

**New Program Proposal**  
**B.S. in Bioengineering with Concentrations in**  
**Biomaterials Engineering and Bioelectrical Engineering**  
**Clemson University**

**Summary**

Clemson University requests approval to offer a program leading to the Bachelor of Science degree in Bioengineering with concentrations in biomaterials engineering and bioelectrical engineering, to be implemented in Fall 2006.

The proposal was approved by the Clemson Board of Trustees on October 22, 2004, and submitted for Commission review on November 15, 2005. The proposal was reviewed and voted upon favorably by the Advisory Committee on Academic Programs at its meeting on January 18, 2006. There was an extensive discussion about the value in programs that are complementary but not duplicative at Clemson and USC-Columbia and of the need for the state to create the ability to attract high-tech industries that depend on bachelors level workers in the bioengineering and biomedical areas. Clemson, USC, and MUSC are partners in the Bioengineering Alliance of South Carolina, which was approved in 1984 to facilitate 1) the interchange of faculty and students; 2) the development of joint research projects; and 3) the sharing of facilities, equipment, and other resources. In spite of the fact that this has been a successful alliance on the graduate level, including the current construction of a shared research facility at MUSC, the lack of undergraduate programs in bioengineering in the state has limited the state's success in attracting bioengineering and biomedical employers. Provosts Becker (USC) and Helms (Clemson) agreed that South Carolina was late in developing programs in bioengineering and will need to "play catch up" with neighboring states and do so successfully since bioengineering fields will encompass a significant percentage of the economic development of the future.

The purpose of the proposed program is to meet a growing local, regional, and national need for bachelors-level professionals in bioengineering and to complement Clemson's long-standing Masters and Doctorate-level programs in bioengineering. This need is driven by an aging population that will require more, and more advanced, bioengineering technology to maintain quality of life. It is also driven by a highly competitive international environment that will require increasing numbers of trained bioengineering workers in this country in order to maintain leadership in the industry. Data presented in the proposal indicates that, according to the U.S. Bureau of Labor Statistics (BLS), there will be a 26.1% increase in bioengineering jobs by 2012. This growth rate is approximately twice

that of other engineering jobs. The report includes computer-assisted surgery and molecular, cellular and tissue engineering as well as rehabilitation and orthopedic engineering as areas of rapid development.

The proposed bioengineering major will have concentrations in biomaterials engineering and bioelectrical engineering. According to the proposal and the course descriptions, the program will have a strong foundation in basic engineering principles, science and design. The proposal states that the program was developed to meet engineering accreditation standards through the Accreditation Board for Engineering and Technology (ABET). Students will concentrate either in materials science and engineering (biomaterials concentration) or electrical and computer engineering (bioelectrical concentration) in their sophomore and junior years with the senior year dedicated to intensive applications coursework in bioengineering. This approach is based, according to the proposal, on examination of traditional bioengineering programs and “observations and criticism from the Biomedical Engineering Society ABET Accreditation Committee, the Whitaker Foundation and the Council of Chairs of Bioengineering/Biomedical Engineering Departments in the United States.”

Although there are many bioengineering programs nationally, Clemson currently has the only such programs in the state and they are Masters- and Doctorate-level programs. South Carolina students desiring a Bachelors-level program must go out-of-state. Only two bachelors programs for South Carolina residents are available through the Academic Common Market (ACM) at Louisiana Tech and the University of Tennessee (Knoxville). The University of Georgia recently withdrew its bioengineering program from the ACM. Additionally, USC-Columbia is proposing a new program leading to the B.S. degree in Biomedical Engineering which, according to Clemson, builds on strengths that are more traditionally-oriented (e.g. mechanical and chemical engineering) than is the Clemson program (e.g. electrical/computer engineering and materials science). Clemson also states that its program will build on existing faculty, facilities and Clemson partnerships with other institutions, including MUSC.

In order to transfer from Freshman Engineering into the bioengineering degree program, a student must have a 3.0 minimum cumulative grade-point ratio in courses taken at Clemson University and must have completed the General Engineering freshman curriculum with a *C* or better in each course in the freshman curriculum including the humanities/social science requirement.

First semester enrollment in year one is estimated at 75 students (81.7 FTE) students, and is projected to grow to 200 students (226.7 FTE) in year four. The proposal estimates that there will be fifty new students admitted to the program in

the first year and in each year thereafter. The estimate is based on enrollments in bioengineering programs in Georgia, North Carolina and Virginia.

The proposed program will consist of 128 credit hours. Coursework in both concentrations will include 18 credit hours in General Education courses, 19 credit hours in Bioengineering, 16 credit hours in Biosciences, and three credit hours in a Capstone Design course. In addition, the biomaterials concentration will require 46 credit hours in Basic Math and Science and 59 credit hours in Engineering Topics. The bioelectrical concentration will require 55 credit hours in Basic Math and Science and 53 credit hours in Engineering Topics. Clemson will add six new courses to its catalog to support the program and will heavily revise five others.

Current Clemson University undergraduate engineering courses are accredited through ABET. The proposed program has been designed to meet ABET accreditation standards and three faculty members received specialized accreditation evaluation training through the Biomedical Engineering Society in order to guide the design of the proposed program and facilitate accreditation of the program in 2011.

Personnel for the proposed program include eight existing faculty (2.0 FTE) and four new faculty members (2.0 FTE), a fraction of one administrator (0.25 FTE), and four new staff persons (4.0 FTE). The new faculty members will be hired in years 2, 3, and 4 of the program. New staff members, primarily full-time technical support staff for the program's high-tech laboratories, will be hired in years 1, 2, and 3.

There are no new facility requirements associated with the proposed program. Some existing facilities will be renovated for instructional and compliance needs at a total cost of \$195,000. New equipment will be required for four new student labs: cell culture (\$321,500), surface engineering (\$247,994), and biomechanics and biomedical design (\$168,100). Clemson has stated that all but \$250,000 worth of this equipment will be purchased in the current budget year from existing funds.

The proposal states that, due to long-standing graduate programs in bioengineering, the library holdings are adequate to support the undergraduate program and that no additional funds will need to be allocated for that purpose.

New costs for the program are estimated to begin at \$491,750 in the first year, \$455,850 in the second year, \$528,910 in the third year, and \$ 488,910 in the fourth and fifth year. Categories of costs over the first five years of the program's implementation include faculty salaries (\$487,500); graduate teaching assistants (four per year at \$20,000 each - \$400,000), clerical and support personnel

including technicians (\$676,830), supplies and materials (\$445,000), equipment (\$250,000), and facilities (\$195,000). The total estimated new cost for the program during the first five years is \$2,454,330.

Shown below are the estimated Mission Resource Requirement (MRR) costs to the state and new costs not funded by the MRR associated with implementation of the proposed program for its first five years. Also shown are the estimated revenues projected under the MRR and the Resource Allocation Plan as well as student tuition.

Year	Estimated MRR Cost for Proposed Program	Extraordinary (Non-MRR) Costs for Proposed Program	Total Costs	State Appropriation	Tuition	Total Revenue
Year 1	\$1,090,177		<b>\$1,090,177</b>	\$0	\$526,036	<b>\$526,036</b>
Year 2	\$2,344,538		<b>\$2,344,538</b>	388,558	\$1,132,226	<b>\$1,520,785</b>
Year 3	\$3,342,773		<b>\$3,342,773</b>	836,010	\$1,614,167	<b>\$2,450,177</b>
Year 4	\$4,544,595		<b>\$4,544,595</b>	1,192,420	\$2,194,292	<b>\$3,386,712</b>
Year 5	\$4,544,595		<b>\$4,544,595</b>	1,621,096	\$2,194,292	<b>\$3,815,388</b>

These data demonstrate that if the institution meets the projected student enrollments and contains costs as they are shown in the proposal, the program will not be able to cover costs during each of its first five years. The proposal states that existing funds will be reallocated to cover initial costs for equipment and for program support in the first five years of the proposed program.

In summary, Clemson University proposes a program leading to the Bachelor of Science degree in Bioengineering with concentrations in biomaterials engineering and bioelectrical engineering. The program will prepare graduates for employment in various health-related industries, government employment, and continued education in related graduate fields. The program will have a strong engineering focus, with concentrations in biomaterials and bioelectronics. The program will complement existing bioengineering graduate programs at Clemson and allow for economic growth in the state through increased ability to attract bioengineering research and manufacturing companies.

**Recommendation**

The staff recommends that the Committee on Academic Affairs and Licensing commend favorably to the Commission Clemson University’s proposed program leading to the Bachelor of Science degree in Bioengineering with concentrations in biomaterials engineering and bioelectrical engineering, to be

implemented in Fall 2006, provided that no “unique cost” or other special state funding be required or requested.