Proposal for a new Bachelor of Science Degree Program:
Engineering Biology

Oakland University

Department of Biological Sciences, College of Arts and Sciences
School of Engineering and Computer Science

Approved by the School of Engineering and Computer Science
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ABSTRACT

The Department of Biological Sciences in the College of Arts and Sciences and the School of Engineering and Computer Science propose a new major: the Bachelor of Science in Engineering Biology. This program has been designed by an interdisciplinary committee including faculty from the Departments of Biological Sciences, Computer Science and Engineering, and Chemistry. The committee also consulted with members of the Departments of Mechanical Engineering, Electrical and Computer Engineering, Industrial and Systems Engineering, Mathematics and Statistics, and Physics. In recent years the demand for graduates with a background in engineering biology has been increasing, due to increased interest in bioengineering products and services in the industrial sector. Interdisciplinary research in this area has received increased support by funding agencies. Academic institutions nationwide have recently developed such programs and their enrollments are growing. A number of students at Oakland University have shown interest in graduate studies in bioengineering, and are looking for the best preparation for such graduate programs. Oakland has extensive expertise in this area, with faculty from the aforementioned departments having established research collaborations in bioengineering and computational biology and having published in these areas.

The purpose of this program is two-fold: (1) to produce undergraduates with an outstanding preparation for graduate studies in bioengineering, and (2) to produce undergraduates who are fully prepared to work in an engineering position requiring expertise in one of the tracks of the proposed Engineering Biology curriculum.

1. Program Description

a. Introduction

Over the past decade, the demand for interdisciplinary training has expanded greatly in both industry and academia, primarily as a result in the availability of more complex technology and new potential applications in a myriad of fields. Funding agencies have established or strengthened their cross-cutting programs to encourage researchers to innovate and have added statements like “preference will be given to interdisciplinary teams” to their request for proposals. More employers are interested in candidates with sufficient depth of knowledge in an area to be successful at their jobs and sufficient breadth of knowledge and diversity to ensure cohesive operation of the company, a critical component of success and growth. Many of these candidates are sought for leadership positions both in management and in technical positions (as engineers or developers). Institutions and agencies, such as the Whittaker Foundation, have responded to these trends by providing funds to start or enhance graduate programs in bioengineering and biomedical engineering.

Historically, bioengineers have held graduate degrees along with other specialized training. Graduate programs in bioengineering have traditionally had difficulties incorporating students from different undergraduate engineering and science disciplines into their graduate biomedical engineering and bioengineering programs. Existing graduate programs have expanded to include newer areas of biomedical engineering, ranging from CAT scans and kinematics to micro-devices, and have experienced growth pains in trying to fit all topics into a single degree. Recognizing these curricular problems, the National Science Foundation, among others, has funded teacher-scholars around the country to develop cross-cutting textbooks and programs. Funding entities have worked to promote new methods for integrating people from engineering and natural sciences into bioengineering programs. They have also served key roles in helping to develop undergraduate and graduate programs in bioengineering.

The Department of Biological Sciences in the College of Arts and Sciences (CAS) at Oakland University has a tradition of excellence in undergraduate education and research. The department graduates by far the largest number of majors in the sciences, and these graduates have had high success rates in graduate and professional studies, including medical, dental, and veterinary school admissions, and in employment in biologically related fields. Faculty in the department have research interests that range across all the traditional biological areas as well as in a number of newer, interdisciplinary areas including Cell Communication and Bioengineering.

Oakland University’s School of Engineering and Computer Science (SECS) has long been known for excellence in educating students in mechanical, electrical, computer, and systems engineering and computer science. All of the engineering programs offered by SECS have always taken an integrated approach to engineering, and SECS has earned a reputation for producing students who take a “systems” approach. This approach, interdisciplinary within engineering, has distinguished SECS at Oakland University for almost 40 years.

At Oakland University, faculty from biology, computer science and engineering, chemistry, mathematics, and physics have established interdisciplinary collaborations over the past decade. Faculty from all the departments involved in the interdisciplinary degree presented in this proposal have enthusiastically supported the development of a new program in Engineering Biology. The Department of Biological Sciences in the College of Arts and Sciences and the School of Engineering and Computer Science together are in a position to produce students with a solid background in both Biology and Engineering, qualified for either additional studies in Bioengineering or employment in a wide range of bioengineering-related industries.

We believe this to be an outstanding opportunity for Oakland University to begin a cutting-edge interdisciplinary program in a field which will continue to grow at a fast pace. An Engineering Biology program will make this interdisciplinary work more visible to students and other faculty who are interested in and capable of conducting research in bioengineering and computational biology. The program will attract more undergraduate students who would otherwise be forced to select another institution for their bioengineering interests.

b. Program Goals

The goal of this program is to combine training in biology with depth in either computation or engineering in order to add an interdisciplinary degree to the undergraduate curriculum at OU. All students in the program will take a set of core courses from science and engineering. Students will finish out their courses through a choice of one of the following specialization areas: Bioinformatics, Computational Biology, Biomedical/Biophysical Engineering, Biosensors/Devices, or Quantitative Biology. These specialty areas combined with the engineering biology core will give students a solid foundational background in engineering and natural sciences with specific depth areas useful to industry and as precursors to graduate studies.

Additional goals of the proposed program are to increase enrollment in science and engineering at Oakland University; increase Oakland's visibility through the addition of this modern interdisciplinary program; and stimulate research collaborations and funding within Oakland and between the University and industry.

2. Rationale for the program

a. Nature of Work for Individuals Trained in Engineering Biology

By combining biology with engineering and computing, bioengineers develop devices and procedures that solve biological and health-related problems. Bioengineers typically have expertise more closely related to engineering supplemented with biology, chemistry, physics, and mathematics. *Biomedical* engineers, on the other hand, typically have expertise more closely related to engineering supplemented with biology, chemistry, and medicine. In many cases the term "biomedical engineer" is used to describe both bioengineers and biomedical engineers. Many such biomedical engineers carry out research along with life scientists, chemists, and medical scientists to develop and evaluate systems and products for use in the fields of biology and health. These devices can include artificial organs, prostheses (artificial devices that replace missing body parts), instrumentation, medical information systems, and health management and care delivery systems. Bioengineers design devices used in various medical procedures, such as the computers used to analyze blood or the laser systems used in corrective eye surgery. Such engineers also develop artificial organs, imaging systems such as magnetic resonance, ultrasound, and x-ray, and devices for automating insulin injections or controlling body functions. Most engineers in this specialty require a sound background in one of the basic engineering specialties, such as mechanical or electronics engineering, in addition to specialized biological or biomedical training.

b. Program Need and Employment Opportunities

With medical devices emerging as fundamental tools in the treatment of many physical biological systems, bioengineering and computational biology have both come to the forefront in science. The demand for professionals with training in these interdisciplinary areas is large, and growth is expected despite the recent economic climate. According to the US Bureau of Labor Statistics (BLS), the number of biomedical engineering jobs will increase by 26.1 percent from 2005 by 2012, almost twice as fast as the overall average.

Biomedical engineers held about 7,600 jobs in 2002. Manufacturing industries employed 38 percent of all biomedical engineers, primarily in the pharmaceutical and medicine manufacturing and medical instruments and supplies industries. Many others worked for hospitals. Some also worked for government agencies or as independent consultants.

Because of the growing concern regarding infectious diseases, many companies and universities have focused their research-oriented initiatives on the creation of new biomedical devices designed by biomedical engineers. Examples cited by the BLS include "computer-assisted surgery and molecular, cellular, and tissue engineering." The BLS also adds, "In addition, the rehabilitation and orthopedic engineering specialties are growing quickly, increasing the need for biomedical engineers. Along with the demand for more sophisticated medical equipment and procedures is an increased concern for cost efficiency and effectiveness that also will boost demand for biomedical engineers."

Median annual earnings of biomedical engineers were $60,410 in 2002. The middle 50 percent earned between $58,320 and $88,830. The lowest 10 percent earned less than $48,450, and the highest 10 percent earned more than $107,520. According to a 2003 salary survey by the National Association of Colleges and Employers, bachelor's degree candidates in biomedical engineering received starting offers averaging $39,126 a year, and master's degree candidates, on average, were offered $61,000.

In the academic setting, there are a number of universities that have well-established graduate degrees in bioengineering and computational biology and more recently in undergraduate bioengineering. Therefore, students who wish to pursue graduate training at schools other than OU will have many opportunities available to them.

c. Promotion of the Role and Mission of Oakland University

The Bachelor of Science degree with a major in engineering biology will contribute to making Oakland University an institution with programs of distinction. The training involved for undergraduate students in these new majors will come from qualified, interdisciplinary scientists with research focus on medical applications, unusual for a university of Oakland's size. These interdisciplinary majors will continue to foster interdisciplinary work among engineering, computation, biology, and mathematics, in particular, giving increased visibility to interdisciplinary scholarship. Qualified students will be able to participate, as undergraduates, in interdisciplinary research in computational biology and bioengineering.

Students majoring in these fields will be eligible for support such as tuition for summer workshops provided by the National Science Foundation and other agencies that require the terms "bio and engineering" in the degree title.

d. Comparison to Similar Programs Nationally

Several academic institutions across the nation offer bachelor degrees in bioengineering that are similar to the proposed program. A representative list of these includes Arizona State University, Boston University, Carnegie Mellon, the University of California at Los Angeles, the University of California at San Diego, Case Western Reserve University, Duke University, the University of Illinois at Chicago, the John's Hopkins University, Louisiana Tech University, the University of Michigan, the University of Pennsylvania, Rensselaer Polytechnic Institute, Vanderbilt University, Tulane University, the University of Washington, and Texas A&M University. Enrollment in bioengineering has increased at all of these institutions.

In Michigan, there are three Bio engineering programs, namely:

1. The University of Michigan Biomedical Engineering Program (http://www.bme.umich.edu/**) .**The UM bioengineering program is funded by the NASA. According to their Chair "We now have over 160 students in the BS program and over 200 in the graduate program. We have now graduated 125

students in our first four BS classes and the undergraduate program is fully primed with about 60 students per year. A number of new undergraduate courses have been developed and we recently received ABET accreditation, effective October 1, 2004."
This program is growing very rapidly, not only in terms of students, but also in terms of funding. This may be a harbinger for a similar growth in our own program.

2. The Wayne State University Biomedical Engineering Program (http://ttb.eng.wayne.edu/**).** Even though it is one of the oldest Biomedical Engineering programs in the nation, having started with research on head injuries in car crashes, it remains a graduate program only.

3. The Michigan Tech Biomedical Engineering Program (http://www.biomed.mtu.edu/**).** The Michigan Tech department of Biomedical Engineering was established in the fall of 1998 through a $1million Whitaker Foundation grant. Currently, the department has seven (7) full-time Ph.D. professors encompassing the research areas of Biomaterials, Bioinstrumentation, Biomechanics, Human Physiology, and medical heat and mass transfer. The Department of Biomedical Engineering at Michigan Technological University (Houghton, MI) offers a curriculum leading to a Bachelor of Science Degree in Biomedical Engineering (BSBE).

Both UM and Michigan Tech programs are focused on biomedical which is only one of the tracks in our Engineering Biology program. In comparison, our program has a broader scope, with five tracks the students can choose from. The added distinctive Undergraduate experience at Oakland and the fact that demand for this field is still growing makes us very hopeful that our program is very competitive and will fill a definite need.

e. Source of Students

Over the past five years, a number of students in the School of Engineering and Computer Science have inquired about which major would be most appropriate in order to be prepared for entering a bioengineering graduate program. Some of the enrollment in the proposed new engineering biology program would thus come from existing engineering, mathematics, and natural science students who possess an interest in bioengineering studies. The program is also expected to attract new students to Oakland University because of its interdisciplinary nature and its relevance to industry, society, and graduate school.

Oakland University will be an attractive option for students who wish to major in engineering biology because it will be a smaller, individualized program incorporating unique undergraduate experiences not offered by larger institutions at the undergraduate level. The program will improve retention because many students initially seek Oakland as an institution where they can study locally, then transfer to another institution which has the specific program in which they develop an interest. Presently, students interested in bioengineering must select a university other than Oakland or major in a traditional engineering discipline at Oakland. This makes them less competitive for a job requiring bioengineering skills after their baccalaureate degree, and places them at a disadvantage for graduate studies in bioengineering.

Overall, there is an undeniable growing interest in Engineering Biology and related fields from the students. Offering this major we will attract students who would not have come to Oakland otherwise; failing to cater to this growing interest will lead students to transfer out to institutions that do. This has been substantiated by the results of a survey conducted in the month of January 2007 of students in SECS core courses and in a spectrum of courses in biology.

During the last two weeks of January 2007, 220 students in BIO 111, BIO 113, and 140 students in BIO 325 and BIO 341, were surveyed. The answers to the key questions are shown in the table below:

	Yes		No		No opinion	
	Lwr	Upr	Lwr	Upr	Lwr	Upr
Should Oakland offer a degree in Engineering Biology?	68%	68%	3%	0.6%	28%	30%
Would a degree in Engineering Biology enhance your career?	37%	25%	33%	35%	29%	38%
If offered, would you consider enrolling in EGR/BIO. in OU?	**26%**	**17%**	55%	65%	19%	17%
If not offered, would you consider transferring to another school?	**8%**	**5%**	64%	72%	26%	22%

Of particular interest are the answers to the last two questions, which show respectively, **the likelihood of high enrollment** if the program is offered and the **risk of losing students** if the program is not offered.

Even more dramatic results were born out by the survey of SECS students. During the weeks of January 2007, 58 students taking Core Courses in SECS (100- and 200-level courses) were surveyed. The answers to the key questions are shown in the table below:

	Yes	No	No opinion
Should Oakland offer a degree in Engineering Biology?	74%	0%	26%
Would a degree in Engineering Biology enhance your career?	39%	27%	34%
If offered, would you consider enrolling in EGR/BIO. in OU?	**48%**	42%	10%
If not offered, would you consider transferring to another school?	**20%**	63%	17%

3. Self Study of the Academic Units

a. Status of the Units

The School of Engineering and Computer Science consists of four departments which collectively offer a Bachelor of Science in Engineering with 4 major areas: electrical engineering, systems engineering, computer engineering and mechanical engineering. It also offers four Bachelor of Science degrees in computer science, information technology, engineering chemistry, and engineering physics. The last two are offered jointly with the College of Arts and Sciences.

The College of Arts and Science consists of fifteen department and programs, which offer over sixty majors in Bachelor of Arts, Bachelor of Science and Bachelor of Music degrees. The Department of Biological Sciences in the College of Arts and Sciences offers a Bachelor of Science and Bachelor of Arts in the Biological Sciences with several specializations, including microbiology, cell/molecular biology, anatomy and applied statistics. In conjunction with the Department of Chemistry, it also offers a Bachelor of Science in the interdisciplinary field of Biochemistry.

b. How the Goals of the Units are Served by the Program

The program is consistent with the goals of the University to serve the needs of the Michigan and Oakland County in particular. The program will also enhance the units' visibility to attract a larger pool of students in other programs as well, and more research contracts and grants through interactions with the industry and with the faculty on campus from other units. The program will help stabilize and grow the enrollments in each of the units because of future projections of job growth in bioengineering and related fields.

c. Staffing Needs

Initially, existing faculty can implement the administrative and teaching requirements for the proposed majors. The program will only use existing courses in the first two years. These courses have been assembled by faculty in biology, mathematics, chemistry, physics, and computer science and engineering.

As the 3rd and 4th year, new courses will be offered to the students (see program details below). Additional faculty will then be required. We included one faculty position in the second year of the program and one in the 3rd year. The new hires will be expected to have leading roles in the development and growth of the program. As this happens, additional release time may be required to run the program.

In addition, the program requires one full-time secretarial position. This resource will be divided equally between the Department of Biological Sciences and the School of Computer Science and Engineering.

d. Faculty Qualifications

Each of the departments involved in these programs has faculty members who have the required teaching expertise for the courses proposed in these programs. Subsequently, these programs will be enriched by faculty whose expertise is singularly in systems engineering, mathematics, and biology since the programs are designed to emphasize SECS "systems approach" to engineering.

More specifically, faculty members conducting research in bioengineering, biology, and computational biology have the necessary qualifications to implement a program in Engineering Biology. Appendix B lists short biographies of some of the SECS and CAS faculty whose research and teaching interests are most closely related to the engineering biology program. These faculty members have published journal papers in these areas and either chair or serve on committees for graduate students in engineering who are focusing their masters or doctoral studies on applications in bioengineering. The School of Engineering and Computer Science has graduated several students with doctoral degrees in Systems Engineering who have written dissertations with applications and advancements in bioengineering.

e. Library Holdings

The library holdings are quite adequate resources for the program at this point. Because this is a new field, we will need to remain current by acquiring new books as they appear, and have included a line item in the budget for it. Research oriented material could be provided via the interlibrary loan system. As the program grows, and as more publications appear in this emerging new field, we will reassess and possibly request new subscriptions and acquisitions.

f. Classroom, Laboratory, and/or Studio Space

No additional laboratory or classroom space is necessary for the program.

g. Equipment

At this time, we do not anticipate any additional equipment to run the courses, but rather, will use existing equipment which is maintained and operated by CAS and SECS departments. An equipment maintenance and equipment replenishing line items have been included in the proposal budget.

4. Program Plan

a. Degree Requirements

Major in Engineering Biology

Major technological advances are being made in the bioengineering field at a rapid pace. Engineering Biology is an interdisciplinary major in which students must not only embrace multiple subject areas but must also be interested in applying engineering principles to challenges in engineering and biology. Students should gain a strong background in the fundamentals of engineering and biology and develop a willingness to accept and thrive on change. The engineering biology program at Oakland University is designed to provide students with the basic knowledge and skills needed to effectively apply engineering principles to problems in their specialization areas in the years ahead. A balance between theoretical and practical experience and an emphasis on both engineering and biology are key elements to the university's engineering biology major.

To earn the degree of Bachelor of Science with a major in engineering biology, students must complete a minimum of 130 credits. They must demonstrate proficiency in writing (see *Undergraduate degree requirements*) and meet the following requirements:

PROGRAM CREDIT STRUCTURE

		Credits
Core courses		
MTH 154-155	Calculus	8
MTH 254	Multivariable Calculus	4
APM 255	Introduction to Differential Equations and Matrix Algebra	4
STA 226	Applied Probability and Statistics	4
Subtotal		**20**
PHY 151-152	Introductory Physics I and II	8
Subtotal		**8**
CHM 157-158	General Chemistry I and II (includes Lab)	10
CHM 201	Introduction to Organic and Biological Chemistry	4
Subtotal		**14**
BIO 111-113	Biology I and II	8
BIO 116	Biology Laboratory	1
BIO 325	Biochemistry I	4
BIO 321	BIO 321 Physiology, or BIO 309 Biology of the Cell, or BIO 319 General Microbiology	4
BIO 341	Genetics	4
Subtotal		**21**
EGR 120	Computer Graphics and CAD	1
EGR 141	Computer Problem Solving in Engineering and Computer Science	4
EGR 240	Introduction to Electrical and Computer Engineering	4
EGR 250	Introduction to Thermal Engineering	4
EGR 280	Design and Analysis of Electromechanical Systems	4
Subtotal		**17**
EBO 3XX	Introduction to Engineering Biology *(new course)*	3
EBO 490	Research Project/Capstone Design *(new course)*	3
Subtotal		**6**
Core Subtotal		**86**
Professional Subjects (Choose one of 5 tracks) see below.		**15-16**
General education (excluding mathematics and science)		**24**
Free Electives[1]		**4**
Grand Total[2]		**130**

[1] Students can use the free electives credit to satisfy their writing requirements.
[2] The general CAS distribution requirement does not apply to this program

Professional Track 1: Bioinformatics

Required: (Choose four courses including BIO 443 and CSE 461)

CSE 230	Object Oriented Computing I	4
CSE 361	Design and Analysis of Algorithms	4
BIO 443	Functional Genomics and Bioinformatics	4
CSE 345	Database Design and Implementation	4
CSE 461	Bioinformatics	4
Total Cr.		**16**

Professional Track 2: Biomedical and Biophysical Engineering**

Required:

PHY 325	Biological Physics	4
BIO 4XY	Thermodynamics in Biological Systems *(new course)*	4
ME 361	Mechanics of Materials	4
ME 461	Analysis and Design of Mechanical Structures (requires ME 361)	4
Total Cr.		**15**

Professional Track 3: Computational Biology

Required:

MTH 275	Linear Algebra	4
APM 4XX	Mathematical Models of Biosystems *(new course)*	4
BIO 482	Evolutionary Biology or BIO 483 Community and Population Biology	3

Electives: (Choose one)		4
APM 357	Elements of Partial Differential Equations	4
APM 433	Numerical Methods	4
APM 434	Applied Numerical Methods: Matrix Methods	4
APM 455	Intermediate Ordinary Differential Equations	4
Total Cr.		**15**

Professional Track 4: Electronic Devices/Signal Analysis/Bio-sensors**

Required:

ECE 316	Circuits and Systems	4
ECE 327	Electronic Circuits and Devices	4
CSE 465	Intro to Micro- and Nano-technology *(new course)*	*4*
CHM 428	Intro to Bio-instrumentation/Bio-sensors *(new course)*	4

Highly Recommended:

In addition to the required courses, students are strongly encouraged to consult their faculty adviser for advice on taking more advanced courses related to this emerging track.

Total Cr. **16**

Professional Track 5: Molecular Engineering Biology

Choose four (Choice must include BIO 319, BIO 423 and BIO 441):

PHY 325	Biological Physics	4
BIO 309	Biology of the Cell	4
BIO 319	General Microbiology	4
BIO 323	Developmental biology	4
BIO 423	Immunology	4
BIO 441	Microbial Biotechnology	4
Total Cr.		**16**

b. Course Catalog Descriptions *(new courses)*

APM 4XX: Mathematical Models of Biosystems (4)
Mathematical models will be derived and analyzed both theoretically and computationally for problems such as tumor growth, allometry, population harvesting, competition theory, influenza epidemics, blood flow (tracer dyes), flow of nutrients in zooplankton & phytoplankton populations, glucose/insulin regulation, and enzyme reactions. Also, mathematical models for the biological processes involved in the co-evolution of parasites and vertebrate hosts will be studied. Other mathematical topics that will be covered include the pathogenicity of HIV, Mycobacterium tuberculosis, Shigella, Plasmodium falciparum, and other microorganisms.

CHM 428 Biosensor and Chemical Sensor Technology (4)
An overview of basic sensor technology (thermal sensors, optical sensors, acoustic wave sensors, electrochemical sensors and biosensors, sensor arrays and pattern recognition) with examples drawn from existing products and literature. Emphasis will be placed on understanding sensor operation, issues limiting the use of sensors for measurements, and selection of sensors for specific applications.

CSE 465 Micro and Nano- Technology (4
The course provides a general introduction to the multi-disciplinary field of micro and nano technology. Topics include basic microelectronics, nano-electronics, MEMS and NEMS, micro-fluidics as well as basic nano-materials. It also covers different applications of micro and nano-technology including cantilever based bio-sensors, molecular electronics, self-assembly, force measurements on individual molecules and cells, bio-chip based DNA-analysis, and nano-scale manipulators.

EBO 3XX Introduction to Engineering Biology (4)
This course is a survey of topics and career opportunities in bioengineering and engineering biology. Its goal is to help students choose their track for the remainder of the program and gain a general view of the field. Topics covered include bioinformatics, computational biology, electronic devices, biosensors, biomedical and biophysical engineering, and quantitative biology.

EBO 490 Research Project/Capstone Design (4)
Students integrate the multi-disciplinary knowledge and the various skills in laboratory work and communication, to solve novel problems using engineering biology principles under real world constraints. Working in teams, students will present project proposals to the faculty advisory panel, demonstrate feasibility, implement the projects, present the final projects, and compete for best project.

BIO 4XX Thermodynamics in Biological Systems (4)
Provides an introduction to thermodynamic principles as applied to biological molecules and their interactions that result in complex biological structures and pathways.

c. Admission Criteria

Students will be admitted to the program upon declaring a major. Student enrolled in the School of Engineering and Computer Science, or the Department of Biological Sciences, or the Biochemistry Program are natural candidates for the program. Yet, the goal of the program is precisely to broaden participation in the sciences and engineering by also reaching out to other students from within Oakland as well as other institutions.

d. Administrative Personnel/Procedures Needed to Support Program

To effectively implement the new program in Engineering Biology it will be administered by a coordinator and a steering committee, much the same way as the biochemistry program (jointly run by the departments of biological sciences and chemistry). The steering committee will be made of three full-time faculty members from biological sciences and three from SECS. A faculty coordinator will Chair the steering committee. The coordinator appointment will be for three year and will rotate between the two departments.

There will be two faculty advisers, one from each department. The two advisers will be members of the steering committee and one of them could be the coordinator. Graduation audits will be done as a team work by the two advisers.

In additional the program will require secretarial support. Initially it is anticipated that one full-time administrative assistant or two assistants in half-time capacity, with job responsibilities in the two partner units will be sufficient. As the program matures, additional administrative staff will be requested as needed.

e. Sample 4-year Schedule

ENGINEERING BIOLOGY SAMPLE SCHEDULE							
Freshman	**Cr.**	**Sophomore**	**Cr.**	**Junior**	**Cr.**	**Senior**	**Cr.**
Fall Semester		**Fall semester**		**Fall semester**		**Fall semester**	
EGR 120	1	BIO 113	4	EGR 280	4	Prof Elective 1	4
MTH 154	4	EGR 240	4	BIO 321	4	Prof Elective 2	4
BIO 111	4	CHM 158	5	APM 255	4	EBO 3XX	3
CHM 157	5	Gen Ed	4	Gen Ed	4	Gen Ed	4
Gen Ed	4						
	18		**17**		**16**		**15**
Winter semester	**Cr.**	**Winter semester**	**Cr.**	**Winter semester**		**Winter semester**	
MTH 155	4	EGR 250	4	BIO 325	4	Prof Elective 3	4

PHY 151	4	MTH 254	4	BIO 341	4	Prof Elective 4	4
EGR 141	4	CHM 201	4	STA 226	4	EBO 490	3
RHT 160	4	PHY 152	4	Gen Ed	4	Gen Ed	4
		BIO 116	1				
	16		**17**		**16**		**15**
						Grand total	**130**

f. New Course Syllabi

See appendix A.

g. Support and Consent from Other Academic Units

Since this is a joint program between the College of Arts and Sciences (CAS) and the School of Engineering and Computer Science (SECS), and two departments, it has a rather broad base of support. Letters of support from the Department Chairs of Biological Sciences, Computer Sciences, Chemistry, Mathematics and Statistics, and Physics, as well as from the Deans of CAS and SECS are attached in appendix B.

h. Student Recruiting, Retention, Monitoring and Advising

One of the key missions of the introduction of this program is the opportunity to attract new students to Oakland and to the units involved. We will therefore devote valuable resources to the recruitment, advising, and mentoring to ensure that they are properly advised and retained in the program. We see the need for proper advertising of the program and the need for outreach efforts to make it visible as the main rationale for requesting additional dedicated faculty positions and support personnel.

Recruitment efforts for this program can be coordinated with other initiatives taking place on campus. The Summer Institute for Bioengineering and Health Informatics (SIBHI) offered by the School of Engineering and Computer Science in collaboration with the Department of Biological Sciences and School of Health Sciences targets undergraduate and graduate students from OU and neighboring institutions and mentors them in research for the purpose of attracting them to the field of bioengineering. Ads and fliers sent every year to targeted SIBHI participants can be paired with ads about the new Engineering Biology program. The various Research Experience for Undergraduates (REU) programs in Computer Science and Engineering, Mechanical Engineering, Physics, Biological Sciences, Chemistry also recruit primarily students from neighboring institutions. Students who enroll in these programs will also be solicited to join Oakland and enroll in one of our programs, notably the Engineering Biology.

To ensure that the program and the students receive adequate attention, the steering committee will appoint two of its members, one from each unit, as faculty advisers for the Engineering Biology program. Advising will be carried out by the advising staffs of the School of Engineering and Computer and the College of Arts and Sciences staff.

5. Revenue/Costs

	Acct.	FY08 1	FY09 2	FY10 3	FY11 4	FY12 5
Revenue Variables:						
Headcount (incremental only)		**15**	**30**	**45**	**60**	**60**
Total Credit Hours		**450**	**900**	**1350**	**1800**	**1800**
Undergraduate		450	900	1350	1800	1800
Graduate						
Total FYES		**15.00**	**30.00**	**45.00**	**60.00**	**60.00**
Undergraduate (cr.÷30)		15.00	30.00	45.00	60.00	60.00
Graduate (cr.÷24)		0.00	0.00	0.00	0.00	0.00
Doctoral (cr.÷16)		0.00	0.00	0.00	0.00	0.00
Tuition Rate Per Credit Hour						
Undergraduate (composite)		$231.88	$231.88	$231.88	$231.88	$231.88
Graduate		$383.00	$ 383.00	$383.00	$383.00	$383.00
Revenue						
Tuition		$104,343.75	$208,687.50	$313,031.25	$417,375.00	$417,375.00
Other		$	$	$	$	$
Total Revenue		$104,343.75	$208,687.50	$313,031.25	$417,375.00	$417,375.00
Compensation						
Salaries/Wages						
Faculty Inload (Replacement Costs)	6301	$	$	$	$15,000.00	$15,000.00
Faculty Salaries	6101	$	$70,000.00	$140,000.00	$140,000.00	$140,000.00
Faculty Overload	6301	$	$	$	$	$
Part-time Faculty	6301	$	$	$ -	$	$
Visiting Faculty	6101	$	$	$	$	$
Administrative	6201	$	$	$	$	$
Administrative - IC	6221	$	$	$	$	$
Clerical	6211	$35,000.00	$35,000.00	$35,000.00	$35,000.00	$35,000.00
Wages	6401	$	$	$	$	$
Student	6501	$	$	$	$	$
Graduate Assistant Stipends	6311	$13,000.00	$26,000.00	$26,000.00	$39,000.00	$39,000.00
Out of Classification	6401	$	$	$	$	$
Overtime	6401	$	$	$	$	$
Total Salaries/Wages		$48,000.00	$131,000.00	$201,000.00	$229,000.00	$229,000.00
Fringe Benefits	6701	$18,445.00	$47,264.00	$76,083.00	$77,418.00	$77,418.00
Total Compensation		**$66,445.00**	**$178,264.00**	**$277,083.00**	**$306,418.00**	**$306,418.00**
Operating Expenses						
Supplies and Services	7101	$15,000.00	$15,000.00	$15,000.00	$ 15,000.00	$15,000.00
Supplies and Services (advertising)	7101	$20,000.00	$10,000.00	$5,000.00	$	$ -
Supplies and Services (equipment maintenance)	7101	$6,000.00	$12,000.00	$18,000.00	$18,000.00	$18,000.00

Graduate Assistant Tuition	7101	$13,248.00	$26,496.00	$26,496.00	$39,744.00	$39,744.00
Travel	7201	$ -	$ -	$ -	$ -	$ -
Telephone	7301	$500.00	$500.00	$500.00	$500.00	$500.00
Equipment	7501	$5,000.00	$5,000.00	$5,000.00	$5,000.00	$5,000.00
Library	7401	$ -	$10,000.00	$10,000.00	$10,000.00	$10,000.00
Total Operating Expenses		**$59,748.00**	**$78,996.00**	**$79,996.00**	**$88,244.00**	**$88,244.00**
Total Expenses		$126,193.00	$257,260.00	$357,079.00	$394,662.00	$394,662.00
Net Income/Loss		$(21,849.25)	$(48,572.50)	$(44,047.75)	$22,713.00	$22,713.00

6. Implementation: Five-year Timetable

Due to the strong interest in the degree, we plan to begin the program in the Fall 2007. Since the core courses are available, the starting time does not pose any immediate changes in the current curriculum.

a. New Faculty Positions

The current faculty in the participating units are sufficient to begin implementation of the Engineering Biology program in Fall 2007. It is anticipated that one additional faculty member will be recruited by each of the two participating units (one in year two and one in year three), increasing the participating faculty by a total of two by Fall 2010.

b. Course Offerings Each Semester

The curriculum in Engineering biology mostly consists of three components:

1. The General Education and Math and Sciences: These courses offer a wide range of choices and are offered sufficiently frequently not to constrain students' schedules.
2. The Engineering Core: All of the engineering Core courses are offered at least twice a year (Fall and Winter).
3. The Biology Core: Most of the Biology Core courses are offered twice a year, or at the very least once a year. The sample schedule is organized to reflect semesters of offering.
4. The Engineering Biology Core (EBO 3XX and EBO 490). Starting from the second year of the program, EBO 3XX will be offered every Fall semester and EBO 490 will be offered every Winter semester.
5. The Professional Electives. Starting from the third year, at least three non-Professional Electives will be offered every semester. Because most of the professional electives are parts of other curricula, they will be offered anyway.

c. Predicted Enrollment Levels for Each Year

The field of bioengineering is a rapidly growing enterprise suggesting that enrollments in the program will be robust. Currently there are over 450 majors in Biological Sciences and over 280 in Computer Sciences. Based upon expressed student interest, it is anticipated that ~ 2% of these students or 10-15/year will enroll in the Engineering Biology program. In addition, we anticipate an additional 10-15 students will be recruited to Oakland University specifically because of the Engineering Biology program. Therefore the total expected is 25-30 students a year.

d. "Steady State" Operation of Program

The Engineering Biology program is designed to be a four year program. At maturity we project a steady-state enrollment of 75-120 majors.

7. Program Evaluation

The quality of the Engineering Biology program is instrumental to its success. The program will be subjected to the same assessment used for all engineering programs and approved by ABET. The assessment plan identifies three constituent groups that the program serves, that is, students, employers and faculty; setting objectives for each educational program that describe the skills necessary for successful modern engineering practice; and identifying outcomes for each educational program that ensure the skills necessary to achieve the program educational objectives.

Assessment question: Do Engineering Biology students demonstrate achievement of the program outcomes before graduation? **Program outcomes** are a set of skills necessary for successful professional practice, and include problem solving, laboratories, design, teamwork, ethics, interpreting data, communication, information literacy, contemporary issues and modern engineering tools.

The program assessment/improvement process involves both indirect and direct measures of the success of each course within the program as well as overall measures of the educational program and of the assessment process itself. Each component of the assessment process is described briefly below.

Program Evaluation. The overall success of a program is measured by whether the students of that program can demonstrate achievement of all outcomes as they graduate, and if the graduates of the program demonstrate the objectives of the program as they are professionally employed. Key courses are identified where students have the opportunity to demonstrate the achievement of the program outcomes; the set of key courses is chosen to insure that all of the program outcomes are demonstrated. Student materials are collected from the key courses that provide evidence that the outcomes have been achieved. External evaluators, including faculty not directly involved with the course and steering committee members, review these materials to establish whether the students in that class have achieved some or all of the program outcomes. The steering committee reviews the results of these external evaluations and generates appropriate plans to improve the achievement of the program outcomes.

Course Evaluation. Each core and professional elective course has a set of course objectives, developed by the instructing faculty and department curriculum committees, which ensure the logical sequence of topics necessary to the eventual achievement of the program outcomes. At the end of each semester, the students and faculty in each course rate how well that particular course section achieved its objectives. The faculty identify the specific program outcome(s) achieved in the course and provide evidence in support of their contention. In addition, students and faculty are encouraged to comment on how well the course fits into the overall scheme of the program and to suggest improvements to the course, the course objectives and the overall program of study. The program's coordinator and the steering committee review the course evaluations annually and forward the suggestions for improvement to appropriate departments for consideration, prioritization and action.

Input of Constituents. In addition to directly measuring the demonstration of program outcomes, three online surveys are used to gather additional information about the overall health and success of the program. Students are surveyed as they exit the SECS programs and are asked about every aspect of their OU experience, focusing on the achievement of the program outcomes. Alumni are surveyed every two years and are asked how well the SECS programs prepared them for professional employment and are solicited for suggestions for program improvement. Employers of our graduates are asked to comment on the preparation of the graduates for professional employment and are also solicited for suggestions for program improvement. The results of these surveys are examined and evaluated by the coordinator and the program's steering committee, who subsequently generate plans to improve the programs based on this input.

APPENDICES

APPENDIX A: COURSE DESCRIPTIONS

Syllabus for CSE 465

(taught as Special topics in Summer 2006)

Course Title: Micro and Nano Technology (4 Credits).

Course Description: The course provides a general introduction to the multi-disciplinary field of micro and nano technology. Topics include basic microelectronics, nano-electronics, MEMS and NEMS, micro-fluidics as well as basic nano-materials. It also covers different applications of micro and nano-technology including cantilever based bio-sensors, molecular electronics, self-assembly, force measurements on individual molecules and cells, bio-chip based DNA-analysis, and nano-scale manipulators.

Prerequisites: Major Standing in any engineering discipline or graduate status.

Required Text: *An Introduction to Microelectromechanical Systems Engineering, 2nd edition,* Nadim Maluf and Kirt Williams, Artech House 2004

Other references: *Microsensors, MEMS, and Smart Devices,* Julian Gardner, Vijay Varadan, and Osama Awadelkarim, Wiley 2002

Topical Contents:

This course will focus on introducing micro-scale embedded systems. This includes digital, analog, mixed-mode, and micro-electromechanical systems (MEMS). An introduction to embedded systems design tools and simulators for the design of these systems, including basic fabrication techniques for analog and micro-electromechanical systems will be given. The course will focus on applications that have been developed and are currently under development in mixed-mode, MEMS, and micro-fluidics, particularly for automotive, consumer products, sensors, and biomedical applications. Although the course focuses on micro-embedded systems, technology of nano-scale will also be discussed. This course is not a design course, however, successful students will be able to apply the knowledge obtained as a precursor to working with specific electronic design automation (EDA) tools and will have the ability to design mixed-mode systems while understanding the broader impacts of micro-technologies. In addition to the homework, students will participate in a high-tech case study that will result in a report, a poster, and a PowerPoint presentation.

Grading:

Grading will be based of the following:

In-Class Exercises	30 %
Homework	5 %
Exams	55 %
Case Study	15 %
	100 %

Syllabus for EBO 490

Course Title: Research Project/Capstone Design (3 Credits)

Catalog Description:
Students integrate the multi-disciplinary knowledge and the various skills in laboratory work and communication, to solve novel problems using engineering biology principles under real world constraints. Working in teams, students will present project proposals to the faculty advisory panel, demonstrate feasibility, implement the projects, present the final projects, and compete for best project.

Course Objectives: The purpose of this class is to introduce the engineering biology student to the principles of successful engineering design and to guide students through practical design experiences.

Course Procedures and tentative schedule: In this course, students will work in groups of three under the mentorship of a panel of faculty members representing the specialties from the 5 tracks. Once the projects groups are formed, most of the class time is devoted to group meetings and consultations with the faculty panel. The faculty panel will mentor the students and advise them to make sure that they select a project relevant and of the right level of difficulty, and that they conduct the project in compliance with biological fundamentals and engineering principles. The faculty panel will also serve as a resource for expertise to the students. The following is a tentative schedule of the course:

Week 1: Introduction to the course, examples of projects are shown to the students. Student profiles are collected. Groups assignments are made.

Week 2: Lectures on general principles of design, in particular: 1. **Design process:** Objectives and criteria, synthesis, analysis, construction, testing and evaluation. 2. **Design constraints:** Human factors, safety, economic factors, reliability, aesthetics, ethics and societal impact.

Weekly: Group meetings; individual written progress reports, project notebooks.

Week 4: Written design proposals, identification of project managers.

Week 8: Oral progress presentations.

Week 10: Rough draft of written report.

Week 13: Oral presentations.

Week 14: Competition.

- Grading: All grading in this course will be based on the quality of design work, its analysis and subsequent oral and written presentation. All of the projects in this course will be team efforts and will usually include the design, construction and testing of some device.

BIO 4XX Thermodynamics in Biological Systems (4)

Required Texts

Silbey, R., R. Alberty, and M. Bawendi. *Physical Chemistry*. New York, NY: John Wiley & Sons, 2004. ISBN: 047121504X.

Dill, Ken A., and Sarina Bromberg. *Molecular Driving Forces: Statistical Thermodynamics in Chemistry and Biology*. New York, NY: Garland Science, 2003. ISBN: 0815320515.

Grading

Grades will be based upon 4 exams worth 100 points and 4 homework assignments worth 10 points each.

Proposed Topics

Introduction to the impact of Physical Chemistry in Biological Systems
Heat, Energy, and Work
First Law of Thermodynamics
Entropy and the Second Law of Thermodynamics
Entropy Measurements, Third Law of Thermodynamics
Free Energy

Exam 1

Applications of thermodynamics: DNA base recognition and replication fidelity
Gibbs Free Energy
Chemical Equilibrium
Non-ideality of solutions
Redox Reactions and Chemical Potential
Applications: Bioenergetics

Exam 2

Reaction Rates and Mechanisms
Kinetics and Mechanisms of Enzymatic Reactions
Applications: Photosynthesis
Structure and Spectroscopy
Applications: Fluorescence and Scanning Microscopy

Exam 3

Applications: X-ray and Protein/DNA/RNA Structure

Final Exam (Comprehensive)

CHM 428 - Chemical and Biosensor Technology (4)

Course Objective: In recent years, sensor research has experienced a revolution, promising to have a significant impact on a broad range of applications relating to national security, health care, the environment, energy, food safety, and manufacturing. The convergence of the Internet, communications, and information technologies with techniques for miniaturization has placed sensor technology at the threshold of a period of major growth. The goal of this course is to provide graduate and upper-level undergraduate students with a deeper understanding of chemical sensors and biosensors; specifically, it will provide undergraduate and graduate students with a practical, working knowledge of modern sensor technologies. The course will offer an overview of basic sensor technology (Thermal sensors, optical sensors, acoustic wave sensors, electrochemical sensors and biosensors, sensor arrays and pattern recognition) with examples drawn from existing products and literatures. During the course of the semester, several external university professors and scientists in local industry working in the fields of chemical and biosensors will be recruited to present lectures or seminars for the class. At the end of the course, students should understand how many sensors work, what issues limit the use of sensors for measurements, and how to select sensors for specific applications.

Textbook: Literature hand out

Reference Book: Chemical Sensors and Biosensors; ISBN 0-471-89914-3

Required items: Calculator with logarithms, exponential and scientific notation.

Homework: Reading literature handout about sensor techniques discussed in the lectures is an important part of homework assignments. Problems from the literature will be announced weekly. Experience shows that your grade in the course is proportional to the effort you make in reading and doing the assignments! The homework is not graded but will be discussed in the lecture.

Exams: There will be three exams. Two midterm exams, the other is final. Each midterm is 250 points. Final exam will be 300 points. In addition, each student will choose a particular sensor topic and present a 30mins of presentation which counts as 200 points.

Grade: > 85% A (3.6-4.0); 75-85 % B (3.0- 3.5); 60%-75 % C (2.0-2.9); D < 60% (1.0-1.9)

APM 4XX: Mathematical Models of Biosystems (4)

Mathematical models will be derived and analyzed both theoretically and computationally for problems such as tumor growth, allometry, population harvesting, competition theory, influenza epidemics, blood flow (tracer dyes), flow of nutrients in zooplankton & phytoplankton populations, glucose/insulin regulation, and enzyme reactions. Also, mathematical models for the biological processes involved in the co-evolution of parasites and vertebrate hosts will be studied. Other mathematical topics that will be covered include the pathogenicity of HIV, Mycobacterium tuberculosis, Shigella, Plasmodium falciparum, and other microorganisms.

Prerequisites: APM 255, MTH 275, proficiency in a computer programming language, and instructor permission.

Potential Book: Mathematical Models in Biology, by Leah Edelstein-Deshet

Also, lectures will be taken from the following book: Differential Equations: An Applied Approach by Jim Cushing

- Population Dynamics: Sections 1.5.1, 3.6.1, 4.6.1, 7.5.1, 8.9.3, 9.7.2
- Epidemics: Sections 2.6.1, 8.9.1, 9.7.2
- Drug Kinetics: Sections 5.8.1, 6.5.1, 9.7.2
- Objects in Motion: Sections 1.5.2, 3.6.2, 4.6.2, 5.8.2, 6.5.2, 7.5.2, 8.9.2
- Oscillations: Sections 3.6.1, 5.8.2, 6.5.2, 8.9.3
- Temperatures and Flows: Sections 2.6.2, 2.6.3, 3.6.3, 4.6.1

APPENDIX B: FACULTY BIOGRAPHIES

This short synopsis highlights some of the most relevant activities of SECS and CAS faculty whose research and teaching interests are closely related to the Engineering Biology program.

Chaudhry, Rasul, Professor, Biological Sciences

Research Interests: Embryonic stem cell (ESC) research:

- Research published in journals *J Biomed Mater Res, J. Biomed. Biotech. FEMS Microbiol. Lett. and others.*
- Research related to engineering biology:
  Molecular regulation of neural and osteogenic differentiation of ESC; tissue engineering and regenerative medicine; development of toxicological assays using ESC.

Teaching Interests:

- General Microbiology, 300-level.
- Virology, 400- and 500- level
- Molecular Biology, 400- and 500- level

Dvir, Arik, Associate Professor, Biological Sciences

Research Interests: Mechanism and regulation of eukaryotic gene expression:

- Research published in journals *J. Biol. Chem., Proc. Natl. Acad. Sci. (USA), Biochimica et Biophysica Acta, and others.*
- Research related to engineering biology:
  Biosensor technology as a method to probe for key molecular interactions in gene expression.

Teaching Interests:

- Biochemistry, 300- and 400- level.

Hanna, Darrin, Assistant Professor, CSE

Research Interests:

- "A Review of Nanobioscience and Bioinformatics Initiatives in North America," Barbara Oakley and Darrin Hanna. Invited paper by the Editor of the *IEEE Transactions on Nanobioscience*. 2003 **2** (4), 74-84.

- "Using a System-on-a-Chip Implantable Device to Filter Circulating Infected Cells in Blood or Lymph ," Darrin Hanna, Barbara Oakley, and Gabrielle Stryker. *IEEE Transactions on Nanobioscience* 2003, **2** (1), 6-13.

Teaching Interests:

- Introduced and taught CSE 465: Introduction to Micro- and Nano-technology.

Lal, Shailesh, Assistant Professor, Biological Sciences

Research Interests: Plant transposable elements, plant genome evolution, regulation of gene expression, pre-mRNA processing:

- Research published in journals *Biochimica et Biophysica Acta, Plant Cell, Plant Molecular Biology, and others.*
- Research related to engineering biology:
  Bio informatics, genomic analysis of transposable elements in Maize. Participant in Oakland University's Summer Institute in Biomedical and Health Informatics, NSF, NIH.

Teaching Interests:

- Introductory Biology, 100-level
- Botany, 300-level
- Bio-informatics, 400- and 500- level.

Lindemann, Charles, Professor, Biological Sciences

Research Interests: Sperm motility and the motility of cilia and flagella.

- Research published in journals *Biophysical Journal, Cell Motility and the Cytoskeleton, Journal of Structural Biology, and others.*
- Research related to engineering biology:
  Molecular biology and Biophysics of flagellar axoneme function. Developing a computed model describing the mechanical properties of the eukaryotic flagellum.

Teaching Interests:

- Human physiology, 200- and 400-level

Mili, Fatma, Professor, CSE, SECS

Research Interests: Formal methods, Data and Knowledge Modeling and Validation, Sensor Networks

- Co-author of two books.

- Research published in *Acta Informatica, IEEE TSE, Science of Computer Programming, Theoretical Computer Science, Innovations System Software Engineering.*
- Research has been funded by NSF (formal methods), DaimlerChrysler (knowledge modeling), TACOM (system validation).

Teaching Interests: Interests in motivating and mentoring students.

- PI and co-PI on two NSF REU grants.
- PI on a Bioinformatics and Bioengineering Summer Institute SIBHI funded by NSF and NIH.
- Co-launched the CIT program promoting IT through interdisciplinary studies.

Oakley, Barbara, Associate Professor, ISE, SECS

Research interests:

- Area Editor of the Sensors and Instrumentation Section of the *Wiley Encyclopedia of Biomedical Engineering*. Published April, 2006.
- Research published in such venues as *Bioelectromagnetics*, *IEEE Transactions on Nanobioscience*, *IEEE Transactions on Biomedical Engineering*, **50** (7), 916-921.
- Co-authored "A Review of Nanobioscience and Bioinformatics Initiatives in North America," Barbara Oakley and Darrin Hanna. Invited paper by the Editor of the *IEEE Transactions on Nanobioscience*. 2003 **2** (4), 74-84. This paper was used by the editor-in-chief to help authors from Europe and Japan write their own similar papers.

Teaching interests:

- Introduced ME 495 Introduction to Nanobioengineering in Winter 2004

Qu, Hongwei, Assistant Professor, ECE, SECS

Research Interests: MEMS Technology. Funded projects in which worked include:

- Integrated Inertial Sensor Using CMOS-MEMS Technology, funded by NASA/UCF Space Research Initiative.
- CMOS-MEMS Micro-mirror for Optical Coherence Tomography applications.
- Nano-Structure and Electrical Properties of Copolymer PVDF Thin Film.

Teaching Interests:

- Micro-and Nano Technology, course under preparation.

Roth, Bradley, Associate Professor, Physics

Research Interests: bioelectric phenomena, such as the electrical activity of nerve and muscle. A particular the electrical stimulation of the heart.

- Research published in journals *Annals Biomed. Eng., Med. & Biol. Eng. & Comput., Electrophysiol., and others.*
- Research related to engineering biology:
  Bio- and biomedical physics. Developing the mathematical *bidomain model* is a mathematical model that determines the electrical potential inside and outside heart cells.

Teaching Interests:
- Introductory physics, 100-level
- Biological Physics, 300-level
- Medical Physics, 300-level

Singh, Gautam, Associate Professor, CSE, SECS

Research Interests: Bioinformatics and High Performance Computing.
- Author of 12 book chapters in bioinformatics
- Research published in journals *Biophysical Research Communications, Trends in Genetics, Applied Bioinformatics, Molecular Biotechnology.*
- Research and teaching grants related to engineering biology:
  - Summer Institute in Biomedical and Health Informatics, NSF, NIH.
  - Integrating Bioinformatics Modules in Computer Science Curriculum. NSF.
  - Open Source Middleware for Bioinformatics, FutureSoft Corporation.

Teaching Interests:
- Currently developing an undergraduate textbook in Bioinformatics *Fundamentals in Bioinformatics and Computational Biology*Jones and Bartlett, due Fall 2007.
- Developed and taught a 400/500 course in Bioinformatics.
- Launched the bioinformatics course Computer Applications in Molecular Genetics at Wayne State University Medical School

Xia, Yang, Professor, Physics

Research Interests: Microscopic Imaging (NMR Microscopy (μMRI) – transverse resolution as fine as tens microns; Optical Microscopy (PLM); Electron Microscopy (TEM); Fourier Transform Infrared Imaging (FTIRI))

- Research published in journals *Annals Biomed. Eng., Med. & Biol. Eng. & Comput., Electrophysiol., and others.*
- Research related to engineering biology:
  Biomedical imaging: articular cartilage, bone, and osteoarthritis (OA), eye and cataract, spider and dragline silk, vascular flows in plants.

Teaching Interests:
- Introductory physics, 100-level
- Modern Physics, 300-level
- Nuclear Physics, 300-level
- Electricity and Magnetism I, 300-level

Zeng, Xiangqun, Associate Professor, Chemistry

Research Interests: electroanalytical and surface chemistry at solid electrodes; development of new analytical techniques, chemical and biosensors;.

- Research published in journals *Anal. Chem., J. Phys. Chem. B., Journal of the Electrochemical Society,, and others.*
- Research related to engineering biology:
  Electrochemistry. Developing piezobiosensors and electrochemical sensors for detection in complex environmental and clinical samples by combining excellent sensitivity of electrochemical and mass sensing with the superb selectivity of biological recognition processes.

Teaching Interests:
- General Chemistry, 100-level
- Electrochemistry, 300-level
- Biosensor and Chemical Sensor Technology, 400-level

APPENDIX C: LETTERS OF SUPPORT

Arik Dvir, Chair, Biological Sciences
Andrei Slavin, Chair, Physics
Jack Nachman, Chair, Mathematics and Statistics
Mark Severson, Chair, Chemistry
Ishwar Sethi, Chair, Computer Science & Engineering

2/21/2007

MEMORANDUM

TO: **Dr. Ronald Sudol, Interim Dean of CAS**

FROM: **Arik Dvir, Associate Professor and Chair, Department of Biological Sciences**

RE: **Letter of Support for the new Engineering Biology B.Sc. program**

Date: **February 21, 2007**

The proposed B.Sc. Program in Engineering Biology has been evolving over the last several years, and received a significant boost last Fall (2006) after a large group of faculty from the CAS and SECS expressed strong interest in the program and became engaged in a discussion group that was assembled for this purpose. Indeed, from the two schools there are at least 15 full-time faculty that conduct active research and have direct interest in areas that involve various aspects of engineering biology or bioengineering. This list includes several faculty from our department. This fact alone is a source of immense strength to launching the proposed Engineering Biology program, and one that makes it very feasible in the immediate future.

Interdisciplinary research and education are new and exiting areas of academic growth and development and are echoed as a growing trend in the workforce. This proposed program is designed to give students an opportunity to acquire knowledge in engineering principles and methodologies and combine it with studies of biomedical sciences. The combination of these two disciplines provides education and skills in new tracks such as bioinformatics, biomedical and biophysical engineering, computation biology, electronic devices, signal analysis and biosensors, and molecular engineering biology. Recent surveys, both at the National and local levels, including recent internal survey at Oakland University, indicate a strong base of interest and demand in bioengineering, and a short supply of similar academic programs in the region.

The department of Biological Sciences in the CAS and the Department of Computer Sciences in SECS are the two academic units that will jointly administer the Engineering Biology program. The proposal has been fully discussed in Biological Sciences with overwhelming enthusiasm, and received a unanimous vote of confidence from the faculty. We are looking forward to the approval of this program.

2/21/2007

MEMORANDUM

TO: **Dr. Ronald Sudol, Interim Dean of CAS**
FROM: Andrei Slavin, Professor of Physics and Chair of the Physics Dept
RE: **Letter of Support for the new Bioengineering program**
Date: **February 21, 2007**

The goal of the bioengineering program is to train undergraduate students to apply physical/engineering principles/technology as solutions to significant biomedical and biological problems. It is widely anticipated that the broad area of bioengineering will have high growth and significant impact in science and technology in the 21st century.

During the last summer, several faculty members from the Physics Dept were invited to participate in a study group to discuss a new bioengineering undergraduate program administered jointly by the Department of Biology and the School of Engineering. In fact, several research projects in the Physics Dept have scientific components that extend to the research areas in bioengineering. For example, the research projects of Professor Roth Brad have centered on bioelectric and biomagnetic phenomena: the biological and medical applications of electric and magnetic fields. This is a field at the interface of physics and biology. The current research project of Professor Yang Xia has centered on microscopic imaging of biological system (articular cartilage). Over the last twelve years, Professor Xia has incorporated microscopic MRI, polarized light microscopy, and Fourier-transform infrared microscopy into his biomedical research. I believe that they and other members of the Physics Department can contribute significantly to the operation of this bioengineering program. I offer my strongest support on behalf of the Physics Dept.

MEMORANDUM

TO: **Ronald Sudol, Interim Dean**
College of Arts and Sciences

FROM: **Louis J. Nachman**
Professor and Chairperson
Department of Mathematics and Statistics

RE: **Support for the new Engineering Biology B.Sc. program**

Date: **February 9, 2007**

The proposed new interdisciplinary B.SC. degree program in Engineering Biology is academically sound, will provide students trained to meet current and future workplace needs, and involves faculty in the College or Arts and Sciences and the School of Engineering and Computer Science who have the interdisciplinary experience to make it work. From the point of view of the Department of Mathematics and Statistics (DMS), the twenty hours of mathematics and statistics in the core courses of the proposed program are precisely the ones needed for any in-depth applied science program. As Chairperson of the DMS I fully support this program.

I also enthusiastically support Professional Track 3, Computational Biology. The proposed new course, APM 4XX, Mathematical Models of Biosystems, and the elective topics course in mathematical bio-modeling and computing will be exciting and welcome additions to our undergraduate curriculum, as well as necessary courses for the Track.

MEMORANDUM February 8, 2007

TO: Ronald Sudol, Acting Dean, College of Arts and Sciences

FROM: Mark Severson, Professor and Chair,
Department of Chemistry

RE: Proposed Engineering Biology Program

On behalf of the Department of Chemistry, I wish to state our strong support for the proposed new program in Engineering Biology at Oakland University. When this program joins the existing Engineering Chemistry and Engineering Physics majors next fall, it will strengthen the collaborative interdisciplinary efforts between the College of Arts and Sciences and the School of Engineering and Computer Sciences. The new program is in an area of particular interest to students due to the projected large growth of employment opportunities. It promises to attract new students to Oakland University in a program which will benefit both the College of Arts and Sciences and the School of Engineering and Computer Sciences.

In the Department of Chemistry, we will be very happy to participate in this program both through the teaching of lower-level required chemistry courses and through the creation of a new course in Biosensor and Chemical Sensor Technology which will be required for one of the specialization tracks for the Engineering Biololgy major.

Department of Computer Science & Engineering
School of Engineering and Computer Science

Rochester, Michigan 48309-4478
(248) 370-2200 Fax: (248) 370-4625

Memorandum

February 9, 2007

To: Dean Pieter Frick
School of Engineering and Computer Science

From: Ishwar K Sethi, Chair
Computer Science & Engineering Department

Subject: Letter of Support for the new Bachelor of Science Program in Engineering Biology

I am writing this memo to express my personal and departmental support to the proposed Bachelor of Science Program in Engineering Biology (BS in EB). The proposed program reflects the emerging trend of interdisciplinary research and educational programs. The program proposal has been discussed extensively by our faculty and has received strong support.

Through this memo, I am reiterating the strong support of the Department of Computer Science and Engineering to this new program and look forward to its expedited approval at all levels so as to begin it in Fall 2007.