

**SELF-REVIEW**

**UCLA BIOENGINEERING DEPARTMENT**

**SUBMITTED TO THE UNDERGRADUATE  
COUNCIL**

**OCTOBER 2008**

## EXECUTIVE SUMMARY

Over the past 5 years, the Bioengineering Department (BE) has established a vibrant undergraduate degree program and has recruited faculty with diverse backgrounds who are directing innovative and productive research programs. After wide-ranging discussions involving faculty, industrial advisors, and students, the department realizes that much remains to be accomplished to bring UCLA BE to the top tier of Bioengineering programs. Specifically, we agree:

→ **To maintain and enhance the excellence of undergraduate education.** The BE undergraduate curriculum was initially designed for class sizes of approximately 25 students per year. The recent substantial increases in the BE undergraduate student population to approximately 75 students per year mandates the need for the Department to optimize its undergraduate curriculum in order to provide an excellent education for this larger student pool. The curriculum was also initially designed primarily for students who would pursue higher degrees (Ph.D. or M.D.) after graduation. Since approximately 1/3 of graduates do not pursue higher degrees after graduation, the Department has worked closely with our Industry Advisory Board to design three tracks of specialization for our undergraduate curriculum to provide options for graduates who wish to directly enter the job market.

→ **To enhance the excellence of faculty research.** BE will fill its remaining three allocated ladder faculty FTEs by 2010 to increase the total faculty FTE to 10, which is considerably less than other top ranked bioengineering departments which average approximately 20-25 FTE. The department needs additional faculty lines and space to more adequately teach its curriculum and to obtain a critical number of faculty to develop a research presence that can compete with more established bioengineering departments. At present, we are fortunate that there are many faculty on campus, such as those in the Biomedical Engineering Interdepartmental Program (BME), who are interested in 0% Joint Appointment positions in BE. We are currently working on recruiting joint faculty members who will help build strong research focus areas within BE. These joint appointments can also help our department with teaching, research training, and committee services. Involvement of these faculty will reinforce the crucial connection of the BE department to the UCLA School of Medicine and other basic science units on campus, and will allow growth of more diverse research areas within the BE Department, beyond what is possible with current FTE allocations.

→ **To develop excellence in graduate education.** BE faculty currently teach core courses, recruit students for, and administer the graduate BME program. As soon as we build to critical numbers in faculty size, we will propose a new Bioengineering graduate program that will focus on the areas of research strength represented by the core and joint appointment BE faculty. We will be working closely with the School of Medicine, and other campus departments and institutes to realize the potential for an excellent Bioengineering PhD program that is possible at UCLA.

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## **A. Introduction**

The 2008 Bioengineering Department (BE) Self-Review of our academic program was planned and completed in several stages. The Chair of the Department, Professor Timothy Deming, worked with the BE administrative staff and faculty to collect the pertinent data on the department. Using this data and comments from the recent external review of the Biomedical Engineering Interdepartmental Program (BME IDP) in 2007, a draft of this self review was prepared. This draft was circulated to the Faculty of BE for discussion. A revised Self-Review was approved on October 13, 2008 (7 in favor, 0 opposed and 0 abstentions).

The Department of Bioengineering teaches and conducts research in the rapidly developing field of bioengineering. At the undergraduate level, the Department offers a B.S. degree in bioengineering. Our research is focused on building upon our core areas of strength in biomaterials and medical devices, while also connecting with campus efforts in other bioengineering-related areas. To this end, we are committed to build increasingly strong interactions with the School of Medicine, the School of Dentistry, and the California NanoSystems Institute.

### **A1. Vision Statement**

We aim to establish a culture of excellence by developing an innovative curriculum that emphasizes research and lifelong learning and encourages and rewards excellence, in order to produce graduates who are well-grounded in fundamental sciences and the rigorous analytical engineering tools necessary for success in the many possible bioengineering careers.

The Department is constantly self-evaluating the strengths and weaknesses of the curriculum in order to improve the educational experience both in the classroom and in the laboratory. This is most evident in our latest curriculum changes aimed at improving educational quality, both in breadth and in depth, against the tide of increasing class size. The Department emphasizes the importance of classroom and laboratory teaching, and recognizes teaching as an essential component of promotion. We are very proud that our faculty have been recognized by the School-wide awards for their teaching excellence. The Department is even more proud of the academic excellence of our students, as evident by the school-wide recognitions that our graduates received, and the quality of graduate programs they entered. The faculty will continue to work closely with students and administration to consider their individual perspectives, and respond with carefully thought-out action plans in a timely manner whenever possible, in order to maintain the culture of excellence that we have worked so hard to produce.

## **B. General Information**

UCLA Bioengineering currently enjoys the strongest undergraduate student applicant pool in the School of Engineering. This is consistent with the high national demand for bioengineering from students, academia, industry, and the public. Although the competition for the top students has become increasingly fierce, the department expects to enhance our competitive advantage by featuring an innovative curriculum, recruiting new core faculty, and adding joint appointments to strengthen areas of specialized research in bioengineering.

In the late 1990's, UCLA joined the ranks of ~100 other U.S. universities to offer biomedical engineering (BME) degrees. An embryonic Interdepartmental Program (IDP) in BME was formed with support from faculty throughout the UCLA campus. With the support of A.R. Frank Wazzan and Gerald S. Levey, Provost of the Medical Sciences and Dean of the School of Medicine, UCLA Chancellor Albert Carnesale and UC President Richard Atkinson approved the Biomedical Engineering Graduate Program. In 1997, the interdepartmental program (IDP) housed in the School of Engineering and Applied Science, began operations and recruited graduate students for Fall Quarter 1998.

Based on data compiled by the Whitaker Foundation, there are approximately 100 U.S. universities offering some form of training in Biomedical Engineering / Bioengineering. At least 65 of these feature formal Departments, Institutes, Centers, or Divisions. 42 of these 65 schools offer both graduate and undergraduate degree programs in biomedical engineering. 13 schools offer graduate training only, and the remaining 10 schools currently offer undergraduate training only. At least 22 undergraduate bioengineering programs have been accredited by the Accreditation Board for Engineering and Technology currently ([www.abet.org](http://www.abet.org)). The 100 universities include all of the "Top 20 Engineering Schools" (US News). Ten of the "Top 20 Engineering Schools" offer both graduate and undergraduate studies in bioengineering. Nine of these 20 top universities feature a "Top 20" graduate bioengineering programs (US News). More interestingly, it should be emphasized that all of the "Top 20" graduate bioengineering programs have established formal bioengineering departments/divisions/ institutes.

Around the same time, undergraduate student demand for biomedical engineering training was increasing at UCLA, as evident by the creation of biomedical engineering degree options in Electrical Engineering and Chemical Engineering. A proposal to create an undergraduate Bioengineering Department at UCLA was approved in 2002, and the undergraduate Bioengineering degree program was approved in 2003. The overall goal of this program was to provide the undergraduate student with the scientific knowledge and engineering training necessary for continued education in the engineering or scientific disciplines. The three main objectives of the program were to (1) provide the student with a rigorous course of training in engineering and biological sciences; (2) provide exposure to and knowledge of state-of-the-art-research in bioengineering; and (3) provide problem-solving and team-building skills necessary to succeed in a career in bioengineering. It was expected that the majority of the Bioengineering students would immediately continue on to either professional (i.e. medical or dental) school or graduate training in either engineering or the life sciences.

In its current form, the BME IDP is administered by the Bioengineering Department, and BE faculty and staff also are heavily involved in running the BME IDP: by teaching core graduate courses, administering the comprehensive and preliminary examinations, chairing admissions and fellowship committees, advising students and managing grants/payroll, and chairing the program. Details of these committee duties are given in Table 1 below. Historically, the Chair of the Bioengineering Department has also served as the Chair of the IDP. Prof. Timothy Deming replaced Prof. Carlo Montemagno as Chair of Bioengineering in July 2006, when Prof. Montemagno left UCLA. Prof. James Dunn was recently appointed chair of the BME IDP following a recommendation from the recent review of the BME IDP that the IDP have a chair who is separate from the chair of the BE department. Prof. Dunn is currently considering this

position, and if he accepts the responsibility, he will work closely with Prof. Deming to meet the strategic mission of the BE Department.

**Table 1. BIOENGINEERING FACULTY COMMITTEE CHAIR ASSIGNMENTS**

July 1, 2007 – June 30, 2009

BME Admissions – Jacob Schmidt  
 BME Fellowship – Timothy Deming  
 BME Prelim Exam – Daniel Kamei  
 BME Graduate Curriculum – James Dunn  
 BME Seminar Coordinator (Biomed 299) – Warren Grundfest  
 BE 4 Year Review Chair – Timothy Deming

BE Open House – Daniel Kamei  
 BE Undergraduate Curriculum – Benjamin Wu  
 BE Faculty Search Committee – Benjamin Wu  
 BE ABET Committee – Warren Grundfest, Andrea Kasko  
 HSSEAS FEC BE Rep - Jacob Schmidt

**B1. Size and Diversity of the Faculty**

At present, there are 7 FTE faculty who are members of the BE Department (Table 2). These faculty members participate in the teaching activities of the program and many are also advising and funding biomedical engineering graduate students. There are 3 faculty (Dunn, McCabe, Aberle) who hold 0% joint appointments in Bioengineering, and one faculty (Tawil) who is an adjunct assistant professor. The 7 faculty in the table below are 100% FTE in BE and make up 7 of the original 10 FTE given to the BE department.

**Table 2. Bioengineering Faculty**

<b>FACULTY</b>	<b>TITLE</b>	<b>DEPARTMENTS</b>
Deming, Timothy, Ph.D.	Chair and Professor	Bioengineering/Chemistry and Biochemistry
DiCarlo, Dino, Ph.D.	Assistant Professor	Bioengineering
Grundfest, Warren, M.D., FACS	Professor	Bioengineering/Electrical Engr/Surgery
Kamei, Daniel, Ph.D.	Assistant Professor	Bioengineering
Kasko, Andrea, Ph.D.	Assistant Professor	Bioengineering
Schmidt, Jacob, Ph.D.	Assistant Professor	Bioengineering
Wu, Benjamin, D.D.S., Ph.D.	Assoc. Professor /Vice Chair	Bioengineering/Mat. Sci & Engr/Dentistry

The core BE faculty bring a diverse range of expertise to the department, with specialties including chemistry, materials science, chemical engineering, physics, electrical engineering, and medicine. This broad range of experience has proved to be extremely valuable in preparing and teaching our undergraduate curriculum. Brief summaries of core BE faculty research interests and activities are provided below. Note that most of our faculty also train many BE undergraduate students in their labs.

The BE faculty have earned numerous awards, including a National Science Foundation Career Award, a Kimmel Scholar Award, a Professor of the Year Award from the Engineering Society of UCLA, an Early Career Award from the Wallace H. Coulter Foundation, two Northrop Grumman Teaching Awards from the Henry Samueli School of Engineering and Applied Science, and a Samsung-IUPAC Young Scientist Award from the IUPAC Macromolecular Division. Faculty have also received 3 NSF Awards in support of research on ultrasound, haptic feedback, and terahertz imaging technologies.

Professor Deming trains a group of *ca.* 10 Ph.D. students in the field of synthetic biopolymers. In this highly collaborative work, students are involved in chemical synthesis, molecular and supramolecular characterization, materials processing and mechanical testing, and evaluation and application in living systems.

Professor Grundfest directs several projects in the UCLA CASIT laboratory developing instrumentation for minimally invasive surgery and image-guided therapy. He also maintains a laboratory examining laser applications in medicine. He is Advisor or Co-Advisor to 8 Ph.D. students working in these laboratories.

Professor Wu trains a large research group of 10 graduate students and 10 undergraduate students on multidisciplinary projects to investigate and engineer microenvironment to promote specific cellular functions.

Professor Schmidt trains a group of 5 Ph.D. and 5 undergraduate students in biophysics membranes and membrane proteins and engineering of biological sensors.

Professor Kamei's research focuses on developing an integrative methodology for identifying innovative solutions to engineering molecular therapeutics. He trains 5 Ph.D. and 10 undergraduate students in drug delivery/drug discovery/diagnostics research combining computational modeling with experimental validation.

Professor Kasko trains a group of 5 Ph.D. students and 3 undergraduate students in the development of new materials for biomedical applications, where the critical aspects of physiological materials and processes are replicated by controlling molecular structure, assembly and interaction on multiple levels.

Professor DiCarlo has just started and trains a group of 6 Ph.D. students on exploiting unique physics, microenvironment control, and the potential for automation associated with miniaturized systems for applications in basic biology, medical diagnostics, and cellular engineering.

The BE department has plans to establish research strengths in five areas: Biomaterials/Regenerative medicine, Molecular therapeutics/Personalized medicine, Devices/Sensors, Imaging, and Neuroengineering. With our current faculty, we have strength in the Biomaterials/Regenerative medicine and Devices/Sensors areas, and plan to grow other areas through future hires, but also mainly through joint appointments of faculty from other departments on campus (e.g. the BME IDP).

In terms of diversity, the BE department is currently very near its expected levels of female and minority candidates, and we plan on improving this with our future hires. For candidates at the junior level, our applicant pool is diverse with a reasonable percentage of female candidates (we have identified an average of 18.6% over the past 3 years). We have also interviewed an average of 28.6% female faculty candidates over the past 3 years of recruiting. We will continue to interview and attempt to recruit female and other minority candidates for our assistant professor positions.

At the more experienced level, we have identified ~10 accomplished potential female candidates (below) who are faculty at or near the associate professor level and in top BE departments, or BE related fields. We plan to invite these individuals out for seminars/interviews in the coming two years and attempt to recruit the most promising candidates.

Beckman fellows:

Rachel Wilson, Harvard  
Laura Kaufman, Columbia  
Krystyn VanVliet, MIT  
Rebekah Drezek, Rice  
Christine Keating, Penn State

Coulter Fellows:

Elizabeth Hillmann, Columbia  
Jennifer Elisseeff, Hopkins  
Karen Haberstroh, Brown  
Helen Lu, Columbia  
Shelly Sakiyama-Elbert, Wash. U

The BE department currently has 3 open positions and with these we plan to hire at least 1 female candidate, more if possible, which will bring our departmental average above the national average for BE.

## **B2. Non Academic Support Items**

The operating budget is allocated to the Bioengineering Department through the School of Engineering. The current (2008-2009) budget allocation to the Bioengineering Department is \$663,491, exclusive of faculty salaries. The Bioengineering Department also has a nonacademic staff of 4 career employees who are heavily involved in running both the BE Department and the BME IDP. Our staff members are very effective in handling student concerns, curriculum conflicts, administering exams and ensuring smooth operation of both these programs, but are overworked due to our large undergraduate and graduate student populations, and growing number of faculty.

Staff Support for BE has remained at the same level for many years. The current titles, names and responsibilities are:

*Departmental Administrator*, Ms. Stacey Tran: Oversees the staff and overall administration of the Bioengineering Department and IDP, academic and non-academic personnel and payroll matters, budget, and class scheduling of bioengineering courses.

*Student Affairs Officer*, Mr. Larry Nadeau: Graduate student recruitment and admissions, program requirement changes, academic apprentice personnel appointments, class schedule of biomedical engineering courses and student fellowships for the Biomedical Engineering IDP.

*Fund Manager*, Ms. Lee Yang: Contracts and grants administration, fund management, procurement and equipment management.

*Administrative Assistant*, Ms. Apryll Chin: Provides assistance to the Chair and Bioengineering Department faculty, process travel reimbursements, coordinate events, handles faculty recruitment and maintain undergraduate alumni information.

### **B3. Faculty Teaching**

A core responsibility for each ladder faculty is to teach both undergraduate and graduate students. Teaching extends beyond classroom instruction to include directed study and research programs. The purpose of the undergraduate program is to provide a solid foundation in Bioengineering which integrates fundamental scientific principles with engineering analysis, problem solving skills, and biomedical perspectives. Grounded in this foundation, the graduates are well prepared for success in industry, professional and graduate training, and a lifetime of learning and employment. The faculty also saw the need to ensure that the teaching assistants were prepared to provide an excellent educational experience for the undergraduate students, and therefore, BME 495 is being taught for the first time this quarter to emphasize effective teaching methods to our graduate students. At the graduate level, BE faculty teach graduate courses for the BME IDP, including the core courses CM201, CM202, and CM203, and BMEC204, BMEC205, and BMEC206. Since bioengineering faculty currently do not have a graduate program of their own, they provide a core teaching resource to the BME IDP.

Our BE faculty are currently overloaded with teaching responsibilities, primarily arising from needs of the undergraduate program. While we have hired lecturers to help cover required courses, some of these have not worked out and ladder faculty have had to perform additional teaching duties to cover our courses and maintain a level of excellence for our students. This problem was particularly acute for our senior capstone design course (BE 182), where the lecturer went on medical leave. We expect recent and future hires will help alleviate this problem, but it may arise again with the introduction of new courses for our graduate program.

### **B4. Accomplishments and Goals**

Some of the key BE accomplishments in recent years include: graduation of our first senior class; strong support of the Biomedical Engineering Society (BMES) student group; hosting of Biomedical Engineering research meetings including the University of California System-wide Bioengineering Conference, the California Tissue Engineering Meeting, the Los Angeles Wound Healing Initiative, and co-hosting the national Biomedical Engineering Society Meeting in Los Angeles; and the recruitment of excellent faculty. Since the inception of the Department, we have developed and implemented a rigorous undergraduate curriculum that continues to attract students. In fact, the Bioengineering major attracts many of the best students applying to UCLA's School of Engineering and Applied Science. Our student population has grown dramatically since undergraduates were first admitted to the program in Fall of 2004, where we now matriculate approximately 75 new students each year.

Even though we have only 2 graduating classes to date, we have already seen excellent placement of many of our graduates. Several of our students have started their post-graduate education at top medical and graduate programs. Out of the 7 students in the Class of '07, one is an MD/PhD student at UCSF, while two other students are medical students at UCLA and UC Davis. Out of the 26 students in the Class of '08, one is an MD/PhD student at Mayo Medical School, another is a medical student at Stanford, another is a dental school student at UCLA, and three of our students were accepted by top bioengineering PhD programs (MIT, Stanford, and Michigan). These three students also won nationwide fellowships (NSF, Dept of Homeland Security, and the Whitaker International Fellows). The student who received the Whitaker fellowship is also spending a year at Oxford as part of his Whitaker Fellowship prior to joining the bioengineering department at Stanford. Our students have also succeeded in obtaining jobs. From the Class of '07, two are working in companies in northern California, while another is a lab researcher at UC Davis. From the Class of '08, we know of at least four students working in beginning scientific career positions at companies such as Abbott Vascular and Schlumberger and at research institutions such as the City of Hope.

To the best of our knowledge, this is the most up-to-date information about our two classes of graduates:

### **Class of '07**

#### *MD/PhD*

James Pinney (Outstanding BS Student for School of Engineering for Class of '07, MD/PhD student at UCSF)

#### *MD*

Tim Canaan (Outstanding BS Student for the BE Dept, MD student at UCLA)  
Vu Nguyen (UC Davis)

#### *MS in UCLA BME IDP*

David Boren (applying to medical school)

#### *Industry*

Phuong Dang (Junior Specialist at UC Davis, applying to graduate school)  
Jessica Nguyen (working at a company in Northern California)  
Riju Gupta (working at a company in Northern California)

### **Class of '08**

#### *MD/PhD*

Xun Gong (Mayo Clinic)

#### *MD*

Edward Pham (Outstanding BS Student for the BE Dept, MD student at Stanford)  
Mike Chung (Kentucky)

#### *DDS*

Xuan Yue (UCLA)

*PhD with Fellowships*

Chris Ng (NSF, MIT BE)

Ariel Hecht (Dept of Homeland Security, Michigan BE)

Kunal Mehta (Whitaker International Fellows and Scholars Program, Oxford as part of the program, but will start at Stanford BE in Fall 09)

*MS in UCLA BME IDP*

Kevin Zhang

Linda Wang

Brian Ho (also applying to medical school)

*Applying to professional schools*

Sarah Vasend (applying to veterinary school)

Daniel Biocini (applying to medical school)

Yang Li (applying to medical school)

Brandon Jang (applying to law school)

Clinton Jang (applying to law school)

Nanye "Francisco" Lei (applying to medical school)

Ben Pei (applying to law school)

Mrigender Virk (applying to medical school)

*Industry*

Talal Bayaa (Schlumberger)

Orson Hwang (Schlumberger)

Brian Hahn (Research Technician, City of Hope)

Melissa Chow (Product Performance Engineer, Abbott Vascular)

Elvira Khialeeva (working, now applying to grad school)

*Undecided*

Anais Sahabian

Jeff Matsumoto

Dave Karlik

## **B5. Industry Outreach**

A large portion of the Department's industrial outreach has come on a case-by-case basis through industrial contacts of individual BE faculty. The Bioengineering Department has also sponsored tours of local industry, including Medtronic and Amgen. The Bioengineering Department has recently established an Industrial Advisory Board, with participants from major biomedical and biotechnology companies (see Table 3 below). This board has provided valuable feedback on our Department's curriculum and provided excellent advice on the introduction of tracks to better enable our graduates to find employment, and have assisted in our preparations to obtain accreditation by ABET

**Table 3. Industrial Advisory Board**

<p><b>Laurent Audoly, PhD</b> Senior Director Dept. Biologics Research Merck &amp; Co West Point, PA laurent_audoly@merck.com</p>	<p><b>Jane S. Lebkowski, Ph.D.</b> Senior Vice President of Regenerative Medicine Geron Corporation 230 Constitution Drive Menlo Park, CA 94025 JLebkowski@Geron.com</p>
<p><b>Tim Bertram, D.V.M., Ph.D.</b> Vice President, Science and Technology Tengion Winston-Salem, North Carolina tim.bertram@tengion.com</p>	<p><b>Leslie Momoda, Ph.D.</b> Research Director HRL Laboratories, LLC Malibu, CA momoda@HRL.com</p>
<p><b>David Chang, PhD</b> Director, Process Development Genentech, Inc. 1 Antibody Way Oceanside, CA chang.david@gene.com</p>	<p><b>Anthony Ratcliffe, PhD</b> President and CEO Synthasome, Inc 3030 Bunker Hill Street, Suite 308 San Diego, CA anthonyratcliffe@synthasome.com</p>
<p><b>Arthur J. Coury, Ph.D.</b> Vice President, Biomaterials Research Genzyme Corporation 1 Kendall Square Cambridge, MA art.coury@genzyme.com</p>	<p><b>Nick Susner</b> President &amp; CEO STI, International nick@sti-hawaii.com</p>
<p><b>Andreas Goppelt, Ph.D.</b> Senior Director R&amp;D Baxter BioScience BioSurgery Wagramer Strasse 17-19 A-1220 Vienna andreas_goppelt@baxter.com</p>	<p><b>Ben Walthall, Ph.D.</b> Director Biologics R&amp;D Zimmer, Inc 12024 Parke Vista Austin, TX ben.walthall@zimmer.com</p>
<p><b>Elliott A Gruskin, PhD</b> Vice President Global R&amp;D, Biomaterials SYNTHES Gruskin.Elliott@synthes.com</p>	<p><b>David Balaban, Ph.D.</b> Vice President, Research &amp; Development Informatics Amgen dbalaban@amgen.com</p>

## C. Bylaws

### C1. General and Academic Personnel Procedures

Pursuant to Academic Senate By-law 55, the Bioengineering Department has set up the following procedures for academic personnel review process for professorial appointments to the faculty, temporary FTE or visiting faculty, merit increases, promotions, and faculty recruitment

## Recruitment Procedures and Guidelines

Faculty Search Committee Chair, in conjunction with the Department faculty, identifies the research area for recruitment, drafts the ad, and is in charge of reviewing faculty candidate applications.

The Faculty Search Committee Chair with consultation and voting amongst the faculty will identify the selection pool and interview pool prior to inviting any candidates out for a visit.

### Review Committees

1. Faculty Selection and Promotion Committee
  - a. The Faculty Selection and Promotion Committee shall consist of all voting faculty members from the Department and will handle all academic personnel cases.

### Ladder Track Faculty Personnel Matters

Full Faculty will be given notice and time to review the committee report and Chair's letter before the case is submitted to the Dean's Office. The right to review the committee and chair's letter is part of the personnel process.

### Appointment of Full Professor, Associate Professor or Assistant Professor

Review and discussion by all voting faculty within the department. Voting as follows.

Appointment Type	Voting Body
Full Professor	All tenured faculty
Associate Professor	All tenured faculty
Assistant Professor	All tenured faculty and Assistant Professors

Ad Hoc Committees – also according to appointment type.

### Promotion to Full Professor or Associate Professor

Review and discussion by the department faculty for promotion to a full professor rank and associate professor rank as specified by By-Law 55. Voting by:

Appointment Type	Voting Body
Promotion to Full Professor	Full Professor
Promotion to Associate Professor	Full and Associate Professor

### Merit Increase for Full Professors and Associate Professors

Review and discussion by the department faculty. For merit increases to Professor, Step VI and Professor Above Scale and any actions which require review beyond the Dean, discussion by all faculty.

Appointment Type	Voting Body
Merit Increase for Full Professor	Full Professor and Associate Professor
Merit Increase for Associate Professor	Full and Associate Professor

Merit Increase to Professor, Step VI and Professor Above Scale and actions which require review beyond the Dean	Full Professor
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Merit Increase within Professor Above-Scale

Recommendation by tenured faculty members of the department. Committee report and Chair’s letter required.

Merit Increase for Assistant Professor

Recommendation by tenured faculty members of the department. Committee report and Chair’s letter required.

Assistant Professor Appraisals

Review, discussion and voting by tenured faculty members of the department. Committee report and Chair letter required.

Assistant Professor Renewal of Appointment

Recommendation by tenured faculty members of the department. Review and submission of dossier is not required, provided there is no change in the original terms of the appointment. Chair will submit letter to the Dean for renewal of appointment.

Assistant Professor Non-Renewal of Appointment

Recommendation, discussion and voting by tenured faculty members of the department.

Joint Appointments

Review, discussion and voting by all members of the department. Chair writes the letter. No committee report required.

**Adjunct Faculty & Visiting Professor Personnel Matters**

Appointment of Adjunct Faculty

Review, discussion by all faculty members. Voting as follows:

Appointment Type	Voting Body
Adjunct Professor	All tenured faculty
Adjunct Associate Professor	All tenured faculty
Adjunct Assistant Professor	All tenured faculty and Assistant Professors

Renewal/Promotion/Merit Increase to Adjunct Professor or to Adjunct Associate Professor

Review, discussion by all faculty members of the department for promotion to an Adjunct Professor rank, merit increases to Adjunct Professor Step VI and to Adjunct Professor Above Scale, promotion to an Adjunct Associate Professor rank as well as accelerated actions which require reviews beyond the Dean. Voting as follow:

Appointment Type	Voting Body
Promotion to Full Professor	Full Professor
Promotion to Associate Professor	Full and Associate Professor

### Appointment / Renewal of Lecturer and Visiting Professor Appointment

For appointments and renewals of appointment – recommendation by sponsoring faculty member (or instructor in charge) and departmental approval by the Chair.

### **Emeriti Faculty**

Emeriti faculty will not have voting rights on any personnel matters within the department.

### **OVERHEAD RETURN STANDING POLICY:**

The Department of Bioengineering will keep 10% of each faculty's overhead return funds received from the Dean's Office each academic year. The policy will remain the same every year unless change is made to the bylaw.

## **C2. Teaching**

**Annual departmental course load.** All ladder faculty are expected to teach a minimum of three (3) “formal courses” which typically include lectures and labs which parallel established loads at other institutions. At least one (1) of these is expected to be an undergraduate course, in keeping with the minimum number of undergraduate-courses-per ladder-faculty as is now required by UC policy. Currently the Department Chair receives two quarters of course release for his administrative duties. New hires receive one or two quarters of course release to build their labs.

**Additional teaching responsibilities.** All ladder faculty are expected to teach at least one (1) additional “informal course”, which typically includes:

- a. Other scheduled courses.** These courses are not part of the “annual departmental course load” (see II.b.). They might include Fiat Lux, Honors Sections and Contracts, TA Apprentice, Research Team Meetings, Journal Club Seminars, and other similar teaching situations.
- b. Directed Individual Study.** Generally, these courses are numbered 89HC, 99, 189HC, 195-199, and 596-599.

The above guidelines will be followed to provide compensation for both existing faculty, and incentive to recruit new faculty. In all cases, for all forms of course release, written agreements or a memorandum of understanding will be created to clearly state the precise form of release, begin date, end date, and conditions which trigger termination of course release. To eliminate the perception of privileged and non-privileged faculty, and to promote equity across departments, all course release requests must be discussed in departmental faculty meetings and approved by the Department Chair. Course release for the sole purpose of research is discouraged, and will be highly scrutinized by the Department Chair.

**Buyouts from Extramural Funds.** The department does not allow individual faculty to use extramural funds to buyout their standard course teaching load (usually to devote additional time to research).

**Non-Teaching Term.** Faculty may “stack” courses to produce a quarter in which no formal courses are taught. This does not relieve faculty, who are obligated to have a significant presence on campus, of their other university duties during this time period (i.e., advising students, departmental and university service, etc.). Not having formal teaching obligations in a term is *not* a leave of absence; faculty are subject to the same residency requirements as in quarters in which they teach scheduled courses.

**Sabbatical.** Faculty who take partial year sabbaticals are relieved of a maximum of one (1) formal course and one (1) informal course per academic quarter.

**Research/Creativity/Scholarly Inactivity.** The Departments will modify teaching loads for faculty members who are no longer productive in their research/creative/scholarly activities on a case by case basis, depending on the reason for the loss of productivity. In the extreme case, faculty who supervise zero (0) PhD students, have zero (0) active sponsored research support, and have zero (0) scholarly publications will be required to teach six (6) courses, at least five (5) of which must be “formal courses” as described above. However, accommodations and appropriate adjustments will be made if the reason for the inactivity is due to medical reasons. Each case will be discussed in departmental faculty meetings and approved by the Department Chair.

**Other Special Considerations.** Other factors may affect the assignment of teaching responsibilities, and must be discussed in departmental faculty meetings and approved by the Department Chair. The following categories are representative but not exhaustive:

- Course development – a maximum of one (1) quarter preparation may be given for each required course. No relief will be given for developing elective courses which are not required for graduation.
- Director/Co-Director of research centers which provide funds to compensate for administrative duties.
- Health reasons – faculty requiring extensive outpatient therapy, post-surgical recovery, maternity leave, and similar medical needs are relieved of a maximum of one (1) formal course and one (1) informal course per academic quarter.

## **D. Undergraduate Program**

### **D1. Goal of the Program**

The overall goal of the program is to provide the undergraduate student with the scientific knowledge and engineering training necessary for continued education in the engineering or scientific disciplines. There are three main objectives of the educational program. First, to

provide the student with a rigorous course of training in engineering and biological sciences (**depth**); second, to provide exposure to and a knowledge of state-of-the-art-research in bioengineering (**more depth**); and third, to provide problem-solving and team-building skills necessary to succeed in a career in bioengineering (**lifelong learning**). The program is rounded out with school wide technical breadth requirements, as well as university-side general education requirements to ensure **breadth**.

The program follows a typical engineering curriculum for the first two years, adding introduction to bioengineering, bioengineering thermodynamics, and molecular and cellular biology courses. The third year focuses on physical chemistry, molecular biology, transport and biochemical reaction kinetics, modeling, ethics and accountability in biomedical research, transducers, and signal processing in order to acquaint the student with the fundamental processes of living systems. The fourth year also provides an integrated approach to problems in engineering, biology, and medicine, through two quarters of specially designed courses focusing on system integration. This is accompanied by courses in biocompatibility and bioengineering design. The upper division student has the opportunity to take additional electives to develop an area of specialization. This course of study is designed specifically to prepare the student for continued academic advancement or for a starting position within industry. It was originally expected that most of our graduates would continue their educational activities to obtain advanced degrees. As such, the core curriculum was highly structured to ensure depth and breadth, integrating lectures with labs and clinical visits to appreciate the application of advanced concepts in practical situations, and encourage students to design and innovate through the senior capstone sequence. Due to the increasing class size and realizing that 1/3 of our students go to industry, we have made the clinical rotations optional, and are in the process of getting tracks approved for our Department that may enhance the employability of our students in industry after obtaining a BS degree.

Our undergraduate program has been very successful in attracting and recruiting excellent students to UCLA (Table 4). This in part has been due to the high interest in bioengineering among high school graduates as well as our considerable efforts to recruit top students, mainly through our Open House recruitment presentations and meet and greet sessions. We have fostered a family-like, community atmosphere among our undergraduate students, and over 20 of them volunteered to help during our last Open House, which was held on a Sunday. This turnout was significantly larger than those from other departments, which usually have about 5 to 7 students volunteering. In fact, our students helped those departments that were understaffed on the day of the Open House. With such efforts, we have competed successfully for these students against other excellent California schools, some with much more established bioengineering programs (see statistics in Table 4). Note that our program also admits typically 10-15 junior transfer students into the major each year as well.

**Table 4. BE undergraduate freshman admission statistics.**

	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>
# Applied	791	790	960	950	1142
# Admitted	164	196	317	308	314

# Matriculated	40	29	63	61	64
Average SAT	1474	1403	2146	2168	2138
Average Unweighted GPA	3.94	3.92	3.84	3.91	3.93

Note: Average SAT & GPA for 2004, 2005, & 2006 are based on Matriculated Students  
Average SAT & GPA for 2007 and 2008 are based on Accepted Students

## D2. Description of the Program

The current bioengineering undergraduate curriculum is shown below in Table 5.

<b>Table 5. Bioengineering Core Curriculum</b>		<b>CURRENT</b>
<b>Freshman Year</b>		Units
<i>1st Quarter</i>		
English 3	English Composition, Rhetoric, and Language	5
Chem 20A	Chemical Structure	4
Math 31A	Differential Calculus	4
<i>2nd Quarter</i>		
BE 10	Introduction to Bioengineering	2
Chem. 20B	Chemical Energetics and Change	4
Math. 31B	Integration and Infinite Series	4
Physics 1A	Physics for Scientists and Engineers: Mechanics	5
<i>3rd Quarter</i>		
GE Elective	HSSEAS GE Elective	5
Chem. 20L	General Chemistry Laboratory	3
Math 32A	Calculus of Several Variables	4
Physics 1B	Physics for Scientists and Engineers: Oscillations, Waves, Electric and Magnetic Fields	5
<b>Sophomore Year</b>		Units
<i>1st Quarter</i>		
Chem 30A	Chemical Dynamics & Reactivity: Introduction to Organic Chemistry	4
Math. 32B	Calculus of Several Variables	4
Physics 1C	Physics for Scientists and Engineers: Electrodynamics, Optics, and Special Relativity	5
Physics 4AL	Physics Laboratory for Scientists and Engineers: Mechanics	2
<i>2nd Quarter</i>		
BE 100	Bioengineering Fundamentals	4
LS 2	Cells, Tissues, and Organs	5
Math. 33A	Linear Algebra and Applications	4

Physics 4BL	Physics Laboratory for Scientists and Engineers: Electricity and Magnetism	2
<i>3rd Quarter</i>		
	HSSEAS GE Elective	5
Chem 30B	Organic Chemistry: Reactivity and Synthesis, Part I	4
Chem 30AL	General Chemistry Laboratory II	4
Math 33B	Differential Equations	4
<b>Junior Year</b>		<b>Units</b>
<i>1st Quarter</i>		
	Technical Breadth	4
BE 120	Biomedical Transducers	4
Chem. 153A	Biochemistry: Introduction to Structure, Enzymes, and Metabolism	4
LS 3	Introduction to Molecular Biology	5
EE 100	Electrical and Electronic Circuits	
<i>2nd Quarter</i>		
CS 31	Introduction to Computer Science I	4
MAE 103	Elementary Fluid Mechanics	
BE 165	Bioethics and Regulatory Policies in Bioengineering	4
Chem 30BL	Organic Chemistry Laboratory I	3
	Technical Breadth Requirement	4
EE 102	Systems and Signals	
<i>3rd Quarter</i>		
BE 110	Biotransport and Bioreaction Processes	4
LS 4	Genetics	5
	Technical Breadth Course	4
	BME Elective	4
BE 182A	Bioengineering Capstone Design Course	
<b>Senior Year</b>		<b>Units</b>
<i>1st Quarter</i>		
BME CM 180	Introduction to Biomaterials	
BE 176	Principles of Biocompatibility	4
BE M106	Biophysics	
ENG 183	Engineering and Society	
BE 180	System Integration in Biology, Engineering, and Medicine I (SIBEM I)	4
BE 180L	System Integration in Biology, Engineering, and Medicine I Laboratory (SIBEM I Lab)	3
BE 182A	Bioengineering Capstone Design Course	4
	Technical Breadth	
<i>2nd Quarter</i>		
	HSSEAS GE Elective	5
BE 181	System Integration in Biology, Engineering, and Medicine II (SIBEM II)	4

BE 181L	System Integration in Biology, Engineering, and Medicine II Laboratory (SIBEM II Lab)	3
BE 182B	Bioengineering Capstone Design Course	4
	Technical Breadth	
<i>3rd Quarter</i>		
BE 182C	Bioengineering Capstone Design Course	4
BE 180	System Integration in Biology, Engineering, and Medicine I (SIBEM I)	
	BME Elective	4
	HSSEAS GE Elective	5
	BME Elective	
<b>Total</b>		<b>185</b>

The current curriculum can also be broken down into preparation and major courses:

### **Preparation for the Major**

Required: Bioengineering 10; Chemistry and Biochemistry 20A, 20B, 20L, 30A, 30AL, 30B, 30BL; Computer Science 31; Life Sciences 2 (satisfies HSSEAS GE life sciences requirement), 3, 4; Mathematics 31A, 31B, 32A, 32B, 33A, 33B; Physics 1A, 1B, 1C, 4AL, 4BL.

### **The Major**

Required: Bioengineering 100, 110, 120, 165, 176, 180, 180L, 181, 181L, 182A, 182B, 182C, Chemistry and Biochemistry 153A; three technical breadth courses (12 units) selected from an approved list available in the Office of Academic and Student Affairs; and two major field elective courses (8 units) from Biomedical Engineering C101, CM102, CM103, CM145, CM150, CM150L, C170, C171, CM180, C181, C185, C187.

The freshman and sophomore curriculum for the undergraduate degree in bioengineering are similar to those in the other six SEAS departments, as they include six quarters of mathematics, five quarters in humanities and social sciences, and basic instruction in physics and chemistry. In addition, the program provides instruction in relevant aspects of biology, an introduction to bioengineering, and a course in bioengineering thermodynamics (Fundamentals of Bioengineering). These first two years build a strong foundation in the physical and biological sciences and provide the student with the ability to deal with more complex engineering material. Transfer students entering in their junior year will be required to take the Intro to Bioengineering and Fundamentals of Bioengineering courses, but would otherwise complete the curriculum as proposed.

In the junior year the program focuses on molecular biology, physical chemistry, genetics, biotransport and reaction processes, biosystem modeling, biomedical transducers, and cellular biology. At the same time the student will take three electives and a 4-unit course in ethics and accountability in biomedical research.

In the senior year, the student will take a systems approach to bioengineering studying the principles of biocompatibility and systems integration in biology, engineering, and medicine. This course and laboratory, offered in the first and second quarters, is specifically tailored to the

strengths of UCLA's bioengineering program in nanosystems, tissue and protein engineering, and sensor development and leverages the presence of our outstanding medical school. Also in this year, undergraduate students are required to take a 12-unit bioengineering design course, which ensures the student has the problem solving and analytical skills necessary to succeed as a bioengineer.

### **D3. Advising**

Undergraduate student advising is handled primarily by the School of Engineering (HS-SEAS), but BE faculty are also heavily involved in individual advising of students as described below.

#### **Undergraduate Advising**

All undergraduate School of Engineering and Applied Science (HSSEAS) students are assigned and have access to:

- An academic counselor in the Office of Academic and Student Affairs. Academic counselors are by major. The HSSEAS Office of Academic and Student Affairs is the engineering student's source for information, not only regarding advising, but also for questions pertaining to scholarship opportunities, scheduling, academic standing, HSSEAS events, policies and procedures. Students who have questions are encouraged to stop by the Office of Academic and Student Affairs, 6426 Boelter Hall, or call (310)825-2826 for assistance. Information is also posted on the web at [www.seasoasa.ucla.edu](http://www.seasoasa.ucla.edu).

- A faculty advisor

Faculty advisors are assigned to each engineering student in their first quarter. The faculty advisor is assigned to assist the student in choosing elective courses in the major and for insights regarding career options and graduate schools.

- The computerized Academic Program Planner (APP) and Degree Audit Reporting System (DARS) - The APP is a tool utilized by Academic Counselor for students in catalogs 2005-06 and prior. This interactive self-advising program informs the user immediately if his or her planned academic program meets the requirements for graduation, and can also be used to check student Study Lists and grades. HSSEAS is presently working to implement DARS - Degree Audit Reporting System which will replace the APP for catalogs 2006 and later.

- Students can meet with their academic counselor for advising by appointment or on a walk-in basis in the HSSEAS Office of Academic and Student Affairs, 6426 Boelter Hall. The listing of the HSSEAS academic counselors and their contact information can be found at <http://www.seasoasa.ucla.edu/counselor.html>

- Biomedical Engineering Society (BMES)

Our student society, BMES, has helped the faculty and staff foster a family-like, community atmosphere for our program. Along with the Department, they annually co-host a welcome back picnic, a holiday party, and an end-of-the-year banquet. These events allow the students to mingle with the faculty and staff in an informal atmosphere. In the case of the last two welcome back picnics, the faculty even played softball against the students. BMES also held two

infosessions last year that were supported by our faculty. One infosession focused on preparing our students for medical school consisting of a panel of one of our faculty (who is also a pediatric surgeon at UCLA), a current resident, a current first-year MD student (who is also an alumnus of our BS program), and a BE senior who was applying to medical schools. The other infosession focused on preparing our students for graduate school, and one of our faculty created a handout to help students in planning for and applying to graduate schools and fellowships. He also served on two review panels for the National Science Foundation Graduate Fellowship, and communicated relevant information to the students. BMES also started a mentorship program pairing upperclassmen with lowerclassmen with regard to interests (e.g. pre-med, graduate school, fields of interest, etc.).

## **Student Advising**

### **I. New Students (Freshmen, Transfers, Change of Majors)**

Academic advising is required for all incoming students. Advising appointments are scheduled before the student's first term, either during the Summer Orientation Program or at pre-arranged appointment times. During the advising appointments students are informed of: advanced standing credit (Advanced Placement, transfer credit), the curriculum requirements, University requirements (Entry-Level Writing or English as a Second Language (ESL) and American History and Institutions.), HSSEAS policies and procedures, HSSEAS enrollment instructions. Students are advised on their quarterly schedules. Students are encouraged to attend the New Student Orientation and are informed of their advising appointment times by the Orientation program. Students who do not attend Orientation are sent e-mail notices from the HSSEAS Office of Academic & Student Affairs.

### **II. Continuing Students**

Students are encouraged to meet with their Academic Counselors or contact them through email or via telephone. Information is available to students in various formats such as the Announcement (HSSEAS catalog), Enrollment Instructions and list of Frequently Asked Questions. Information is available in hard copy and on the web.

<http://www.seasoasa.ucla.edu/counselor.html>.

The Academic Counselors monitor student Study Lists each term. Students who are not meeting SEAS Study List requirements are sent letters informing them of the problem.

Students can request exceptions to curriculum requirements via a petition process through HSSEAS OASA. [http://www.seasoasa.ucla.edu/current/petition\\_process.html](http://www.seasoasa.ucla.edu/current/petition_process.html)

Academic Counselors monitor students' academic standing. Each term academic audits are done and letters are sent to students who have been placed on Academic Probation (AP) or Subject to Dismissal (STD) due to failure to meet minimum grade point average (GPA) requirements. The letters either encourage these students, or require them (dependent upon the severity of their poor academic standing), to see an Academic Counselor for advising.

<http://www.seasoasa.ucla.edu/current/FAQs.html#probation>

Continuing students who want to take courses at other schools during summer or through the

Education Abroad Program (EAP) are instructed to complete evaluation forms, requesting transfer credit review, to assure students are meeting course requirements.

<http://www.seasoasa.ucla.edu/current/sumrequiv.html>

Students who are considering a change of major within SEAS are encouraged to see an Academic Counselor. <http://www.seasoasa.ucla.edu/current/change.html>

### **III. Students Beginning Upper Division Coursework**

Students are sent email notifications informing them of their Faculty Advisor (from the BE department). Sample notification below:

“The Henry Samueli School of Engineering and Applied Science boasts an outstanding faculty. This faculty is an excellent resource for upper division students and offers information and insights into the engineering profession and graduate school. Each quarter, selected upper division students are required to meet with their faculty advisors. You must meet with your faculty advisor this quarter, Spring 2008. During this meeting you will receive important information about resources available to you and strategies for success in the larger goal of launching yourself into a fulfilling career. Some examples of the information include research opportunities, future career opportunities, internship opportunities, and choices of specialization within your department. Furthermore, this meeting will establish a relationship with your advisor that could prove invaluable should you encounter a serious difficulty and need to turn to your advisor for assistance.

Please follow the instructions below to see who your advisor is and to change your faculty advisor, if you choose to do so.

1. login to <http://courseweb.seas.ucla.edu>
2. go to [My Courseweb] if not already there
3. in "My Profile" box on the left, click on "My Advisors"

You will need to arrange a meeting with your faculty advisor by email or by telephone. This meeting is not meant to address specific questions about course planning and degree requirements. These questions may be directed to Mr. Erkki Corpuz, academic counselor, at 6426 BH.”

Each HSSEAS undergraduate, in addition to an academic counselor, is assigned a faculty advisor for advisement in areas such as major field specialization, major field electives, research, graduate school program options and career specialization.

### **IV. Special Programs and Scholarships**

Students following the engineering curricula are eligible to be named to the Deans Honor List each term. Minimum requirements are a course load of at least 15 units (12 units of letter grade) with a grade point average equal to or greater than 3.7. Students are not eligible for the Dean’s Honors List if they receive an Incomplete (I) or Not Passed (NP) grade or repeat a course. Only courses applicable to an undergraduate degree are considered toward eligibility for Deans Honor. Each term letters are sent to students who have been placed on the Dean’s Honor List.

The school may nominate exceptionally promising juniors and seniors as Departmental Scholars to pursue bachelors and masters degree programs simultaneously. Letters are sent to students notifying them of acceptance into the Department Scholar Program.

The Exceptional Student Admissions Program (ESAP) guarantees admissions to students who meet eligibility to the graduate program in the department in which they earned their B.S. degree. Emails notices are sent to students notifying them of their eligibility.

<http://www.seasoasa.ucla.edu/current/esap.html>

HSSEAS awards annual undergraduate scholarships. All students are sent email notifications. Flyers and information is posted at the HSSEAS Scholarship website:

<http://www.seasoasa.ucla.edu/scholarships/index.html>

## **V. Graduating Seniors**

Graduating seniors are informed of the degree audit process and provided with notifications of final degree requirements. [http://www.seasoasa.ucla.edu/current/degree\\_audit.html](http://www.seasoasa.ucla.edu/current/degree_audit.html)

Graduating students are sent an email by the Degree Auditors and asked to complete an exit survey.

## **D4. Teaching lab space**

For our undergraduate lab courses (primarily BE180L, BE181L, and BE 182) we currently have the following space in Boelter Hall (BH): BH 7718 (539 sq. ft.), BH 7732 (891 sq. ft.), and BH 7736 (523 sq. ft.), which has been adequate for our recent smaller class sizes of 10-20 students. With our class sizes increasing rapidly to 40 students this year and approx. 70 students next year, our department needs additional teaching lab space. We just learned from HS-SEAS Associate Dean Pottie that our request has been approved for more teaching lab space adjacent to our existing lab space, namely: BH 7738 (470 sq. ft.), BH 7731 (384 sq. ft.), BH 7750 (277 sq. ft.), and BH 7719 (344 sq. ft.); however, much of this is unavailable until current occupants move their labs into Engineering V. We have re-organized our lab course offerings and have broken our design course into modules with overlapping sessions in order to maximize efficiency of the space to accommodate our growing student population.

## **D5. Future Plans**

Due to increased numbers of undergraduate students in the BE major, as well as feedback from our initial experiences in teaching the full curriculum and from our industrial advisors, we plan to continue to optimize and modify our curriculum. The summary of our proposed changes are shown below. These changes have been submitted for formal approval by the HS-SEAS Faculty Executive Committee, to be effective Fall Quarter 2009.

Overall, the total proposed curriculum changes are given below:

- 1) CREATE 3 new tracks in (i) Biomaterials and Regenerative Medicine; (ii) Biomedical Devices; and (iii) Biotechnology and Pharmaceuticals

- 2) ACCEPT a maximum of two (2) BE 199 (8 total units) towards BME electives
- 3) REMOVE prerequisites for BE 182A but still restrict the course to majors only
- 4) ADD BE M106, EE 100, one (1) additional BME elective (add 12 units)
- 5) MODIFY BE 120 (No unit change)
- 6) CONVERSION of BE 181, 180L and 181L from “Required” to “Optional” (remove 10 units)
- 7) ADD BE 199, BE M104, BE M105, BE 131, BE 181, BE 180L, BE 181L, BME CM140, BME CM183, BME CM186B, BME C187 to list of BME electives
- 8) ACCEPT ENG 183 or BE 165 to satisfy ethics requirement

Present – 185 minimum units required	Proposed – 187 minimum units required.
<p>1. Bioengineering 100, 110, 120, 165, 176, 180, 180L, 181, 181L, 182A, 182B, 182C, Chemistry and Biochemistry 153A; three technical breadth courses (12 units) selected from an approved list available in the Office of Academic and Student Affairs; and two major field elective courses (8 units) from Biomedical Engineering C101, CM102, CM103, CM145, CM150, CM150L, C170, C171, CM180, C181, C185, CM186C.</p> <p>2. Life Sciences 2 (satisfies HSSEAS GE life sciences requirement), 3, 4</p> <p>3. Bioengineering 10; Chemistry and Biochemistry 20A, 20B, 20L, 30A, 30AL, 30B, 30BL; Computer Science 31; Life Sciences 2 (satisfies HSSEAS GE life sciences requirement), 3, 4; Mathematics 31A, 31B, 32A, 32B, 33A, 33B; Physics 1A, 1B, 1C, 4AL, 4BL</p> <p>4. HSSEAS general education (GE) requirements. See <a href="http://www.seasoasa.ucla.edu/ge.html">http://www.seasoasa.ucla.edu/ge.html</a> for details</p>	<p>1. Bioengineering 100, <b>M106</b>, 110, 120, <del>165</del>, 176, 180, <del>180L</del>, <del>181</del>, <del>181L</del>, 182A, 182B, 182C; <b>Electrical Engineering 100</b>;; Chemistry and Biochemistry 153A; <b>Bioengineering 165 or Engineering 183</b>; three technical breadth courses (12 units) selected from an approved list available in the Office of Academic and Student Affairs; and <del>two</del> <b>three</b> major field elective courses (<del>8</del> <b>12</b> units) from <b>BE M104, M105, 131, 181, 180L, 181L, 199</b>, Biomedical Engineering C101, CM102, CM103, <b>CM140</b>, CM145, CM150, CM150L, C170, C171, CM180, C181, CM183, C185, <b>CM186B</b>, CM186C, C187.</p> <p>2. Life Sciences 2 (satisfies HSSEAS GE life sciences requirement), 3, 4</p> <p>3. Bioengineering 10; Chemistry and Biochemistry 20A, 20B, 20L, 30A, 30AL, 30B, 30BL; Computer Science 31; Life Sciences 2 (satisfies HSSEAS GE life sciences requirement), 3, 4; Mathematics 31A, 31B, 32A, 32B, 33A, 33B; Physics 1A, 1B, 1C, 4AL, 4BL</p> <p>4. HSSEAS general education (GE) requirements. See <a href="http://www.seasoasa.ucla.edu/ge.html">http://www.seasoasa.ucla.edu/ge.html</a> for details</p> <p>5. The 3 technical breath requirement courses and the 3 BME electives courses may be selected to comprise one of the three bioengineering tracks: (i) Biomaterials and Regenerative Medicine; (ii) Biomedical Devices; and (iii) Biotechnology and Pharmaceuticals. Please see <a href="http://www.bioeng.ucla/tracks.html">www.bioeng.ucla/tracks.html</a> for complete course listing.</p>

## Rationale

- 1) CREATE 3 new tracks in (i) Biomaterials and Regenerative Medicine; (ii) Biomedical Devices; and (iii) Biotechnology and Pharmaceuticals

The current Bioengineering curriculum prepares the Bioengineering graduate with a set of Preparatory courses and Major courses to enable them with fundamental principles to address a broad variety of biomedical problems. The current curriculum includes 3 courses that fulfill school wide Technical Breadth Requirement, and 3 BME electives; and BE students are encouraged to use these 6 courses to focus on one specialty area of interest. With the current curriculum, our graduates have been extremely successful in gaining admission into hyper-competitive MD-PhD programs (UCSF, Mayo Medical School, etc.), PhD programs (MIT,

UCLA, Stanford, Michigan, etc.), MD programs (UCLA, Stanford, etc), and DDS programs (UCLA).

The proposed tracks are aimed at helping the remaining Bioengineering students who are not interested in advanced degrees, but are interested in industry. Our Bioengineering Industrial Advisory Board (please see Table 3 for list of IAB members) has repeatedly recommended that specific tracks be developed, with specific courses within each track. These tracks are used by their hiring managers to identify the capabilities of the students.

The specific courses for each proposed track are listed below.

(i) Biomaterials and Regenerative Medicine

1. BE 199 (Undergraduate Research)\*
2. BE M104 ( Physical Chemistry of Biomacromolecules)
3. BE M105 (Biopolymer Chemistry and Bioconjugates)
4. Biol Chem CM153G (Macromolecular Structure)
5. BME CM140 (Introduction to Biomechanics)
6. BME CM183 (Targeted Drug Delivery and Controlled Drug Release)
7. BME C185 (Introduction to Tissue Engineering)
8. BME C187 (Applied Tissue Engineering: Clinical and Industrial Perspectives)
10. Chem C140 (Bionanotechnology)
11. Chem C181 (Polymer Chemistry)
12. MCD BIO 168 (Stem Cell Biology)
13. MSE 104 (Science of Engineering Materials) <sup>TBR</sup>
14. MSE 110 (Introduction to Materials Characterization A) <sup>TBR</sup>
15. MSE 111 (Introduction to Materials Characterization B) <sup>TBR</sup>
16. MSE 120 (Physics of Materials) <sup>TBR</sup>
17. MSE 130 (Phase Relations in Solids) <sup>TBR</sup>
18. MSE 132 (Structure and Properties of Metallic Alloys) <sup>TBR</sup>
19. MSE 140 (Materials Selection and Engineering Design) <sup>TBR</sup>
18. MSE 143A (Mechanical Behavior of Materials) <sup>TBR</sup>
20. MSE 150 (Introduction to Polymers) <sup>TBR</sup>
21. MSE 151 (Structure and Properties of Composite Materials) <sup>TBR</sup>
22. MSE 160 (Introduction to Ceramics and Glasses) <sup>TBR</sup>
23. MSE 161 (Processing of Ceramics and Glasses) <sup>TBR</sup>
24. Phys Sci C150 (Musculoskeletal Mechanics)
25. Phys Sci C152 (Musculoskeletal Anatomy, Physiology, and Biomechanics)
26. Phys Sci 154 (Cellular Communication and Regulation of Physiological Processes)
27. Phys Sci 155 (Development and Structure of Musculoskeletal System)

(ii) Biomedical Devices

1. BE 199 (Undergraduate Research)\*
2. BE M131 (Nanopore Sensing)
3. MAE 180/EE 150 (MEMS) <sup>TBR</sup>

4. MAE 180L/EE 150L (MEMS Lab) <sup>TBR</sup>
5. BME 172 (Design of Minimally Invasive Surgical Tools)
6. EE 100 (Electrical and Electronic Circuits) <sup>TBR</sup>
7. EE 102 (Systems and Signals) <sup>TBR</sup>
8. MAE 187L (Biosensors Laboratory) <sup>TBR</sup>

(iii) Biotechnology and Pharmaceuticals

1. BE 199 (Undergraduate Research)\*
2. BME C101 (Introduction to Biomedical Engineering)
3. BME CM145 (Molecular Biotechnology for Engineers)
4. BME CM183 (Targeted Drug Delivery and Controlled Drug Release)
5. MAE 103 (Elementary Fluid Mechanics)
6. MIMG 185A (Immunology)
7. MIMG CM133 (Frontiers in Biotechnology)
8. Mol Med Pharm M110A (Drugs: Mechanisms, Uses, and Misuse)
9. Mol Med Pharm M110B (Drugs: Mechanisms, Uses, and Misuse)
10. Biomath 204 (Biomedical Data Analysis)\*\*
11. Biostat 100A (Introduction to Biostatistics)
12. Biostat 100B (Introduction to Biostatistics)
13. Biostat 110A (Basic Biostatistics)
14. Biostat 110B (Basic Biostatistics)
15. Biostat 410 (Statistical Methods in Clinical Trials)\*\*
16. ChemE 100 (Fundamentals of Chemical and Biomolecular Engineering) <sup>TBR</sup>
17. ChemE 101A (Transport Phenomena) <sup>TBR</sup>
18. ChemE 101B (Heat Transfer) <sup>TBR</sup>
19. ChemE 102A (Thermodynamics) <sup>TBR</sup>
20. ChemE 103 (Separation Processes) <sup>TBR</sup>
21. ChemE 109 (Numerical and Mathematical Models in Chemical and Biomolecular Engineering) <sup>TBR</sup>
22. ChemE C115 (Biochemical Reaction Engineering) <sup>TBR</sup>
23. ChemE C125 (Bioseparations and Bioprocess Engineering) <sup>TBR</sup>
24. Phys Sci 100 (Experimental Statistics)
25. Phys Sci 135 (Dynamical Systems Modeling of Physiological Processes)

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<sup>TBR</sup> These courses have been identified by their departments to fulfill TBR (as of 10/7/2008). Students may take these courses to fulfill TBR and track courses simultaneously. Alternatively, students may choose the standard track (i.e. no track) and take any approved TBRs and select any of the listed electives to fulfill the track requirement. Students should refer to [http://www.seasoasa.ucla.edu/current/technical\\_breadth\\_files/TBA.pdf](http://www.seasoasa.ucla.edu/current/technical_breadth_files/TBA.pdf) for regular updates to TBR lists. BE majors cannot take BE TBR courses to fulfill TBR.

\* For BE 199 to fulfill a track requirement, the research project must fit within the scope of the track field. The research report must be approved by the supervisor and Vice Chair.

\*\* Graduate level courses (e.g. Biomath 204 and Biostat 410) require HSSEAS approval by petitioning at 6426 BH.

We recognize that these 3 tracks do not completely address the needs of all our students, and certainly do not represent the entire biomedical engineering industry. As we identify other popular tracks, or as new courses become available, we will consider more tracks to better prepare our students for other specialty areas. Meanwhile, students who are not interested in

these 3 tracks are free to choose another combination of courses for their TBR and BME electives in the standard curriculum (i.e. no track). The standard curriculum is essentially the current practice in which students can choose one TBR and any BME electives.

2) ACCEPT a maximum of two (2) BE 199 (8 total units) towards BME electives

The Department of Bioengineering considers undergraduate research to be a powerful tool to motivate intellectual curiosity and maximize retention of learned information. Tracking of our two graduated classes revealed a undeniable trend that students who engaged in significant undergraduate research were also the most successful in terms of admission into MD/PhD, PhD, MD, and DDS programs, as well as job readiness in industry. Our undergraduate students have also been successful in receiving scholarships from highly competitive university wide research programs, such as the Howard Hughes, Amgen Scholars, and Undergraduate Research Scholars programs. Our students also participate in the university wide Science Poster Day, and two of our students received the Dean's Prize. Moreover, our faculty have also participated in these university wide programs by mentoring students, participating as judges, giving talks, and attending informal receptions and dinners to meet with the students. Based on the success of our students conducting research, we propose to promote undergraduate research by accepting a maximum of two (2) BE 199 *Directed Research in Engineering* (8 total units) towards BME electives. To ensure that the BE 199 course produces a truly valuable educational experience, the acceptance of each BE 199 course as a BME elective will require the approval of the BE 199 Final Report by the supervising faculty and the Vice Chair of the department. The addition of BE 199 also adds scheduling flexibility by avoiding course conflicts, thereby increasing the chances of timely graduation.

3) REMOVE prerequisites for BE 182A but still restrict the course to majors only

Besides the success stories, we also learned from our other graduates that they wished they had started research earlier in their undergraduate studies. Many of them simply didn't realize that they like research until the senior Capstone Design sequence (182A-182B-182C). Unfortunately for those students who started research in the senior year, their research experience was not reflected in their grad school applications. As part of our overall promotion of undergraduate research, the Department will systematically prepare ALL Bioengineering undergraduate students with basic research laboratory skills as early as the sophomore year. This will be accomplished by offering the first course BE 182A of the Capstone Design in the sophomore year. We propose to change the prerequisites for BE 182A in order to allow the course to be offered in the sophomore year. This change will provide BE sophomores with lab skills and experience that will aid them in finding undergraduate research opportunities.

4) ADD BE M106, EE 100 and a BME elective

BE M106 is BE/BME M106/C206 (*Topics in Biophysics of Membranes and Channels*). Students learn about electrostatics in dielectric media and electrolyte, membrane potentials, and action potential propagation.

EE 100 (*Electrical and Electronic Circuits*) is a circuit fundamentals class that will give the students experiences with analyzing and designing simple electronic circuits which form the

foundation of the biomedical instrumentation covered in BE 120 (*Biomedical Transducers*). The circuit basics that used to be covered in BE 120 will be substituted by discussions of image reconstruction and additional biomedical instrumentation (see #5 below).

The Bioengineering Department has consulted with the Electrical Engineering department regarding the potential impact of additional students on this popular EE course. Please see Appendix 1.

An additional BME elective is required in order to (1) fulfill track requirement; (2) ensure that students who apply two quarters of BE 199 credits towards BME electives will take at least one BME elective course. In reality, most students already take above and beyond the current minimum BME elective course requirement of two (2).

5) MODIFY BE 120

With the inclusion of EE 100, circuits will no longer be taught in BE 120 (*Biomedical Transducers*). In their place will be substituted discussions of image reconstruction and additional biomedical instrumentation.

6) CONVERSION of BE 181, 180L and 181L from “Required” to “Optional”

The proposed conversion of BE 180L and 181L (*System Integration of Biology, Engineering, and Medicine Laboratory*) from “required” to “optional” course is necessary since these labs involve many clinical visit modules throughout the UCLA medical center. Unfortunately, many of these modules simply cannot accommodate the anticipated class size. Even with the previous class size of 28 students, the class was divided into two groups in order to fit into some of the modules. BE 181 (*System Integration of Biology, Engineering, and Medicine*) will be changed from a required course to an elective course in order to accommodate the above mentioned modifications.

7) ADD BE M104, BE M105, BE M131, BE 181, BE 180L, BE 181L, BE 199 BME CM140, BME CM183, BME CM186B, BME C187 to list of BME electives

The inclusion of eleven (11) additional BME courses to approved BME electives will enhance the course offerings for our students, and further add flexibility and facilitate timely graduation. In addition to these electives, students may take BME electives listed in the three tracks described above. Furthermore, students may petition for additional courses to be approved as BME electives on a case by case basis.

8) ACCEPT ENG 183 or BE 165 to satisfy ethics requirement.

ENG 183 (*Engineering and Society*) is the Schoolwide ethics course that is offered every quarter, and can be taken by juniors and seniors. BE 165 (*Bioethics and Regulatory Policies in Bioengineering*) is offered only once per year, and is typically taken in the senior year. In the past, students have had to petition to take ENG 183 due to schedule conflicts with BE 165. This

official inclusion of a widely accepted ethics course (ENG 183) increases scheduling flexibility for the student and promote timely graduation.

## **D6. ABET Accreditation Plans**

We have accomplished several major tasks in our efforts to prepare the Bioengineering Department for ABET accreditation.

### **Efforts/Accomplishments**

First, we have defined Bioengineering-specific program objectives and outcomes. These objectives and outcomes were presented to our industrial advisory board for review and subsequently uploaded to Courseweb and Department websites, which fulfills ABET's publishing requirement. Alumni and exit surveys are being generated from these program objectives and outcomes. We have also defined course-specific objectives and topics/outcomes for each required bioengineering course. This allowed us to generate a matrix identifying the contribution of each course towards fulfilling our overall program outcomes. The outcomes/topics are being uploaded this quarter (Fall 2008). This will allow us to begin data collection via topic/outcome driven surveys this year. Surveys will be automatically generated for each course based on these topics/outcomes. Finally, we have started to collect student data from our required courses. For each required course, instructors are keeping copies of student work to demonstrate how the outcomes are fulfilled. We will continue this process for each required course until accreditation.

### **Future Plans**

Three years after our first graduating class (June 2007), we will distribute a survey to the graduates to determine if the program objectives are being met. Based on this data, and the data we receive from our courses (collection began in 2007 for some courses), we will make adjustments to the curriculum as necessary to fulfill ABET's continuous improvement criterion. Due to recent changes in accreditation criteria, the earliest date we could seek accreditation is 2010 (at least one class must be at least three years out from graduation). Over the next few years, we will work with the School of Engineering to make sure we are collecting the proper required data for ABET, and will also consult with other BE departments who have recently gone through the accreditation process (e.g. UC Irvine) to get advice. In 2011, we plan to schedule a mock site visit in preparation for accreditation in 2012-2013. The mock site visit will help us to identify and correct any major roadblocks to accreditation. In 2012-2013, we plan to seek accreditation along with the entire School of Engineering, which goes up for renewed accreditation at this time.

## **E. Comparison to the previous review**

The BE department was officially approved in 2002, and therefore has not previously been reviewed. The BME IDP went through an 8-year external review in Fall 2007, where the BE department was reviewed in the context of the IDP. The outcomes of this review, relevant to the BE department are summarized below:

- Develop a strategic plan to phase the BME IDP into the BE department by reducing the number of research fields to make them stronger, and by developing a MS and Ph.D program in the BE department.
- Reorganization of the BME IDP and BE into one Department should occur by 6/30/2010.

BE faculty currently teach core courses, recruit students for, and administer the Biomedical Engineering Interdepartmental Graduate Program (BME). To build a highly ranked BE department, we will work with BME to incorporate IDP faculty from other departments into BE as joint appointments. Involvement of these faculty will reinforce the crucial connection of the BE department to the UCLA School of Medicine, and will allow growth of more diverse research areas within the BE Department, beyond what is possible with current FTE allocations. With critical faculty numbers we also plan to establish Ph.D. and M.S. degree granting programs in the BE department, as also recommended by the recent review of the BME program.

In accordance with the recent review of the BME program, BE also plans to hire more faculty by filling its remaining three allocated positions. The Department also needs additional faculty lines and space to more adequately teach its curriculum and to obtain a critical mass of faculty to compete with more established bioengineering departments which average 20-25 FTE, as suggested by the review committee.

## F. Resources

### F1. Budget

The BE Budget since the inception of the Department is shown in Table 6. As can be seen, the recent budget cuts have greatly hampered our Department's ability to grow, with significant cuts in operating expenses, and most importantly teaching support. The decreases in teaching support, both in terms of TA positions and lecturer positions, come at a time when our student population is growing rapidly, putting extreme pressure on our faculty to manage the teaching load. In order for the Department to become highly ranked, it is crucial that an investment of resources be made to support the Department's growth.

<b>Table 6. Department of Bioengineering Budget</b>							
	<b>02-03AY</b>	<b>03-04AY</b>	<b>04-05AY</b>	<b>05-06AY</b>	<b>06-07AY</b>	<b>07-08AY</b>	<b>08-09AY</b>
<b>Faculty Allocation - # of Faculty</b>	0	4	6	6	6	6	7
Faculty Salary	\$0	\$511,350	\$659,750	\$688,750	\$649,475	\$677,566	\$786,000
<b>Staff Allocation - # of Staff</b>	3	4	4	4	4	4	4

Career Staff Salary	\$122,808	\$133,650	\$183,558	\$198,477	\$214,035	\$231,577	\$235,478
Benefits on 19935	\$27,500	\$12,492	\$12,492	\$12,492	\$12,492	\$12,492	\$12,492
<b><u>Teaching Support</u></b>							
TA Allocation - 19900 & 19935	\$45,606	\$57,344	\$215,355	\$233,160	\$158,366	\$156,417	\$155,715
Temporary FTE - Lecturer Allocation	\$74,700	\$123,255	\$112,050	\$122,508	\$79,248	\$114,996	\$78,260
<b><u>Teaching Budget</u></b>							
Instructional Supplies Allocation	\$0	\$0	\$25,000	\$25,000	\$30,000	\$30,000	\$30,000
Instructional Equipment Allocation	\$30,000	\$30,000	\$30,000	\$30,000	\$30,000	\$35,000	\$35,000
<b><u>Fellowship / Research Support</u></b>							
GSR Allocation	\$82,500	\$100,000	\$75,000	\$73,000	\$85,000	\$90,000	\$85,000
<b><u>Operating Budget - 19935</u></b>	\$85,000	\$85,000	\$50,000	\$45,436	\$31,546	\$31,546	\$31,546
<b>Total Budget Per Academic Year</b>	<b>\$468,114</b>	<b>\$1,053,091</b>	<b>\$1,363,205</b>	<b>\$1,428,783</b>	<b>\$1,290,162</b>	<b>\$1,379,594</b>	<b>\$1,449,491</b>

*Note: For 02-03AY, faculty allocation is \$0 because all faculty hired for Bioengineering were hired into existing Engineering Departments. Faculty appointments were not transferred into the Department of Bioengineering until July 1, 2003.*

## F2. Space

The School of Engineering initially allocated a total of 13,316 sq. feet of space for the Department, of which 2,811 sq. feet were office space for faculty and staff, and 7,698 sq. feet were research laboratory space, and 2,807 sq. feet were teaching laboratory space, all in Boelter Hall. Additional hires added lab space (~2,300 sq. feet) in Boelter Hall and Engineering 1 that brought the Department total up to approximately 10,000 sq. feet of lab space. The Department moved its offices in Fall 2007 to the 4th and 5th floors of the Engineering V Building, which provides approximately 11,357 sq. feet of student, faculty, and staff office facilities and 4036 sq. feet of conference and storage rooms. Movement of faculty research labs into Engineering V is about half complete, outfitting of labs on the 4<sup>th</sup> floor is still underway and we expect to move into these labs sometime in the next 6-12 months. The bioengineering faculty are very excited

about the new labs, and the collaborative atmosphere of having all our labs and offices together, but the space is insufficient to meet the faculty recruitment objectives. The two floors will only provide approximately 12,575 sq. feet of laboratory space, which is not much more than we previously occupied, and is grossly inadequate for our faculty recruitment plan that includes multiple senior hires. To address this problem, we are exploring the possibilities of using existing space that we currently occupy in Boelter Hall, recruiting joint hires with CNSI who could establish core facilities labs in the CNSI building, and joint recruitment of faculty with the UCLA Orthopedic Hospital Research Center, which has lab space but not FTE and fits with our strengths in biomaterials/regenerative medicine. However, these are partial solutions, and will not likely solve our space problems as our faculty size increases.

A detailed breakdown of current total BE space is shown below in Table 7.

**Table 7. Department of Bioenginerring Space**

Room	Building Name	Room Description	Occupant	Square Feet
7718	BOELTER HALL	LAB-WET	DEPT TEACHING LAB	539
7719	BOELTER HALL	RSCH OFF	DEPT TEACHING LAB	344
7731	BOELTER HALL	LAB - DRY	DEPT TEACHING LAB	384
7732	BOELTER HALL	LAB-DRY	DEPT TEACHING LAB	891
7736	BOELTER HALL	LAB-WET	DEPT TEACHING LAB	523
7738	BOELTER HALL	LAB-WET	DEPT TEACHING LAB	470
7750	BOELTER HALL	LAB - WET	DEPT TEACHING LAB	277
4121	ENGR V	CORRIDOR	DEPT.	522
4121A	ENGR V	COPY ROOM	DEPT.	90
4121B	ENGR V	KITCHEN	DEPT.	135
4121C	ENGR V	FAC OFFICE	VACANT	192
4121D	ENGR V	FAC OFFICE	VACANT	136
4121E	ENGR V	FAC OFFICE	MCCABE, E.	136
4121F	ENGR V	FAC OFFICE	TAWIL, B.	136
4121G	ENGR V	FAC OFFICE	WINET, H.	136
4121H	ENGR V	FAC OFFICE	GRUNDFEST, W.	136
4121J	ENGR V	FAC OFFICE	DUNN, J.	136
4121K	ENGR V	FAC OFFICE	DEMING, T.	140
4121L	ENGR V	STAFF OFFICE	VACANT	103
4121M	ENGR V	STAFF OFFICE	FILE ROOM	179
4121N	ENGR V	STAFF OFFICE	HAMASAKI	106
4125	ENGR V	CONF ROOM	DEPT.	127
4129	ENGR V	CONF ROOM	DEPT.	297
4101	ENGR V	SEMINAR ROOM	DEPT.	643
4th floor	ENGR V	BREAKOUT AREA	DEPT.	204
			SCHMIDT/ KASKO/ DEMING/	
4122	ENGR V	STUDENT OFFICE	GRUNDFEST	1,819
4122A	ENGR V	STUDENT OFFICE	UNASSIGNED	149
4122B	ENGR V	STUDENT OFFICE	UNASSIGNED	151
4122C	ENGR V	STUDENT OFFICE	UNASSIGNED	151
4122D	ENGR V	STUDENT OFFICE	UNASSIGNED	151

4122E	ENGR V	STUDENT OFFICE	UNASSIGNED	149
4010	ENGR V	LAB	VACANT	995
4011	ENGR V	LAB	GRUNDFEST, W.	952
4020	ENGR V	LAB	SCHMIDT, J.	1301
4021	ENGR V	LAB	KASKO, A.	1254
4030	ENGR V	LAB	DEMING, T.	923
4031	ENGR V	LAB	DEMING, T.	892
5121	ENGR V	CORRIDOR	DEPT.	522
5121A	ENGR V	COPY ROOM	DEPT.	90
5121B	ENGR V	KITCHEN	DEPT.	135
5121C	ENGR V	CHAIR'S OFFICE	DEMING, T.	192
5121D	ENGR V	FAC OFFICE	VACANT	136
5121E	ENGR V	FAC OFFICE	DICARLO, D.	136
5121F	ENGR V	STAFF OFFICE	TRAN, S.	136
5121G	ENGR V	FAC OFFICE	SCHMIDT, J.	136
5121H	ENGR V	FAC OFFICE	KASKO, A.	136
5121J	ENGR V	FAC OFFICE	KAMEI, D.	136
5121K	ENGR V	FAC OFFICE	WU, B.	140
5121L	ENGR V	STAFF OFFICE	YANG, L.	103
5121M	ENGR V	STAFF OFFICE	NADEAU, L.	179
5121N	ENGR V	STAFF OFFICE	CHIN, A.	106
5125	ENGR V	CONF ROOM	DEPT.	127
5129	ENGR V	CONF ROOM	DEPT.	297
5th Floor	ENGR V	BREAKOUT AREA	DEPT.	204
5101	ENGR V	SEMINAR ROOM	DEPT.	643
5122	ENGR V	STUDENT OFFICE	KAMEI, WU, DICARLO, TAWIL	1819
5122A	ENGR V	STUDENT OFFICE	Undergrads	149
5122B	ENGR V	OFFICE	DUONG & LEE	151
5122C	ENGR V	OFFICE	VACANT	151
5122D	ENGR V	OFFICE	BMES	151
5122E	ENGR V	OFFICE	VACANT	149
5010	ENGR V	LAB	KAMEI, D.	100
5010A	ENGR V	LAB	KAMEI, D.	96
5011	ENGR V	LAB	DICARLO, D.	642
5012	ENGR V	LAB	VACANT	329
5012A	ENGR V	LAB	VACANT	111
5012B	ENGR V	LAB	VACANT	117
5015A	ENGR V	LAB	VACANT	117
5014	ENGR V	LAB	DICARLO, D.	422
5015	ENGR V	LAB	KAMEI, D.	621
5018	ENGR V	LAB	WU, B.	961
5018B	ENGR V	LAB	WU, B.	204
5019	ENGR V	LAB	KAMEI, D.	626
5025	ENGR V	LAB	VACANT	622
5026	ENGR V	LAB	WU, B.	90
5028A	ENGR V	LAB	WU, B.	89
5028B	ENGR V	LAB	WU, B.	247
5030	ENGR V	LAB	WU, B.	70
5030A	ENGR V	LAB	WU, B.	225
5031A	ENGR V	LAB	VACANT	105

5031	ENGR V	LAB	VACANT	464
<b>TOTAL BIOENGINEERING SPACE</b>				<b>28,251</b>
<b><u>SPACE SUMMARY</u></b>				
<b>FACULTY</b>	<b>NON LAB SQ FT.</b>	<b>LAB SQ FT.</b>		
TEACHING LAB SPACE		3,428		includes vacant labs
RESEARCH LAB SPACE		12,575		
VACANT OFFICES / LABS	567	2,860		
CONFERENCE ROOMS	2,542			includes vacant offices includes vacant offices
STUDENT OFFICES	5,140			
STAFF OFFICES	630			
FACULTY OFFICES	2,160			
DEPT GENERAL USE	1,494			
TOTAL	12,533	18,863		
<b>TOTAL EV SPACE</b>	<b>24,823</b>			
<b>TOTAL BH SPACE</b>	<b>3,428</b>			
<b>TOTAL BE SPACE</b>	<b>28,251</b>			