

**Justification of need for the proposed program**

South Carolina State University proposes to develop a new Master's Degree Program in Bioengineering Science. The purpose is to establish a program that is interdisciplinary among Biology, Computer Science, and, to some extent, Engineering. The proposed master's program will be housed primarily in the Department of Biological and Physical Sciences and will aim to develop integrative knowledge in areas such as biomedicine, agricultural and industrial bioengineering. It will be a graduate level instructional program that focuses on the biological and the non-clinical biomedical sciences and technologies underlying bioengineering problems. It will serve as a bridge program for students who would like to be employed in industries using bioengineering or those who choose to enter advanced graduate programs in biological or biomedical sciences. The program will focus on preparation for graduate research and professional careers as biologists and biomedical scientists, but it will also compliment careers in industry and agriculture. The curriculum is concentrated on the general application of various combinations of scientific, mathematical, computational and engineering principles in the analysis and evaluation of bioengineering problems, including applied research in molecular biology, chemistry, computer science, mathematics and biomedical science. In addition, to enhanced employment opportunities in medicine, industry, and agriculture, the program will provide a transition for SCSU undergraduates who plan to enter Ph.D. programs and is intended, in part, to improve the success rate of SCSU graduates applying for graduate school. It will also increase SCSU undergraduates' awareness of graduate school opportunities. This program is unique and fills a need at SCSU, since many of its undergraduates enter master's degree programs at other institutions because no graduate program currently exists at SCSU in the sciences. It is expected that a substantial fraction of the enrollment in this program will be members of underrepresented minority groups. Representation of these groups in scientific professions will be increased as a result.

**Objectives**

The objectives of the Master's Degree Program include the following:

- To establish SCSU's first master's program in the biomedical sciences
- To provide interdisciplinary integration between biology, computer science, and engineering on the graduate level
- To address the shortage of underrepresented minorities who pursue the Ph.D. in bioengineering and related fields
- To increase the interdisciplinary and collaborative graduate programs with other research universities in the state
- To develop a well-trained workforce in bioengineering

### **Anticipated program demand and productivity**

It is expected that students from three areas, Biology, Computer Science, and Engineering will enroll in this master's program. Students from South Carolina will be offered stipends. The proposed master's degree program is funded by a National Science Foundation grant entitled "Research Infrastructure Improvement at SCSU" (NSF/EPSCOR Award EPS-0903795). The grant has allocated stipends for 6 students. The program is in collaboration with USC, MUSC, and Clemson and will complement existing programs at those institutions. It is the expectation that 6-10 students per year will enroll in the program after it has been established. Most of these students will be SCSU graduates who would like to enter a Ph.D. program but need to first broaden their science and engineering background and enhance their experiences. After the fourth year of the program, it is expected that five graduates will be produced annually because we anticipate high retention and graduation rates.

### **Employment Opportunities for Graduates**

The program is designed primarily for students who will enter professional or graduate school after graduation. It is expected that completion of the program will improve rates of acceptance into these programs. For students who do not wish to continue their education after graduation, one of the target employment options will be biomedical engineering. According to the U.S. Bureau of Labor Statistics, a biomedical engineer does not require a Master's degree, but it is recommended for advancement. Biomedical engineering employment opportunities nationwide are expected to increase by 62% by 2020. While South Carolina does not have a high number of biomedical engineering jobs, Charleston and Greenville-Spartanburg are ranked relatively high nationally for these jobs. Also a relatively high number of biomedical engineering jobs exist in North Carolina and Florida, areas of potential employment for graduates. Thus, the need for underrepresented minorities in science and technology fields is expected to increase employment opportunities for graduates.

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

Elements of master's degree programs at USC and Clemson are similar to the proposed program, and some of their courses are included as part of a statewide collaboration. USC offers a Biomedical Engineering master's degree that is narrower in scope than the proposed program in that it is limited to medical application rather than including a more general agricultural or industrial application. The Clemson University Bioengineering program is offered within the Engineering program and focuses on synthesis of biomaterials. As with the USC program, the proposed program at SCSU would be broader in scope than the Clemson program. The proposed program is intended to complement the programs at USC and Clemson, and to broaden the statewide foundation for such programs. Additionally, the HBCU status of SCSU would help provide opportunities for minority students in bioengineering.

### **Relationship of the proposed program to existing programs at the proposing institution**

Currently, SCSU has undergraduate programs in Biology, Computer Science and Engineering Technology. The graduates from these programs will serve as the primary recruitment pool for the Master's Degree Program in Bioengineering Science. In addition, some of our existing faculty in those undergraduate programs will also teach and serve as research advisors for the Master's Degree Program in Bioengineering Science.

### **Relationship of the proposed program to other institutions via inter-institutional cooperation**

The master's degree program will be implemented in collaboration with the University of South Carolina-Columbia, Clemson University, and the Medical University of South Carolina. The USC and Clemson University collaborators will offer online and distance courses and thesis research opportunities, and the MUSC collaborators will serve as co-instructors.

### Outline of curriculum

Semester 1		Semester 2	
Course	credits	Course	credits
BES 510 – Science Communication (capstone course)	2	BES 555 – Seminar	1
BES 520 – Histology	3	BES 540 – Human Anatomy	3
BES 530 – Molecular, Cell & Developmental Biology I	3	BES 531 – Molecular, Cell & Developmental Biology II	3
		BES 550 – Bioanalytical Instrumentation	2
<b>Total</b>	<b>8</b>	<b>Total</b>	<b>9</b>

Semester 3		Semester 4	
Course	credits		credits
BES 655 – Seminar	1	BES 699 – MS Thesis	6
BES 545 – Engineered Physiology	3		
BES Elective 1	3		
BES Elective 2	3		
<b>Total</b>	<b>10</b>	<b>Total</b>	<b>6</b>

### Elective Courses and Instructors

Elective Course (choose any 3)	Instructor
BES 600 -- Computational Structural Biology	Valafar (USC via distance classroom)
BES 610 -- Information Flow in Biological Systems	Scott (SCSU)
BES 620 -- Evolutionary Computation and Genetic Algorithms	Radev (SCSU)
BES 630--Biomedical Basis for Engineered Replacements	Simionescu (Clemson via distance classroom)
BES 640 -- Stem Cell Biology	Simpson (SCSU)
BES 650 -- Methods in Bionanotechnology	Mahtab (SCSU)
BES 660 – Tissue Engineering	Wen (CU via distance classroom)

### Total costs associated with implementing the proposed program

The proposed master's degree program is funded by the National Science Foundation grant entitled "Research Infrastructure Improvement at SCSU" (NSF/EPSCOR Award EPS-0903795). The grant brings funds of \$1.5 million for five years and will contribute to the funding of the program's implementation. It includes funding for three new faculty at SCSU, release time for existing faculty. The general cost to implement the program is \$450,000. The estimate includes salaries for faculty and other personnel at \$170,000, stipends for six graduate students at \$180,000, and equipment, materials and supplies for the state of the art biomedical research laboratory at \$100,000.