BOARD OF HIGHER EDUCATION

REQUEST FOR BOARD ACTION

NO.: BHE 07-03

BOARD DATE: November 16, 2006

MOVED: The Board of Higher Education hereby approves the request of **Bunker Hill Community College** to award the **Associate in Science in Engineering: Engineering Transfer and Biomedical Engineering Options** and the **Associate in Science in Biological Sciences: Biology Transfer and Biotechnology Options.**

For each program, one year after graduating the program's first class, the College shall submit to the Board a status report addressing its success in reaching program goals as stated in the application and in the areas of enrollment, curriculum, faculty, resources, and program effectiveness.

Authority: Massachusetts General Laws Chapter 15A, Section 9(b)

Contact: Aundrea Kelley, Associate Vice Chancellor for Academic Policy

BOARD OF HIGHER EDUCATION

November 2006

Bunker Hill Community College

Associate in Science in Engineering:
Engineering Transfer Option and Biomedical Engineering Option

Associate in Science in Biological Sciences:
Biology Transfer Option and Biotechnology Option

INTENT AND MISSION

Bunker Hill Community College (BHCC) has submitted an expedited proposal to offer the Associate in Science in Engineering: Engineering Transfer and Biomedical Engineering Options and the Associate in Science in Biological Sciences: Biology Transfer and Biotechnology Options. The College's Board of Trustees approved the proposed programs on May 22, 2006. The proposed programs fit the College mission of preparing students for entry-level occupations and for transfer to baccalaureate degree programs. In particular, the programs extend access to affordable post-secondary education in fields that are not well-represented among women and minorities who form the majority of BHCC students. The proposed new programs are also intended to help achieve goals of two state-wide initiatives: the Reach Higher and Massachusetts Defense Technology initiatives.

The Commonwealth's Reach Higher Initiative aims to improve the connections of working adults to post-secondary education and ultimately produce more jobs with family-supporting wages. A focus of Reach Higher is the creation of more certificate and associate degrees by community colleges in order to provide a trained workforce for rapidly growing health-related technologies.

Through the Massachusetts Defense Technology Initiative, established by the Massachusetts High Technology Council, the Commonwealth is collaborating with industry and academic institutions to bolster the state's competitiveness in defense technology clusters so as to generate growth opportunities for Massachusetts employment.

BHCC will establish an industry advisory board for each program to ensure that the programs continue to meet academic and industry standards. Board members will comprise a diverse group representing different disciplines and interests and will participate in program assessment and review, act as ambassadors for BHCC and facilitate collaborations.

In response to the May 2006 circulation of the letter of intent, comment letters in support of the proposed Associate in Science programs were received from Massachusetts Bay Community College, Northeastern University, and the University of Massachusetts Boston. The Bunker Hill Community College Board of Trustees approved each program on May 22, 2006.

ASSOCIATE IN SCIENCE IN ENGINEERING

The Associate in Science in Engineering program with options in Engineering Transfer and Biomedical Engineering is intended to provide access to jobs in the growing engineering fields that support the state's dominant life-science industries.

Need and Demand

BHCC found that while Engineering is offered at several community colleges, the Biomedical Engineering option will be the only one of its kind in Massachusetts at the undergraduate level, and the Engineering Transfer option will be the only one in Massachusetts intended to offer two years of the engineering curriculum and to enable its graduate to transfer as juniors in their major. The Engineering Transfer option is designed to meet the standards of the first two years of a four- to five-year engineering degree that is accredited by ABET. The Biomedical Engineering Transfer option is designed to meet the standards of the first two years of a four to five-year Biomedical Engineering degree accredited by the Biomedical Engineering Society (BMES) of ABET.

As part of its process of considering establishment of an associate degree in engineering, BHCC recruited Dr. Krishna Vedula, one of the Commonwealth's leading STEM educators and former Dean of the School of Engineering at the University of Massachusetts Lowell, to evaluate the College's capacity to develop and offer an Engineering Program and the viability of such a program in terms of enrollment. Dr. Vedula provided the following assessment of potential student demand for an Associate in Science in Engineering degree.

> "Although BHCC still graduates a small number of students in the sciences and mathematics, it is reasonable to expect that introduction of an associate in science degree and a more aggressive recruitment and support of engineering students will increase the number of graduates in mathematics, science and engineering. There is anecdotal evidence that a significant number of BHCC students who transfer after receiving an associate in arts degree often receive only one year's worth of credits upon transferring to four-year colleges or universities. This appears to be particularly true for students pursuing science, engineering or mathematics majors. The associate in science degree will encourage more students to graduate from BHCC with STEM majors by increasing the number of transferable STEM courses required to graduate."

The proposed program is meant to address the engineering workforce needs of the Commonwealth, particularly those of the greater Boston area. The greatest demand for engineers through 2008 will be in the medical instrument and supply industry, according to the U.S. Labor Department. Engineering jobs in the medical sector are forecast to increase by 33.4 percent from 1998 to 2008. Overall demand for engineers in industry will increase by 19.9 percent. According to the Massachusetts Department of Employment, the "proportion of job postings requiring an Associate degree or higher continued to edge up over the year, rising from 36 percent in the fourth quarter of 2004 to 38 percent in the fourth quarter of 2005." The same report also showed a "High" demand for workers with engineering skills, with 1,844 vacancies in engineering and architecture for the fourth quarter of 2005.

The College anticipates that because of their strong preparation in mathematics and physical sciences, graduates of the Engineering Transfer option will have many avenues open to them for further study and that most will pursue the Bachelor's degree and beyond. Advisors intend

to encourage the pursuit of teaching careers in the high-demand areas of secondary school math and science teaching. Others may continue with engineering disciplines, such as Nanotechnology and Robotics, which are likely to increase in demand in years to come.

Biomedical Engineering majors will have the option of transferring to area colleges as third-year students or to enter the job market in entry-level Biomedical/Medical Engineering jobs. Graduates of the Biomedical Engineering program will be positioned to work in well established specialty areas within the field of biomedical engineering such as: bioinstrumentation; biomaterials; biomechanics; cellular, tissue and genetic engineering; clinical engineering; medical imaging; orthopedic surgery; rehabilitation engineering; and systems physiology.

Through a *PowerUp* grant from the Boston Museum of Science, BHCC is working with Greater Boston high schools and the Commonwealth's Tech Prep Program to develop course-by-course articulations with high schools. Similar work is being done under the same grant to develop articulations with four-year colleges and universities. When the grant activities are completed, the College anticipates that a 2 + 2 + 2 articulation program will be in place with at least three high schools and three four-year colleges and universities.

The College has initiated articulation discussions with the University of Massachusetts Amherst, Dartmouth and Lowell to develop a Joint Admission articulation agreement for students in the proposed Engineering Transfer option. The Biomedical Engineering curriculum has also been designed to transfer to the University of Connecticut at Storrs under the New England Board of Higher Education's Tuition Break Program, also called the Regional Student Program (RSP). This program enables New England residents to enroll in other New England public colleges and universities at a discount, when enrolling in a major that is not available at the public colleges in the student's home state.

Curriculum (Attachment A)
In the development of the proposed program the College engaged outside experts to conduct program reviews of its mathematics and science programs for the purpose of identifying strengths and weaknesses and making the necessary changes to strengthen them. As a result of the reviews, the Mathematics Department revised the Calculus Series, Calculus I, II, and III to align them with upper-level university curriculum and the needs of engineering students. A new course in Differential Equations was created to complete the required supporting mathematics courses.

The Engineering Transfer and Biomedical Engineering Option will share common science core courses: General Chemistry I/Lab and General Chemistry II/Lab; College Physics I/Lab and College Physics II/Lab; Calculus I, II, III, and Differential Equations; and Introduction to Engineering. Students in the Engineering Transfer option will also be required to complete Engineering Statics, Engineering Dynamics, and Strength of Materials. While students in the Biomedical Engineering Option will be required to complete Biomedical Engineering I, II and III. Students in both program options complete 66-68 credits, including 21 General Education credits.

Courses are designed to be taken in a particular sequence that will allow students to develop a solid engineering foundation, on which they can build and refine further concepts, methodologies and techniques. The three core courses of the sequence are comprehensive in nature and are intended to provide students with a rigorous academic background and advanced laboratory skills. Students will have a strong background in the mathematical tools required to understand the concepts and to solve problems. Students will be well equipped to

transfer to a four-year college or university and to successfully complete an accredited Engineering degree.

Admission and Enrollment

Bunker Hill estimates steady growth in enrollments and graduation rates over time, with the greatest enrollment growth occurring in the Biomedical Engineering field. Because of the rigor of the proposed programs and the likely need for some participants to take preparatory courses that do not count towards the major, the College anticipates that most students will take longer than two years to graduate.

Engineering Transfer	Year	Full Time	Part Time	# of students in Cohort	*Graduating in Three Years*	Percent
Cohort #1	1	12	8	20	10	*50*
Cohort #2	2	20	10	30	18	*60*
Cohort #3	3	25	20	45	27	*60*
Cohort #4	4	25	20	45	27	*60*
Cohort #5	*5*	*25*	*20*	*45*	*27*	*60*

Biomedical Engineering	Year	Full Time	Part Time	# of students in Cohort	*Graduating in three Years*	Percent
Cohort #1	1	20	10	30	15	*50*
Cohort #2	2	25	20	45	27	*60*
Cohort #3	3	35	25	60	39	*65*
Cohort #4	4	35	25	60	39	*65*
Cohort #5	*5*	*35*	*25*	*60*	*39*	*65*

Resources and Budget (Attachment B)

Faculty members are in place for the required Chemistry, Physics and Biology courses. The College intends to hire a new Biomedical Engineering instructor who will teach Biomedical Engineering courses and coordinate the Engineering program.

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With the exception of the Introduction to Engineering and the first course in Biomedical Engineering, core engineering courses will rely predominantly on virtual experiments and demonstrations as part of lecture and team activities in the classroom. (This is consistent with the approach followed by the University of Massachusetts Lowell for the courses proposed for the Engineering curriculum and by the University of Connecticut at Storrs for the Biomedical Engineering curriculum.) The virtual approach has drastically reduced the investment needed for laboratories, without compromising students' experiential learning. The College's existing Physics/Engineering Laboratory, however, will be upgraded to meet the needs of the new curriculum, including new software to support classroom and laboratory instruction.

The Science Program (Biology, Chemistry, and Physics) has grown dramatically over the last four years, from approximately 40 sections per semester to nearly 100 at present. Part of this growth has been motivated by the requirements of the College's growing Nursing and Allied Health Programs. The proposed engineering program will be housed in the Science Department. The Department Chair, a science faculty member, will provide program coordination and a Laboratory Manager and two Laboratory Technicians to work closely with the Department Chair and faculty to ensure quality laboratory instruction.

Program Goals And Objectives

BHCC identified the following goals and objectives for the proposed engineering program:

1. Enroll 20 students in the AS Degree in Engineering and 20 in Biomedical Engineering in fall 2007.

2. Retain 50 percent of the first Engineering cohort by the end of three years and 75 percent of the first Biomedical Engineering cohort by the end of three years from the first day of contact with applicants through graduation in 2010.

3. Graduate 80 percent of the cohort in three years by spring 2010.

4. Ensure that four graduates from the Biomedical Engineering Option and two graduates from the Engineering Transfer Option are hired after graduation by fall 2010.

5. Ensure the successful transfer of eleven graduates from the Biomedical Engineering Option and eight graduates from the Engineering Transfer option to four-year colleges over the course of three years from fall 2007 to spring 2010.

External Review

Dr. Anil Saigal, Chair, Department of Mechanical Engineering, Tufts University, and Dr. John Andrew White, Professor and Associate Director, Department of Biomedical Engineering, Boston University reviewed the proposed program.

Reviewer Findings. The reviewers offered strong endorsement for the proposed associate in science in engineering and commented positively on the program's consistency with the mission of the College; the need for the program; the coherence, rigor, balance and quality of the curriculum; the appropriateness of the expertise of existing science/engineering faculty and lab staff; the proposed program evaluation; and the commitment of the College's resources to the program. The reviewers found both program options to be of high quality and felt that graduates "would be well prepared for engineering studies at Boston University, Tufts, or any other high-quality engineering university."

The reviewers also made some recommendations to strengthen the overall program:

1) Dedicate high-quality lab space to the degree program.
2) Increase the number of BIOPAC Systems in order to reduce the size of student working groups to two-three, so that each student will receive effective training.
3) Hire additional faculty to design and teach Biomedical Engineering I-III.
4) Phase in courses on computer programming and electrical circuits, in place of Chemistry II.
5) Encourage students to get ahead in their math sequence in order to better prepare the students for intermediate coursework.
6) Encourage students to take the computer programming and electrical circuit courses (once phased in) as electives.

Institutional Response. In response to the reviewer's findings, the College agreed that it would implement the following changes:

1. Schedule a major renovation of the Physics/Engineering Lab for summer 2007 and invest in appropriate equipment and supplies in order to support a first-rate program in Engineering and Biomedical Engineering.
2. Double the number of BIOPACs for the Biomedical Engineering Option, thereby reducing the number of students working on each lab from six down to no more than three, as recommended by the reviewers.
3. Hire a new lab technician specifically for the Engineering Program.
4. Hire additional Biomedical Engineering faculty by summer 2007, earlier than originally proposed, so that he or she can have more time to plan for a fall 2007 start date.
5. Encourage students to take some of their courses, especially mathematics, over the summer months as to reduce their course loads in the fall and spring semesters. In addition, the College will increase their efforts to match their student's computational skills with the demands of the Engineering courses.
6. Carefully advise students regarding electives—including the availability of electives at other area institutions—in order to enhance their transfer goals.

In addition, BHCC doubled the budget for the first year from the $167,000, which the reviewers examined, to $393,000 to include over $100,000 in renovations of the Engineering lab. Also, the College added funds to the second, third, and fourth years of the program to accommodate program growth, equipment and software purchases and upgrades, as well as unanticipated costs. Finally, the College added the new 22-station Mobile Computer/Software package, recently received from Hewlett Packard under its Educational Technology Initiative Grant program, to its engineering instructional resources.

ASSOCIATE IN SCIENCE IN BIOLOGICAL SCIENCES

The proposed Associate in Science in Biological Sciences Biology Transfer option will prepare students for transfer to four-year institutions as biology majors and to pursue proficiency in one or more of the biological sciences, including physiology, ecology, cell biology, biotechnology, genetics, microbiology, biochemistry, and molecular biology. The Biotechnology option will prepare students for direct employment in entry-level research/lab assistant positions available in private industries, academic research institutions, and hospitals locally and nationwide.

Need and Demand

Development of the proposed program began in response to the encouragement of the Massachusetts Biotechnology Council (MBC) and in response to Bunker Hill's survey of students, which indicated a strong interest in courses in Cell Biology, Genetics, and Biotechnology. Data compiled by the MBC pointed to a growing need for biotechnology workers who have two-year degrees or higher, who have a strong educational foundation in the life sciences, and who can continue to learn as the technologies and sciences advance. MBC research data show that Massachusetts has the highest concentration of biopharmaceutical employment, more than twice that of the nation, with nearly 300 biotechnology companies employing over 21,000 workers.

According to the *US States Quarterly Rankings for Biotechnology Jobs*, for the three months ending in March 2006, Massachusetts ranked second to California in the number of Biotechnology jobs. The three-month job vacancy count for Massachusetts was 4,058 with an estimated 325 jobs requiring an associate degree.

According to MBC data, Massachusetts will be a top-growth performer over the next decade and is targeted to increase its biotechnology workforce by 64.3 percent over the next decade. MBC has estimated that 100,000 jobs in life sciences will be created through 2010 with approximately 8,000 jobs, or 8 percent of the total, for entry-level lab and research assistants. According to the MBC directory, the current annual salary for entry level research assistant positions ranges from $32.000-$48.000, while the annual salary for entry level lab assistant positions ranges from $24.000-$33.000. Qualifications for these positions require a biotechnology certificate, associate in science degree or bachelor of science degree with 0-2 years of experience.

BHCC provided the following data biotechnology related programs currently offered:

- Middlesex Community College offers a Certificate in Biomanufacturing with 70 students currently enrolled.
- Springfield Technical Community College offers a Certificate in Biomanufacturing and an Associate in Science in Biotechnology with 10 -12 students enrolled annually over the past 5 years.
- Massachusetts Bay Community College offers an Associate in Science in Biotechnology and an Associate in Science program with a concentration in Forensic Science with eight students currently enrolled
- Boston University offers a Certificate in Biomedical Laboratory and Clinical Science, BLCS with an average of 18-20 students.

Although there may be some overlap between the proposed program and the biotech associate in science degree at Springfield Technical and Massachusetts Bay Community Colleges, the College plans to create its own niche based on its strategic location due to:

- Proximity to the city
- Proximity to many 4-year institutions
- Proximity to the high concentration area of biotech industry and academic research labs in Cambridge

The University of Massachusetts Amherst has already approved the proposed program for articulation under Joint Admission, while the University of Massachusetts Lowell and the University of Massachusetts Boston are currently actively reviewing the program. The College is also working to develop articulation with Northeastern University.

The College has initiated articulation discussions with the University of Massachusetts Boston to develop a Joint Admission articulation agreement for the proposed Associate in Science in Biological Sciences degree.

BHCC projects that recruitment for the proposed program will benefit from many activities presently underway to improve the preparation of Greater Boston high school graduates for STEM careers. Among these activities are:

- *BioTeach.* In response to the fast-growing local Biotechnology industry and its growing needs, the MBC's MassBioEd Foundation launched in 2005 BioTeach**,** a major education initiative to assist public high schools in building self-sustaining biotechnology programs. BioTeach plans to equip every Massachusetts public high school with Biotech equipment and reagents by 2010 and to provide professional development in

Biotech education to high school teachers and guidance counselors. BHCC anticipates that BioTeach will act as a significant feeder program for the proposed Biotech option; several local high schools (Somerville, Cambridge, Arlington and Boston Public Schools) are already BioTeach grant recipients. The BioTeach initiative's promotion of the incorporation of biotechnology in the curriculum aims to produce high school graduates who are "biotechnology literate."

- *The Power Up Project*, a collaboration of community colleges and high schools under the guidance of the Boston Museum of Science and Tech Prep, provides innovative approaches to teaching science. Two BHCC Physics faculty members are instructors under this project.

- The *Greater Boston Pipeline Network* is a partnership of higher education institutions, school districts and individual high schools, nonprofit organizations, museums, workforce development groups and technology networks committed to increasing communication across grade levels, disciplines, programs and institutions, and to replicating successful models across the region in order to increase the numbers of individuals in STEM careers.

- The *Boston Math and Science Institute* is a three-year project of BHCC funded by the Massachusetts Board of Higher Education (BHE) under the Improving Teacher Quality State Grant Program. Under this project, Boston middle and high school mathematics and science teachers work with BHCC faculty to improve math and science instructional effectiveness. The ultimate goal of the project is to ensure that high school graduates are better prepared in math and science, thereby increasing their chances for entering and being successful in STEM careers.

- The *Massachusetts Framework for Science and Technology* and the College Board curriculum for Advanced Placement Biology address the topic of Biotechnology and the latter curriculum incorporates molecular biology labs.

BHCC has hired a project coordinator to establish and maintain STEM partnerships between BHCC, Boston Public Schools, the University of Massachusetts Boston and the University of Massachusetts Lowell that facilitate student recruitment for the College's proposed programs as well as course-by-course articulation.

Curriculum (Attachment C)
The proposed Biology Transfer and Biotechnology options will share the following common science core courses: General Biology I/Lab, General Biology II/Lab, General Chemistry I/Lab and General Chemistry II/Lab as well as some common elective courses, such as Statistics/Lab, Seminar in Biotechnology and Honors Seminar. Students must complete 61-64 credits, including 21 general education credits.

The College's existing collaboration with the Massachusetts Biotechnology Council will facilitate partnerships with local industry and academic research labs that will help promote the program and facilitate internships for motivated students who are seeking direct employment. Internships will play a key role in marketing to students seeking direct employment and in building program reputation, sustainability and success. Genzyme, Novartis and BiogenIdec have already expressed interest and willingness to collaborate, once the program is approved.

Admission And Enrollment

The proposed program will target professionals seeking a career change, adults seeking a college education and high school students who are already biotechnology literate or interested in biology. BHCC anticipates enrolling 20 students in the Biology Transfer and 20 in Biotechnology in fall of 2007 with the first class likely to graduate in 2010. While the proposed program is designed as a two-year program, the College projects that most students will require three years to graduate due to the proposed rigor likely need for students to complete pre-requisite requirements.

Biological Sciences Transfer Option *First Cohort*	**# of Students Year 1**	**# of Students Year 2**	**# of Students Year 3**	**Transfer (T) or Employment (E)**
New Full Time	12			
Continuing Full Time	0	12	10	
New Part Time	8			
Continuing Part Time	0	6	6	
Totals	20	16	16	12 T; 4 E

Biotechnology Option First Cohort	**# of Students Year 1**	**# of Students Year 2**	**# of Students Year 3**	**Transfer (T), Employment (E)**
New Full Time	12			
Continuing Full Time	0	10	10	
New Part Time	8			
Continuing Part Time	0	6	6	
Totals	20	16	16	12 E, 4 T

Resources And Budget (Attachment D)

The College has committed to fund start-up and continuation costs for the proposed program for faculty, equipment, maintenance/upgrading, supply replenishment, marketing, library and information resources

Classroom space and equipment required for the proposed program are currently available at Bunker Hill's Charlestown campus, including a newly renovated Biotechnology Lab (D-318). The College will also develop 'Smart' Classrooms - each with a computer, LCD projector and Smart Board - to support the degree program. In addition, several Science Labs are supported by wireless connections and sets of IMacs that can be moved in carts to locations where they are needed.

The Department Chair, a science faculty member, will provide program coordination. A Laboratory Manager, and two Laboratory Technicians will work closely with the Department Chair and faculty to ensure quality laboratory instruction.

The Science Department has eight full-time Biology faculty and three full-time physical science faculty. Two full-time faculty members were hired to develop and teach courses in the biotechnology curriculum as well as to teach other biology courses offered by the Department. One of the two faculty members will also be responsible for coordinating the Biotechnology Option. Another full-time Biology faculty member will be added in the fall to teach courses in biology and to support the Biology Transfer option. A new Laboratory Technician has also been hired to support the growing biological sciences curriculum.

Program Goals And Objectives

The Engineering Program has identified the following goals and objectives:

1) Enroll 20 students in Biological Sciences and 20 in Biotechnology in fall 2007.

2) Graduate 80 percent of Biological Sciences students and 80 percent of Biotechnology students by spring 2010.

3) Achieve a100 percent growth in retention to graduation for the second cohort in the proposed program. This should be evident semester by semester and in graduation rates after three years.

4) Graduate 12 biology transfer option and four Biotechnology majors who enroll in local four-year institutions through BHCC articulation agreements as Biology or Biotechnology majors, respectively, with the remaining 12 gaining employment by spring 2010.

5) Ensure that Biotechnology students obtain internship positions upon successful completing the proposed course sequence by 2010. In addition, increase academic and industry labs interested in partnerships and offering internships by 2010.

6) Ensure that 12 of graduates from the biotechnology option are hired after graduation. In addition, increase the number and variety of employers interested in hiring BHCC graduates by fall 2010.

7) Ensure that graduates demonstrate proper and adequate use of industry-specific skills during internships and upon employment. In addition, graduates must meet requirements for professional growth, merit and promotion within the first two years of employment.

External Review

Reviewer Findings

Dr. John J. Castellot, Jr., Professor and Director of the Cell, Molecular, and Developmental Biology Graduate Program, Department of Anatomy and Cellular Biology, Tufts University School of Medicine, and Dr. Steven Ackerman, Associate Professor, Biology Department, University of Massachusetts Boston, conducted a site visit for the proposed program in July 2006.

Overall the reviewers were supportive of the BHCC proposed Associate in Science in Biological Sciences degree program.

> "(T)he courses comprising the AS degree, their content, and the sequence proposed for students to complete this program are comparable to what is offered at four-year institutions. With any proposed program, the major concerns are how well the laboratory exercises will be executed and the quality of the instruction. Our site visit confirmed that the faculty have carefully developed the new course offerings, and their expertise and ability in teaching their current courses provide confidence that their new AS degree program will be successful. The Administration has demonstrated, by their genuine enthusiasm for the

Program, a commitment to provide resources and support for this endeavor. The only caution is that the faculty may have underestimated the enthusiasm the BHCC campus will have for this program. The consequence is that their program may expand much faster than anticipated, necessitating a faster utilization of resources, which may then be needed in greater amounts."

The reviewers also made the following recommendations:

1. Anticipate funding increases to meet higher than projected demand. Add funds to the budget to cover contingencies associated with unexpected costs for new lab courses. (The budgeted costs for the Cell Biology labs, the Genetics labs, the Biotech labs, and seminar course labs are all quite modest and likely too low.)
2. Develop for-credit internships with corresponding research projects to strengthen the students' practical skills and in building program reputation, sustainability and success.
3. Continue expansion and renovation of high-quality lab space to the degree program.
4. Hire additional faculty and 'prep' staff as the program expands.
5. Increase college's electronic access to mainstream scientific journals.

Institutional Response
In response to the reviewer's findings, the College proposes implementing the following changes,

1) The overall capital equipment budget was doubled from $65,000.00 to $130,000. The budgets for the individual courses taught in the first and second year were also doubled to cover the larger class sizes anticipated by the reviewers and to include maintenance, repair and other unexpected expenses.

2) The College will expand the last course in the proposed series, "Seminar in Biotechnology," to include internships for course credit. In this case, course credit will be increased from four to eight credits. Collaborations with biomedical research labs in industry and academia will commence upon approval.

3) The renovation and remodeling of a lab space was completed in the fall of 2006. The lab contains the infrastructure needed for teaching biotechnology-related labs (two laminar flow hoods, refrigerator, incubator and electrophoresis set up) and is currently used for two new courses: Cell Biology (BIO 207) and Introduction to Biotechnology (BIO 120).

4) Currently, all core courses proposed, including the two prerequisite courses BIO 195/196, are being taught by full-time faculty. The Science Department intends to reserve the teaching of theses courses to full-time faculty in the future.

5) The library budget was increased from $3,000 for textbooks to $15,000 to include electronic subscriptions to mainstream journals, such as *Science*, *Nature*, *Scientific American* and the series, *Trends in Biotechnology/Biochemistry/Molecular Medicine*.

STAFF ANALYSIS AND RECOMMENDATION

Following thorough review of all documentation provided, staff recommendation is for approval of the Associate in Science in Engineering: Engineering Transfer Option and Biomedical

Engineering Option and the Associate in Science in Biological Sciences: Biology Transfer Option and Biotechnology Option at Bunker Hill Community College.

For each program, one year after graduating the program's first class, the institution shall submit to the Board a status report addressing its success in reaching program goals, as stated in the application, and in the areas of enrollment, curriculum, faculty, resources, and program effectiveness.

Attachment A – Curriculum Outline

Bunker Hill Community College - Associate in Science Degree in Engineering

Required (Core) Courses in the Engineering Major (Total # courses required = *9*)		
Course Number	Course Title	Credit Hours
MAT-281	Calculus I	4
MAT-282	Calculus II	4
MAT-283	Calculus II	4
MAT-284	Differential Equations	4
PHY-251	College Physics I/Lab	4
PHY-252	College Physics II/Lab	4
CHM-201	General Chemistry I/Lab	4
CHM-202	General Chemistry II/Lab	4
ENR-100	Introduction to Engineering with Lab	4
	Subtotal Core Major Credits	36
Required Courses in Engineering Transfer (Total # of courses required = 3)		
ENR-260	Statics	3
ENR-265	Dynamics	3
ENR-270	Strength of Materials	3
	Subtotal Related Credits	9
Required Courses in Biomedical Engineering Option (Total # of courses required = 3)		
BME-100	Biomedical Engineering I	4
MBE-200	Biomedical Engineering II	3
BME-250	Biomedical Engineering III	3
	Subtotal Related Credits	10
Elective Courses (Total # courses required = 2) (attach list of choices if needed)		
Based on Recommendation of Academic Advisor and the Transfer Institution or to improve employability.	Up to two career electives may be taken at BHCC or at another institution based on the requirements of the transfer institution and consistent with the curriculum or to increase job skills for intended career.	Up to 6
	Subtotal General Education Credits	21
	Total credit hours required for degree	66-68

Attachment B – Budget

Associate in Science In Engineering
Start-up Budget and Four-Year Projection

Program	**Item**	**Year 1**	**Year 2**	**Year 3**	**Year 4**
Biomedical Engineering					
	MATLAB With SIMULINK (Student Version_	$3,000		$2,000	
	Complete BIOPACS @ $10,000 each)	$80,000	$40,000		
Engineering	Pro/Engineer-Student and Teacher Edition (for 50 Stations)	$2,500		$2,500	
	MathCAD 13 (50 sets)	$6,500		$2,000	
Serving Engineering, Science and Math Programs	20-Set Mobile Computer Station Funded by **HP Technology for Education Initiative**	$70,000			
	Laboratory Renovations	$105,000			$150,000
Personnel	Full-time Lab Tech	$40,000	$40,000	$43,000	43,000
	Full-time Biomedical. Engineering Instructor	$76,000 (Includes benefits)	$76,000	$78,000	$78,000
Contingency for Both Programs		$10,000	$10,000	$10,000	$10,000
Totals		**$393,000**	**$166,000**	**$137,500**	**$281,000**

Attachment C
Associate in Science in Biological Sciences
Biology Transfer Option

Required (Core) Courses in the Major (Total number of courses required = *2*)		
Course Number	Course Title	Credit Hours
BIO195	General Biology I/Lab	4
BIO196	General Biology II/Lab	4
	Subtotal Core Major Credits	8
Required Courses in Related Subject Areas (Total number of courses required =5)		
CHM201	General Chemistry I/Lab	4
CHM202	General Chemistry II/Lab	4
MAT281	Calculus I	4
PHY201	General Physic I/Lab	4
PHY202	General Physics II/Lab	4
	Subtotal Related Credits	20
Elective Courses (Total number of courses required =5) *(attach list of choices if needed)*		
BIO120	Introduction to Biotechnology/Lab	4
BIO207	Cell Biology/Lab	4
BIO208	Genetics/Lab	4
BIO251	Biotechnology/Lab	4
CHM251	Organic Chemistry I/Lab	4
CHM252	Organic Chemistry II/Lab	4
MAT183	Statistics I/Lab	4
MAT282	Calculus II	4
HON200	Honors Seminar	3
	Subtotal Elective Credits	19-20
	Subtotal General Education Credits	21

Curriculum Summary	
Total number of courses required for the degree	17
Total credit hours required for degree	61 – 64

Prerequisite, Concentration or Other Requirements:
Prerequisite courses include Reading, Writing, and Mathematics.

Associate in Science in Biological Sciences
Biotechnology Option

Required (Core) Courses in the Major (Total number of courses required = 5)		
Course Number	Course Title	Credit Hours
BIO195	General Biology I/Lab	4
BIO196	General Biology II/Lab	4
BIO207	Cell Biology/Lab	4
BIO208	Genetics/Lab	4
BIO251	Biotechnology/Lab	4
	Subtotal Core Major Credits	20
Required Courses in Related Subject Areas (Total number of courses required =3)		
CHM201	General Chemistry I/Lab	4
CHM202	General Chemistry II/Lab	4
MAT197	Precalculus	4
	Subtotal Related Credits	12
Elective Courses (Total number of courses required = 4) *(attach list of choices if needed)*		
BIO252	Seminar in Biotechnology/Lab	4
CHM111	Chemical Science II/Lab	4
CIT110	Microbiology/Lab	4
MAT183	Statistics I/Lab	4
MAT281	Calculus I	4
HON200	Honors Seminar	3
	Subtotal Elective Credits	14-16
	Subtotal General Education Credits	21

Curriculum Summary	
Total number of courses required for the degree	17
Total credit hours required for degree	62-64

Prerequisite, Concentration or Other Requirements:
Prerequisite courses include Reading, Writing, and Mathematics.

Attachment D – Budget

Associate in Science in Biological Sciences

Start-up Budget and Four-Year Projection

ITEM	Comment	Year 1	Year 2	Year 3	Year 4
New Biotechnology	Completed in Summer 2006	-0-	-0-	-0-	*-0-*
Expendable Supplies		$24,000	$32,000	*$50,000*	*$50,000*
Library Materials-Books, Journals and Electronic Databases	Recommended by the External Review Team	$15,000	$10,000	$10,000	$15,000
One-Time Capital Equipment to Outfit New Lab		$130,000	-0-	$10,000	$10,000
Contingency Allocation		$5,000	$5,000	$5,000	$5,000
Totals		***$174,000***	***$47,000***	***$75,000***	**$80,000**