Bioengineering ABET Annual Report AY 2008-2009

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Contents

1. Mission Statement

We plan to revise the mission statement for our Department to be more consistent with the mission statement of the College and the Bioengineering Program Educational Objectives

Current Bioengineering Mission Statement that appears on our Web Site.

The mission of the new Department of Bioengineering at the University of California, Riverside focuses on two interrelated themes:

1.Advancing Bioengineering research, particularly in BioCellular Engineering, and,

2.Preparing future leadership in Bioengineering and related fields.

Our unique interdisciplinary program combines building a solid fundamental foundation in biological science and engineering, developing diverse communication skills and providing training in the most advanced quantitative bioengineering research. The result is a rigorous, but exceptionally interactive and welcoming educational training for Bioengineering students leading towards B.S., M.S. and Ph.D. degrees.

2. Bioengineering Program Educational Objectives

We have revised our Program Educational Objectives to be more consistent with our curriculum goals.

Previous Statement as given in the UC Riverside 2008-2009 General Catalog

> *The objective of the bioengineering (undergraduate) program is to produce graduates who:*
> *1. have life-long learning skills that maintain their high level of professional competence*
> *2. have the skills to apply engineering and biological principles to meet the challenges of this rapidly evolving field*
> *3. be prepared for advanced postgraduate training in bioengineering and biomedical allied fields*

New Statement of Bioengineering Program Educational Objectives that have been submitted for the UC Riverside 2009-2010 General Catalog

The educational objective of the bioengineering program is to produce graduates who:

> *1. Have a strong foundation to apply science, engineering and biological principles to meet the challenges at the interface of engineering, life sciences, and medicine.*
> *2. Have the capability to pursue graduate studies, careers in the medical device or biotechnology industries, or entry into medical or other health related professional schools.*
> *3. Are effective working professionally as individuals and in teams and can communicate effectively to integrate contributions from multiple disciplines to address biological and medical problems*
> *4. Have an appreciation of and sensitivity to a broad range of ethical and social concerns related to bioengineering*

3. Program Outcomes

Previously the Program Outcomes (POs) designated for the Bioengineering Program were exactly the same as outlined in ABET's Criterion 3 (***a*** through ***k***)

This year we decided to use a modified Program Outcomes statement that includes the Bioengineering Program Criteria required by ABET

> *PROGRAM CRITERIA FOR BIOENGINEERING AND BIOMEDICAL ENGINEERING AND SIMILARLY NAMED ENGINEERING PROGRAMS*
> *These program criteria apply to bioengineering and biomedical engineering programs with the exception of agriculturally-based engineering programs.*
> *1. Curriculum*

The structure of the curriculum must provide both breadth and depth across the range of engineering topics implied by the title of the program. The program must demonstrate that graduates have:
(PC1) an understanding of biology and physiology,
(PC2) and the capability to apply advanced mathematics (including differential equations and statistics), science, and engineering to solve the problems at the interface of engineering and biology;
(PC3) the ability to make measurements on and interpret data from living systems, addressing the problems associated with the interaction between living and non-living materials and systems.

New Bioengineering Program Outcomes ***(These phrases come from the ABET Program Criteria for Bioengineering)***

(a) an ability to apply knowledge of mathematics, science (***including biology and physiology (PC1)***), and engineering
(b) an ability to design and conduct experiments, ***make measurements, analyze and interpret data from living systems addressing the problems associated with the interaction between living and non-living materials and systems. (PC3)***
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(d) an ability to function on multidisciplinary teams
(e) an ability to identify, formulate, and ***apply advanced mathematics, science, and engineering to solve problems at the interface of engineering and biology. (PC2)***
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) a broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) a recognition of the need for, and an ability to engage in life-long learning
(j) a knowledge of contemporary issues ***related to bioengineering***
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

In order to document and show continuous improvement we have selected which Bioengineering required courses will be used to satisfy our Program Outcomes. These are shown in black in the following matrix table. Our plan is to have a Faculty Course Appraisal Form (FCAR) for each of the courses. In the FCAR each faculty member (instructor) will designate certain course elements (exam questions, homework questions, projects, reports, etc) that are related to the POs, and student performance and grades for these elements will be assembled for the assessment and evaluation.

Table 3.1 *Program Outcomes*/Course Matrix

Program Outcomes (PO)	A	B	C	D	E	F	G	H	I	J	K
BIEN 10				■		■	■		■	■	
BIEN 105	■			■	■		■				■
BIEN 110	■	■	■		■						■
BIEN 115	■	■			■					■	■
BIEN 120			■	■	■		■				■
BIEN 125	■		■					■	■	■	■
BIEN 130	■	■	■		■						■
BIEN 130L	■	■	■	■			■				■
BIEN 135	■				■						■
BIEN 140 A	■	■			■	■			■	■	
BIEN 155		■	■	■			■				■
BIEN 159	■	■			■		■	■			
BIEN 175 A,B		■	■	■	■	■	■	■	■	■	■

The table below shows our plan to obtain information that will be used for assessment and evaluations. The Senior Project Design Rubric needs to be developed in the future.

Table 3.2 Course Embedded Assessment for *Program Outcomes*

Program Outcomes	Course-Embedded Assessment (FCARS)	Senior Project Design Rubric
(a) an ability to apply knowledge of mathematics, science ***(including biology and physiology (PC1))***, and engineering	BIEN 105, BIEN 110, BIEN 115, BIEN 125, BIEN 130, BIEN 130L, BIEN 135, BIEN 140A, BIEN 159	
(b) an ability to design and conduct experiments***, make measurements, analyze and interpret data from living systems addressing the problems associated with the interaction between living and non-living materials and systems. (PC3)***	BIEN 110, BIEN 115, BIEN 130, BIEN 130L, BIEN 140A, BIEN 155, BIEN 159	
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	BIEN 110, BIEN 120, BIEN 125, BIEN 130, BIEN 130L, BIEN 155,	
(d) an ability to function on multidisciplinary teams	BIEN 10, BIEN 105, BIEN 120, BIEN 130, BIEN 130L, BIEN 155	
(e) an ability to identify, formulate, and ***apply advanced mathematics, science, and engineering to solve problems at the interface of engineering and biology. (PC2)***	BIEN 105, BIEN 110, BIEN 115, BIEN 120, BIEN 130, BIEN 135, BIEN 140A, BIEN 159	
(f) an understanding of professional and ethical responsibility	BIEN 10, BIEN 140A, BIEN 155, BIEN 159	
(g) an ability to communicate effectively	BIEN 10, BIEN 105,	

	BIEN 120, BIEN 130L, BIEN 155, BIEN 159	
(h) a broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	BIEN 125, BIEN 159	
(i) a recognition of the need for, and an ability to engage in life-long learning	BIEN 10, BIEN 125, BIEN 140A	
(j) a knowledge of contemporary issues ***related to bioengineering***	BIEN 10, BIEN 115, BIEN 125, BIEN 140A	
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.	BIEN 105, BIEN 110, BIEN 115, BIEN 125, BIEN 130, BIEN 130L, BIEN 135	

Relationship of Program Outcomes to Program Educational Objectives

This table demonstrates how we will shoe the relationship of the Program Outcomes to the PEOs. Comments for Column 3 will be developed over the next academic year.

Table 3.3 Relationship between *Program Outcomes* and *Program Educational Objectives*

Program Outcomes	Relevant Program Educational Objectives	"How Program Outcomes encompass Criterion 3"
(a) an ability to apply knowledge of mathematics, science ***(including biology and physiology (PC1))***, and engineering	1 Have a strong foundation to apply science, engineering and biological principles to meet the challenges at the interface of engineering, life sciences, and medicine. 2 Have the capability to pursue graduate studies, careers in the medical device or biotechnology industries, or entry into medical or other health related professional schools.	
(b) an ability to design and conduct experiments***, make measurements, analyze and interpret data from living systems addressing the problems associated with the interaction between living and non-living materials and systems. (PC3)***	1 Have a strong foundation to apply science, engineering and biological principles to meet the challenges at the interface of engineering, life sciences, and medicine.	
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety,	1 Have a strong foundation to apply science, engineering and biological principles to meet the challenges at the interface of engineering, life sciences, and medicine. 3 Are effective working professionally as individuals and in teams and can communicate effectively to integrate	

manufacturability, and sustainability	contributions from multiple disciplines to address biological and medical problems 4 Have an appreciation of and sensitivity to a broad range of ethical and social concerns related to bioengineering	
(d) an ability to function on multidisciplinary teams	3 Are effective working professionally as individuals and in teams and can communicate effectively to integrate contributions from multiple disciplines to address biological and medical problems	
(e) an ability to identify, formulate, and ***apply advanced mathematics, science, and engineering to solve problems at the interface of engineering and biology. (PC2)***	1 Have a strong foundation to apply science, engineering and biological principles to meet the challenges at the interface of engineering, life sciences, and medicine.	
(f) an understanding of professional and ethical responsibility	3 Are effective working professionally as individuals and in teams and can communicate effectively to integrate contributions from multiple disciplines to address biological and medical problems 4 Have an appreciation of and sensitivity to a broad range of ethical and social concerns related to bioengineering	
(g) an ability to communicate effectively	3 Are effective working professionally as individuals and in teams and can communicate effectively to integrate contributions from multiple disciplines to address biological and medical problems	
(h) a broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	4 Have an appreciation of and sensitivity to a broad range of ethical and social concerns related to bioengineering	
(i) a recognition of the need for, and an ability to engage in life-long learning	2 Have the capability to pursue graduate studies, careers in the medical device or biotechnology industries, or entry into medical or other health related professional schools.	
(j) a knowledge of contemporary issues ***related to bioengineering***	4 Have an appreciation of and sensitivity to a broad range of ethical and social concerns related to bioengineering	
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.	1 Have a strong foundation to apply science, engineering and biological principles to meet the challenges at the interface of engineering, life sciences, and medicine.	

The following table summarizes the overall relationship of the curriculum, i.e. BIEN courses to the two ABET requirements – Program Educational Objectives and Program Outcomes

Table 3.4 Cross tabulation between *Program Educational Objectives*, *Program Outcomes* and individual BIEN courses

Program Educational Objectives	Program Outcomes	Program BIEN Courses
1. Have a strong foundation to apply science, engineering and biological principles to meet the challenges at the interface of engineering, life sciences, and medicine.	(a), (b), (c), (e), (k)	BIEN 105, BIEN 110, BIEN 115, BIEN 120, BIEN 125, BIEN 130, BIEN 130L, BIEN 135, BIEN 140A, BIEN 155, BIEN 159, BIEN 175A,B
2. Have the capability to pursue graduate studies, careers in the medical device or biotechnology industries, or entry into medical or other health related professional schools.	(a), (i)	BIEN 10, BIEN 105, BIEN 110, BIEN 115, BIEN 125, BIEN 130, BIEN 130L, BIEN 140A, BIEN 155, BIEN 159, BIEN 175A,B
3. Are effective working professionally as individuals and in teams and can communicate effectively to integrate contributions from multiple disciplines to address biological and medical problems	(c), (d), (f), (g)	BIEN 10, BIEN 105, BIEN 110, BIEN 120, BIEN 125, BIEN 130, BIEN 130L, BIEN 140A, BIEN 155, BIEN 159, BIEN 175A,B
4. Have an appreciation of and sensitivity to a broad range of ethical and social concerns related to bioengineering	(j)	BIEN 10, BIEN 115, BIEN 125, BIEN 140A, BIEN 175A,B

4. Curriculum

Over the last few years we have been fine tuning our curriculum to meet our Educational Objectives.

Biology 5C was dropped as a requirement in 2008 because it deals mainly with evolution and ecology that are not particularly relevant to bioengineering.

Biochemistry Laboratory 102 was substituted for Biochemistry 101 in 2008 because of changes in the prerequisites.

Biology 171 (Physiology) was added in 2008 because of ABET's requirement for physiology in the Bioengineering Program Criteria (PC1). It was then learned that ABET required engineering analysis in physiology. For this reason we developed BIEN 115 – Quantitative Physiology to meet the PC1 requirement. This course will be offered for the first time in the 2009-2010 AY.

In AY 2007 and 2008 we found that many of our students were electing biology courses as their technical electives. Under those circumstances they would have about 60 Engineering Topics units which would not meet the minimum ABET Engineering Topics requirement of 72 units.

Thus we have made it mandatory that students elect engineering courses for their technical electives. We also created two additional elective courses – BIEN 160 Biomedical Imaging (4), and BIEN 165 Biomolecular Engineering (4). In addition we contacted other engineering departments to develop a list of courses that would be open to our students as technical electives (listed below).

In AY 2008 EE1A and EE ILA were added as required courses to provide students with adequate preparation in circuits for BIEN 130 Bioinstrumentation and BIEN 130L Bioinstrumentation Laboratory.

In AY 2008 ME 10 Statics was deleted from the program because the needed material was incorporated into BIEN 110 Biomechanics of the Human Body.

Table 4.1 Evolution of B.S. Bioengineering Curriculum

Mathematics and Basic Sciences
Math and Basic Science Reqt. (48)

	Units	2007	2008	2009
MATH 9A	4	√	√	√
MATH 9B	4	√	√	√
MATH 9C	4	√	√	√
MATH 10A	4	√	√	√
MATH 10B	4	√	√	√
MATH 46	4	√	√	√
CHEM 1A	4	√	√	√
CHEM 1LA	**1**	√	√	√
CHEM 1B	4	√	√	√
CHEM 1LB	**1**	√	√	√
CHEM 1C	4	√	√	√
CHEM 1LC	**1**	√	√	√
CHEM 112A	4	√	√	√
CHEM 112B	4	√	√	√
CHEM 112C	4	√	√	√
PHYS 40A	5	√	√	√
PHYS 40B	5	√	√	√
PHYS 40C	5	√	√	√
BIOL 5A	4	√	√	√
BIOL 5LA	**1**	√	√	√
BIOL 5B	4	√	√	√
BIOL 5C	4	√		
BIOL 171	4		√	
BCH 100	4	√	√	√
BCH 101	3	√		
BCH 102	4			√
Total		**86**	**83**	**83**

Engineering Topics
Engineering Topics Reqt. (72)

	Course Units	2007	2008	2009
ME 1C	1	√		
ME 18	2	√		
ME 10	4	√		
ME 118	4	√		
CS 10	4		√	√
EE 1A	3		√	√
EE 1LA	**1**		√	√
STAT 155	4	√	√	√
BIEN 10	2	√	√	√
BIEN 105	4		√	√
BIEN 110	4	√	√	√
BIEN 115	4			√
BIEN 120	4	√	√	√
BIEN 125	4	√	√	√
BIEN 130	4	√	√	√
BIEN 130L	2	√	√	√
BIEN 135	4	√	√	√
BIEN 140A	4	√	√	√
BIEN 140B	4	√		
BIEN 155	2	√	√	√
BIEN 159	4	√	√	√
Major Design Experience				
BIEN 175A	4	√	√	√
BIEN 175B	4	√	√	√
Required Courses		**65**	**58**	**62**

ENGL 1A	4	√	√	√
ENGL 1B	4	√	√	√
ENGL 1C	4	√	√	√
BREATH	20	√	√	√
Humanities	32			
Total		**118**	**115**	**115**

Tech Elective	**16**			
BIEN 140B			√	√
BIEN 160				√
BIEN 165				√
Engineering Topics		**81**	**74**	**78**
Total Units for B.S.		**199**	**189**	**193**

Bioengineering New Courses

Required

BIEN 105 -- Circulation Physiology 4 Units
Catalog Description:
Introduces tensor and vector mathematics that describe the conservation of momentum and mass transport in biological sciences, the cardiovascular system, and pulmonary system. Includes constitutive equations such as the Navier-Stokes and Casson models, significance of fluid stress in biological vessels, and the physiological relevance of fundamental parameters. Emphasizes the relation between function and system behavior.

BIEN 110 -- Biomechanics of the Human Body 4 Units
Catalog Description: Introduces the motion, structure and function of the musculoskeletal system, the cardiovascular system, and the pulmonary system. Topics include applied statics, kinematics, and dynamics of these systems and the mechanics of various tissues (ligament, bone, heart, blood vessels, lung). Emphasis is on the relation between function and material properties of these tissues.

BIEN 115 -- Quantitative Physiology 4 Units
Catalog Description: Analyzes engineering aspects of physiological systems and artificial organs. Covers the nervous system, muscular system, cardiovascular system, respiratory system, and renal system. Addresses ethical and professional considerations in the development and utilization of medical devices and interventions.

Technical Electives

BIEN 160 -- Biomedical Imaging 4 Units
Catalog Description: An introduction to the fundamental physics and engineering principles for medical imaging systems. Covers X-ray, ultrasound, radionuclide, magnetic resonance imaging,

positron emission tomography, optical coherent tomography, and other optical methods. Includes image formation and reconstruction, image characteristics, and quality and image processing.

BIEN 165 -- Biomolecular Engineering 4 Units
Catalog Description: Emphasizes engineering, biochemical, and biophysical concepts and technologies intrinsic to specific topics of biomolecular engineering. Introduces the history of genetic and protein engineering. Topics include biological thermodynamics, molecular kinetics, biochemical and biophysical approaches, protein engineering, high-throughput screening technologies, and protein engineering with unnatural amino acids.

Course Descriptions for Technical Electives Outside of Bioengineering

Chemical and Environmental Engineering

CEE 135. Chemistry of Materials (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): CHEM 112A, MATH 009B. Introduction to the synthesis, structure, properties, and performance of modern materials. Topics include the science of materials, bonding and structure, the strength of materials, electrons in materials, semiconductors, superconductors, and optical properties of materials.

CHE 105. Introduction to Nanoscale Engineering (4)
Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): CHEM 001C, MATH 010A, PHYS 040C; or consent of instructor. An introduction to nanotechnology engineering and its various applications. Includes electromagnetic waves and quantum mechanics; synthesis of nanostructures; assembly of nanostructures; traditional and nontraditional methods of nanolithography and interactions between electronic and optical properties. Also covers the forefront topics such as organic heterostructures, nanotubes, and quantum computing.

CHE 122. Chemical Engineering Kinetics (4)
Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): CHEM 001C, MATH 010A, MATH 046, PHYS 040B; or consent of instructor. Introduction to homogeneous and heterogeneous kinetics and reactor design for chemical and biochemical processes.

ENVE 171. Introduction to Environmental Engineering (4)
Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): CHEM 001C, MATH 009C, PHYS 040B; or consent of instructor. Introduction to mass and energy balances. Overview of contaminants and their effects of human health and the environment. Provides a basic understanding of contaminants, their sources, and their movement and fate in the environment.

ENVE 133. Fundamentals of Air Pollution Engineering (4)
Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): CHE 114, CHEM 112B, ENVE 171; or consent of instructor. Principles, modeling, and design of systems for atmospheric emission

control of pollutants such as photochemical smog and by-products of combustion. Effects of air pollution on health.

CHE 161. Nanotechnology Processing Laboratory (3)
Laboratory, 6 hours; written work, 3 hours. Prerequisite(s): CHE 100 or consent of instructor. An introduction to growth and characterization techniques that involve nanomaterials and devices. Includes preparing thin films; synthesizing Au and CdS nanoparticles; synthesizing carbon nanotubes; synthesizing alumina nanotemplate; synthesizing gold and nickel nanowires; and assembling of nanowires. Also includes imaging samples with optical, scanning electron microscope, scanning tunneling microscope, and atomic force microscope.

ENVE 142. Water Quality Engineering (4)
Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): CHE 114, ENVE 171; or consent of instructor. An introduction to the engineering aspects of water quality management. Water quality characterization and modeling techniques for natural and engineered systems. Application of chemical equilibrium and kinetic models to water quality is discussed.

Electrical Engineering

EE 100A. Electronic Circuits (4)
Lecture, 3 hours; laboratory, 3 hours. Prerequisite(s): EE 001B. Electronic systems, linear circuits, operational amplifiers, diodes, nonlinear circuit applications, junction and metaloxide-semiconductor field-effect transistors, bipolar junction transistors, MOS and bipolar digital circuits. Laboratory experiments are performed in the subject areas and SPICE simulation is used.

EE 100B. Electronic Circuits (4)
Lecture, 3 hours; laboratory, 3 hours. Prerequisite(s): EE 100A. Differential and multistage amplifiers, output stages and power amplifiers, frequency response, feedback, analog integrated circuits, filters, tuned amplifiers, and oscillators. Laboratory experiments are performed in the subject areas and SPICE simulation is used.

EE 105. Modeling and Simulation of Dynamic Systems (4)
Lecture, 3 hours; laboratory, 3 hours. Prerequisite(s): CS 010, EE 001A, MATH 046. Introduction to the mathematical modeling of dynamical systems and their methods of solution. Advanced techniques and concepts for analytical modeling and study of various electrical, electronic, and electromechanical systems based upon physical laws. Emphasis on the formulation of problems via differential equations. Numerical methods for integration and matrix analysis problems. Case studies. Digital computer simulation.

EE 110B. Signals and Systems (4) Lecture, 3 hours; laboratory, 3 hours. Prerequisite(s): EE 110A. Fourier analysis for discrete-time signals and systems, filtering, modulation, sampling and interpolation, z-transforms. Laboratory experiments with signals, transforms, harmonic generation, linear digital filtering, and sampling/aliasing.

EE 114. Probability, Random Variables, and Random Processes in Electrical Engineering (4)
Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): EE 110A. Covers fundamentals of probability theory, random variables, and random processes with applications to electrical and computer engineering. Includes probability theory, random variables, densities, functions of random variables, expectations and moments, and multivariate distributions. Also addresses random processes, autocorrelation function, spectral analysis of random signals, and linear systems with random inputs.

EE 138. Electrical Properties of Materials (4)
Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): upper division standing, PHYS 040C or equivalent. Introduces the electrical properties of materials. Includes the electron as a particle and a wave; hydrogen atom and the periodic table; chemical bonds; free-electron theory of metals; band theory of solids; semi conductors and dielectrics; measurements of material properties; and growth and separation of semidconductors.

EE 139. Magnetic Materials (4)
Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): upper-division standing; PHYS 040C or equivalent. Introduces fundamentals of magnetic materials for the next-generation magnetic, nanomagnetic, and spintronics-related technologies. Includes basics of magnetism, models of the equivalent magnetic charge and current, paramagnetic and diamagnetic materials, soft and hard magnetic materials, equivalent magnetic circuits, and magnetic system design foundations.

EE 143. Multimedia Technologies and Programming (4)
Lecture, 3 hours; laboratory, 3 hours. Prerequisite(s): CS 010 or knowledge of an object-oriented or fourth generation (scripting) programming language, for example, C++, Hypertalk, Supertalk, Lingo, Openscript, ScriptX. Introduces multimedia technologies and programming techniques, multimedia hardware devices, authoring languages and environments, temporal and nontemporal media (interactivity in text, graphics, audio, video, and animation), applications, and trends. A term project is required. Cross-listed with CS 143.

EE 144. Introduction to Robotics (4)
Lecture, 3 hours; laboratory, 3 hours. Prerequisite(s): EE 132. Basic robot components from encoders to microprocessors. Kinematic and dynamic analysis of manipulators. Open-and closed-loop control strategies, task planning, contact and noncontact sensors, robotic image understanding, and robotic programming languages. Experiments and projects include robot arm programming, robot vision, and mobile robots.

EE 146. Computer Vision (4)
Lecture, 3 hours; laboratory, 3 hours. Prerequisite(s): senior standing in Computer Science or Electrical Engineering, or consent of instructor. Imaging formation, early vision processing, boundary detection, region growing, two-dimensional and three-dimensional object representation and recognition techniques. Experiments for each topic are carried out.

EE 152. Image Processing (4)
Lecture, 3 hours; laboratory, 3 hours. Prerequisite(s): EE 110B. Digital image acquisition, image enhancement and restoration, image compression, computer implementation and testing of image processing techniques. Students gain hands-on experience of complete image processing systems, including image acquisition, processing, and display through laboratory experiments.

Mechanical Engineering

ME 114. Introduction to Materials Science and Engineering (4)
Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): CHEM 001B, PHYS 040C; upper-division standing. Covers materials classification, atomic structure and interatomic bonding, crystal structure of metals, imperfections in solids, diffusion, mechanical properties of engineering materials, strengthening mechanisms, basic concepts of fracture and fatigue, phase diagrams, ceramics, polymers, and composites.

ME 138. Transport Phenomena in Living Systems (4)
Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): MATH 046, PHYS 040B. An introduction to the application of the basic conservation laws of mechanics (mass, linear momentum, and energy) to the modeling of complex biological systems. Emphasizes how these concepts can explain and predict life processes.

ME 153. Finite Element Methods (4)
Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): ME 118. Covers weak form formulation, the Galerkin method and its computational implementation, mesh generation, data visualization, as well as programming finite element codes for practical engineering applications.

ME 170A. Experimental Techniques (4)
Lecture, 3 hours; laboratory, 3 hours. Prerequisite(s): EE 001A, EE 01LA, ME 118. Covers the principles and practice of measurement and control, and the design implementation of experiments. Topics include dimensional analysis, error analysis, signal-to-noise problems, filtering, data acquisition and data reduction, and statistical analysis. Includes experiments on the use of electronic devices and sensors, and practice in technical report writing.

ME 180. Optics and Lasers in Engineering (4)
Lecture, 3 hours; laboratory, 3 hours. Prerequisite(s): senior standing; ME 010, ME 110, ME 170A. Focuses on the principles of optics and lasers, optical measurement techniques, and laser material interactions. Involves applications of optical methods using coherent and incoherent lights in mechanical engineering deformation and stress analysis; optical data acquisition and image analysis; and applications of lasers in material processing and characterization.

ME 270. Introduction to Microelectromechanical Systems (4)
Lecture, 4 hours. Prerequisite(s): ME 110, ME 114, or equivalents. An introduction to the design and fabrication of microelectromechanical systems (MEMS). Topics include bulk and surface

micromachining processes; material properties; mechanisms of transduction; applications in mechanical, thermal, optical, radiation, and biological sensors and actuators; fabrication of microfluidic devices; Bio-MEMS and applications; packaging and reliability concepts; and metrology techniques for MEMS. Also discusses directions for future research.

ME 272. Nanoscale Science and Engineering (4)
Lecture, 3 hours; laboratory, 3 hours. Prerequisite(s): ME 01H or consent of instructor. An overview of the machinery and science of the nanometer scale. Topics include patterning of materials via scanning probe lithography; electron beam lithography; nanoimprinting; self-assembly; mechanical, electrical, magnetic, and chemical properties of nanoparticles, nanotubes, nanowires, and biomolecules (DNA, protein); self-assembled monolayers; and nanocomposites and synthetic macromolecules.

5. Survey for Graduating Seniors in Bioengineering 2009

ABET (Accreditation Board for Engineering and Technology) has developed various criteria for accrediting engineering programs. Our Bioengineering Program will be applying for ABET accreditation in the next year or so. As part of this process there are several self study evaluations that are required to assist us in obtaining feedback from our students so that we can continue to strive to improve our program to meet the mission of our Department:

> *Bioengineering at UCR is an interdisciplinary effort that couples expertise in the biosciences and engineering in order to make biologically-based, health and medical-related technological advances for positive societal impact.*
>
> *The mission of the new Department of Bioengineering at the University of California, Riverside focuses on two interrelated themes:*
>
> *1. Advancing Bioengineering research, particularly in BioCellular Engineering, and,*
> *2. Preparing future leadership in Bioengineering and related fields.*
>
> *Our unique interdisciplinary program combines building a solid fundamental foundation in biological science and engineering, developing diverse communication skills and providing training in the most advanced quantitative bioengineering research. The result is a rigorous, but exceptionally interactive and welcoming educational training for Bioengineering students leading towards B.S., M.S. and Ph.D. degrees.*

ABET requires engineering programs to demonstrate that their students attain certain abilities that are listed below in bold type.

Please complete this survey and return it to Denise Sanders.
Your input is very important to us.

Thank you,
Professor Jerome Schultz

Using the following scoring system please enter your evaluation of how the program prepared you for each of the educational goals
1=Not Prepared
2=Somewhat Prepared
3=Prepared
4=Well Prepared

5=Very Well Prepared

15 Students Responding of 17 Seniors Score 5=Best

1. An ability to apply knowledge of mathematics, science, and engineering. 4.1

Comment your understanding of biology and, and the capability to apply advanced mathematics (including differential equations and statistics), science, and engineering to solve the problems at the interface of engineering and biology.

This major is so multi- disciplinary I feel as if I have a basic knowledge of not only of all science fields but all engineering fields I have very solid understanding of the basic physical science and their applications to engineering concepts.

Limited understanding was achieved for use in electrical systems

I think that through our upper division BIEN courses, as well as technical electives. I gained a well-balanced knowledge of biology & engineering. Term projects & undergraduate research opportunity prepared me to solve problems reflecting both biological & engineering challenges. But, because bioengineering is multi-disciplinary, I feel hat the advanced degree is necessary to understand both disciplines well enough. The knowledge gained as an undergrad, seems wide, but shallow…

Biology understanding is very high, math high, science high but certain engineering principles are not well understood. I took most of my engineering at Cal Poly, but what I took here, I felt was not as well presented.

The science and mathematics courses helped me master both disciplines.

I feel well prepared, but I am not sure if my level of preparedness would be adequate for going into industry

2. An ability to design and conduct experiments, as well as analyze and interpret data. 4.3

Comment your ability to make measurements on and interpret data from living systems, addressing the problems associated with the interaction between living and non-living materials and systems.

I do not feel that well prepared in this area.

Knowledge span includes but not limited to the various potentials in biological systems, transport through biological systems.

Insight was well developed Lab courses, especially BIEN 130L, provided me opportunities to work on living systems. I think that I learned enough basic knowledge on taking measurements & analyzing the data. I think that if BIEN 130L was a two-quarter course, then my ability would have greatly increased. Overall I gained more theoretical understanding than the practical knowledge.

I think this area was well practiced in the lab work that was done.

Our Senior Design projects (in addition to the projects assigned in over upper-division courses) gave us plenty of experience in interpreting data.

Biotechnology & various Biology technical electives forced me to look outside of conventional memorization in order to interpret data.

3. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability. 3.6

List the courses or other components of the program (such as faculty mentoring, undergraduate research, field trips and seminars) that were most beneficial for you in achieving this objective

Courses	**Times Mentioned**
BIEN 120	**2**
BIEN 130L	**3**
BIEN 155	**2**
BIEN 175A&B	**7**

Senior design gave a hands on experience of all the parameters that fuel into project (initiation?), sustainability and completion.

The courses in BIEN, such as BIEN 115 & BIEN lab are really build a hands on experiments Also, the undergraduate research in campus is helpful for me, which able me to handle a research project by myself.

This was lacking. However UG research was helpful.

BIEN 120 - Designed a feedback system in the term project BIEN 175A/175B - Designed a bioengineering product by applying the math, chem, & biological knowledge

Undergraduate research - Designed a device to be used in achieving the objective Senior Design, Undergraduate Research with Dr. Rodgers

All the projects we were assigned taught us to work within several constraints

Biotechnology was a course, as well is bioinstrumentation contributed to this

4. An ability to function on multi-disciplinary teams 4.5

List the courses, the components of courses or other components of the program that were most beneficial for you in achieving this objective

Courses	Times Mentioned
BIEN 110	1
BIEN 120	2
BIEN 140A	2
BIEN 155	1
BIEN 175A&B	5

Biomaterials Biosystems & Signals Biotech Lab. All courses with group projects.

The major is designed as such & gives a little more room for venturing at other disciplines.

Senior design which make me understand how to handle a team work, but never work with some other major or field people together.

Performing undergraduate Research

Biochemistry T.E.'s insured this.

BIEN 175A/175B - Senior Design project can be very demanding, and in such a case, it became crucial for each member to be an efficent team player to achieve a common goal.

All courses except 159 & Biophysics. All the others were very instrumental in facilitating a teamwork environment.

Biology, Bioinstrumentation, Biomaterials, Physics

BCH 101: We were able to work alongside students from biochemistry background BIEN 175A/B: Able to share ideas with others who may have different interests in Research

5. An ability to identify, formulate, and solve engineering problems 3.9

List the courses, the components of courses or other components of the program that were most beneficial for you in achieving this objective

Courses	Times Mentioned
BIEN 110	3
BIEN 120	6
BIEN 130	2
BIEN 130L	1
BIEN 135	2
BIEN 140A	1
BIEN 159	3
BIEN 155	1
BIEN 175 A&B	3

Term Project: conducting the project from start to finish with the guidance of the professor definetly increased my ability to see necessary steps to solve engineering problems more clearly.

More of a general intuition gained over all courses.

BIEN 155 - It taught me to set up an engineering problem & answer it with the provided resources.

All

6. An understanding of professional and ethical responsibility 4.2

Comment on your gained views in professional ethics in biological, biomedical and engineering research and development. List the courses, the components of courses or other components of the program that were most beneficial for you in achieving this objective

Courses	Times Mentioned
BIEN 110	1
BIEN 120	1
BIEN 125	1
BIEN 175A/B	7
Psych 178	1
EH & S	1

Engineer is not only a work for design some high-tech staff, but also need to consider the benefit of the design

Senior design lectures gave the best understanding & english breadth

Professor was informative and always gave us constructive criticism/advice on how to present oneself professionally and be responsible professionally.

Each group covered a specific topic related to the ethnical issue and presented the idea. Gave us the opportunity to think about the biomedical issues from different angles.

I think very strongly that a Bioethics course should be taught and well understood for future students. This major has a high responsibility to the well-being of society.

I feel that I have a good understanding of them.

BIEN 175 - Our discussion of ethics proved that most people had the same ideas of ethics.

All

7. An ability to communicate effectively 4.6

Comment on yours skills in presenting your ideas and points of view in different settings, such as oral (podium) presentation, poster presentation and discussion settings.
List the courses, the components of courses or other components of the program that were most beneficial for you in achieving this objective

Courses	Times Mentioned
BIEN 110	**2**
BIEN 120	**2**
BIEN 130	**1**
BIEN 140A	**2**
BIEN 159	**1**
BIEN 155	**1**
BIEN 175 A&B	**2**

All BIEN courses I feel very prepared to give oral presentations in future

All courses in BIEN department were very good in promoting oral presentation skills. BIEN 140A was good. Participating in presentations helped me on my presentation skills. This happened mostly in BIEN 175A/175B All courses except Biophysics helped in this area. Undergrad research also helped in this area.

Because class size was small, there were many opportunities to present ides and communicate with the rest of the classmates. I think my presentation skills and confidence improved a lot compared to before I started coming to UCR.

Every class utilized this. Great!

All BIEN courses gave the student the opportunity to communicate on such terms All courses

All courses with presentations.

All Bioengineering courses that required presentations.

8. Awareness of the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context 4.2

List the courses, the components of courses or other components of the program that were most beneficial for you in achieving this objective

Courses	**Times Mentioned**
BIEN 125	**2**
BIEN 130	**1**
BIEN 130L	**1**
BIEN 140A	**1**
BIEN 159	**1**
BIEN 155	**2**
BIEN 175 A&B	**7**
ENGR 118	**1**
Math	

Math courses need to be allowed at T.E.'s

We learned a lot of engineered protein products that we use & societal/economical impact of those products. Prof. showed us lots of examples. Actually working with familiar braininstruments my awareness of the links between education/academic & the real world (industry). Various types of lectures from professionals in the industry were very helpful. We also learned how the field bioengineering play a role in the society. Various topics (ethnics, patent, etc.) related to the bioengineering were covered. Nothing really prepared me for this specifically, maybe just an overall awareness as a result from all my classes.

The guest speakers that talked about the various aspects of their jobs really brought this into perspective.

9. A recognition of the need for, and an ability to engage in life-long learning 4.7

Comment on your ability to efficiently follow the developments in science and engineering and educate yourself in any new field, in which you might need to venture. List the courses, the components of courses or other components of the program that were most beneficial for you in achieving this objective

Courses **Times Mentioned**

BIEN 110	**2**
BIEN 120	**2**
BIEN 130	**1**
BIEN 140A	**1**
BIEN 159	**1**
BIEN 175 A&B	**2**

Immunology Physiology
All
All courses

All the courses and projects lead me learn how to search the information, how to organize it, and how to learn the new topics by myself

Summer internships

BIEN 110, 120, 175A/B Projects were definitely difficult, yet increased my ability to be resourceful and result-orientated in achieving goal. Increase the ability to educate myself. There were many obsticles we have to overcome. I've learned how to approach problems & seek necessary solutions.

BIEN 140 taught us how to read science articles which I thought was very useful!

Biomaterials - every week we dis- cussed & presented articles that kept us up to date on new developments in Bioengineering. Our engineering projects also kept us up to date

Most of the BIEN courses have included scientific literature in their focus. I feel that constant exposure has been valuable to my education. I can follow most if not all developments because I have gained a broad understanding of science and engineering concepts.

10. A knowledge of contemporary issues 3.7

Comment on the gained knowledge in cutting-edge modern science and engineering. List the courses, the components of courses or other components of the program that were most beneficial for you in achieving this objective

Courses	Times Mentioned
BIEN 110	**1**
BIEN 125	**3**
BIEN 140A	**4**
BIEN 155	**3**
BIEN 175 A&B	**5**

BIEN 155 This course gave a very sound introduction to current biotechnology techniques.

BIEN 125 could only scratch the surface. The rest of the courses did.

BIEN 155 Actually engineering the protein from the start to finish was very helpful in understanding the current market/industry because not only were we exposed to the entire process but also the actual dollar amount was calculated according to the amount of the engineered protein we produced. It was very interesting. Most courses involving a presentation pushed us to look into current and future work.

Our discussions in BIEN 175 kept us up-to-date on contemporary issues.

I feel I have been given the tools to further my knowledge of modern science and have been somewhat exposed to it.

11. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice 4.4

Comment on the different sets of techniques that you were trained in, the level of mastering the techniques (i.e., knowledge about the technique, hands-on experience, strong proficiency in the technique), and the problems at the interface of biology and engineering that it can be applied to.

Courses	**Times Mentioned**
BIEN 120	**1**
BIEN 130	**1**
BIEN 130L	**2**
BIEN 135	**2**
BIEN 155	**6**
BIEN 175 A&B	**2**

I think that BIEN 130L & BIEN 120,155 were the closest to learning real-life techniques. I think this is an area for improvements, though. As I wouldn't feel adequately prepared to go into industry

Our lab classes provided plenty of hands-on experience that allowed us to master several procedures. The projects also made us very with engineering software.

Wet lab techniques are very high because of Senior Design and BIEN 151. I would have liked more varied and consistant training.

Computer Skills: Matlab-intermediate, Comsol, Labview-beginner, Molecular simulation (e.g. Rastop)-intermediate Breadboard, electronic components. Wetlab skills engineering proteins-cloning & expression, general/organic chemistry physics lab. I learned combinationsof many lab techniques. Those practical skills enhances my ability to apply what I learned in classroom to the real life issues.

The ME courses were of most use (and Biothermodynamics).

Performing undergrad research

Protein Purification Circuits Bioinstrumentation

Please provide some specific suggestions on how the program and curriculum could be improved.

~We must have more broader tracks. ~More specialization in tissue engineering.

~More lab courses ~ More opportunities for technical electives ~Ethinic course

~Have more Bioengineering introduction courses for first and second years ~Remove useless CHASS classes like upper division Ethnic Studies.

~Is it possible that senior design can be group as cross major, which can make students knowing how to work with people in different field, also can make the topic more interesting.

~Perhaps difficult at this point, I think it is crucially important to divide the Bioengineering curriculum into more concentrated tracks' similar to what has been adopted by institutions such as UCSD (e.g. imaging, biomechanics, biotechnology, bioformatics, etc.)

~ I definitely think that upper division courses should require more lower division prerequisites. I think it will dramatically increase the efficiency of the classroom.

~ The biotechnology lab course needs a textbook. It's difficult to understand the science behind the procedures without a textbook.

~ It would be incredibly helpful for the faculty & department to familiarize them- selves with the bioengineering prerequisite courses. In almost every BIEN class, the faculty have been surprised to find that students have not had certain material (such as laplace transforms in different class & physical chemistry, for example) The students then get a hurried introduction to material from the basic math & science & less time is available to actually learn engineering. A senior review & modification of the course curriculum & syllabus is necessary (I think).

~ I think that a course in circuits/electrical engineering would be of great benefit because when we take Bioinstrumentation class and lab section, we struggle with this material. Perhaps a good introductory course to MATLAB and COMSOL as well

6. Individual Course Assessments By Students And Faculty

Faculty Assessment   Course Number: BIEN 10

Term offered: Fall 2008

Instructor: Rodgers

1. Any changes made in course since last taught in 2007-2008 Academic Year
   - Emphasized assessment of self, building foundation and creative expression.
   - Included introduction to Matlab.
   - Used student-evaluated procedure for reviewing group presentations.

2. Course Assessment for 2008-2009 AY
   - Course helped develop basic practical writing and oral communication.
   - Course provided sufficient exposure to mathematical tools.
   - Course needs better grounding in bioengineering as a major.

3. Recommendations for 2009-2010 AY
   - Add *Introduction to Biomedical Engineering* text by M. Saltzman.
   - Include more traditional 'homework' from the additional text.
   - Combine concepts of *Studying Engineering, 3rd Edition* byRaymond B. Landis with specific bioengineering examples.

BIEN 010 Student Course Assessment

Fall 2008

41 students responded   5=best

1. I am better prepared for studying the engineering curriculum.	4.0
2. I have developed an introductory ability to utilize basic practical and mathematical tools, an ability to logically think through bioengineering problems from conception to design, and be familiar with the relative significance of my results.	4.1
3. I have had opportunities to further my professional development through practicing written and oral communication skills, working on group assignments, and using modern computer tools.	4.1
4. I have demonstrated confidence in assessing and developing basic mathematical/computational models of bioengineering problems.	3.9
5. I have demonstrated professional accountability for my modeling and design analysis and recommendations.	3.7

Faculty Assessment   Course Number: BIEN 105
Term offered: Fall 2008
Instructor: Rodgers

1. Any changes made in course since last taught in 2007-2008 Academic Year
- BIEN 105 is a new course in response to dividing the content of the original BIEN 110 into two parts. Biofluid mechanics and Biosolid mechanics.
- This course focused on biofluid mechanics.
2. Course Assessment for 2008-2009 AY
- Significant emphasis on fluid mechanic conservation principles related to biotransport problems.
- Significant emphasis on mathematical modeling, presentation of results and engineering assessment.
3. Recommendations for 2009-2010 AY
- Continue with general framework of this course.

BIEN 105 Student Course Assessment
Fall 2008

23 students responded   5=best

1. I understand the basic governing momentum conservation equations and associated basic constitutive equations for describing biomechanical processes.	4.2
2. I am able to apply these governing equations to real biological systems and describe these systems mathematically, develop strategies to analyze the biomechanical problem, recognize particular behavior of real processes, and recognize limitations in approximating the process.	4.0
3. I have developed an ability to utilize practical and mathematical tools, an ability to logically think through biomechanical problems from conception to design, and be familiar with the relative significance of your results.	4.1
4. I have had opportunities to further your professional development through practicing written and oral communication skills, working on group assignments, and using modern computer tools.	4.8
5. I have demonstrated confidence in assessing and developing basic mathematical/computational models of biomechanical problems.	4.1
6. I have demonstrated professional accountability for your dynamic modeling and control strategy recommendations.	4.4

Faculty Assessment   Course Number: BIEN 110

Term offered: Winter 2009
Instructor: Anvari

1. Any changes made in course since last taught in 2007-2008 Academic Year:

A different textbook "Introductory Biomechanics from Cells to Organisms" by C. R. Ethier and C. A. Simmons was used in place of the previous textbook "An Introduction to Biomechanics" by J. Humphry.

2. Course Assessment for 2008-2009 AY
Emphasis on modeling of cell and membrane mechanics using mechanical analogs.

3. Recommendations for 2009-2010 AY

Increase the number of units from 2 to 3, based on the amount of work and the feedback received from students.

Search for an alternate textbook that maintains a balance of theory with relevant experimental examples and results.

BIEN 110 Student Course Assessment

Winter 2009

Students responding 28 5 = best

1. I understand the concepts of normal and shear stress, and strain tensors.	4.3
2. I can use the generalized stress and strain tensor equations for Hookean elastic solids, reduce them to the appropriate formats for various cases, and calculate relevant mechanical parameters.	4.0
3. I understand stress-strain diagrams, and can estimate relevant mechanical parameters from these diagrams.	4.4
4. I understand the concepts of linearity, isotropicity, elasticity, and recognize the deviations of the mechanical behavior of biological materials from these properties	4.4
5. I understand the concept of viscoelasticity.	4.5
6. I can formulate force (stress) - displacement (strain) relationship using various mechanical models that include dashpot and spring components.	4.1
7. I understand the concept of complex modulus and how it can be used to gain insight into the viscoelastic nature of biological materials.	4.1
8. I understand how mechanical properties of biological cell membranes can be experimentally	4.3

measured.

9. I can perform literature search to obtain key relevant information related to a biomechanical phenomenon. 4.5

10. I can write a technical report conveying biomechanical information to a reader in an effective manner. 4.4

Faculty Assessment   Course Number: BIEN 120
Term offered: Winter 2009
Instructor: Rodgers

1. Any changes made in course since last taught in 2007-2008 Academic Year
   - Shifted to using predominantly notes for the course for lack of a specific textbook for the subject
2. Course Assessment for 2008-2009 AY
   - Significant emphasis on application of control theory to biological systems
   - Significant emphasis on mathematically model time-dependent real processes, recognize particular behavior of real processes, analyze a real or modeled process behavior for identification, and design a control schemes to model these bioprocesses
3. Recommendations for 2009-2010 AY
   - Return to textbook coupled with class notes format.
   - Process Control: Modeling, Design and Simulation by B. Wayne Bequett, Prentice Hall. This book uses biomedical engineering examples.

Faculty Assessment   Course Number: BIEN 125
Term offered: Winter 2009
Instructor: Liao

1. Any changes made in course since last taught in 2007-2008 Academic Year
   - Emphasized the calculations of fermentation process
   - Emphasized more on modern molecular engineering techniques
   - Expand the spectrum of biotechnology impact in modern industry
   - Improved integration to accompanying Biotechnology lab course (BIEN155) with more theory explanations
2. Course Assessment for 2008-2009 AY
   - Found the explanations of modern molecular engineering techniques and products led to more enthusiasm and participation
   - The quiz in the discussion session following lecture led to more interests from students and smooth transition to midterm and final
3. Recommendations for 2009-2010 AY

- Increase the contents of modern pharmaceutics and diagnosis resulted from molecular engineering and biotechnology
- To maintain and improve the course quality, large incoming student population will require more TAs

Faculty Assessment   Course Number: BIEN 130
Term offered: Spring 2009
Instructor: Park

1. Any changes made in course since last taught in 2007-2008 Academic Year
   - Change of instructor from Dimoka to Park
   - Eliminated required textbook (Webster) in favor of more highly detailed notes and lectures in order to better accommodate discussion of modern techniques
   - Removed LabView from syllabus
   - Added noise analysis and increased emphasis on Fourier transforms and their applications to bioinstrumentation
   - Improved integration with accompanying lab course (BIEN130L) taught by Anvari
2. Course Assessment for 2008-2009 AY
   - Found that graded Socratic questioning led to a high degree of participation and student interaction
   - Constant improvement was seen through repetition of concepts from homework to weekly quizzes to exams (midterm and final), despite increased difficulty
3. Recommendations for 2009-2010 AY
   - Larger incoming class might necessitate involvement of TA's to maintain an equivalent or better degree of class participation and communicated enthusiasm for material
   - Even tighter integration with lab course as both the lecture and lab will be taught by same instructor (Park)
   -

BIEN 130 Student Course Assessment

Spring 2009

14 students responded 5=best	
1. Be able to select and configure an appropriate device to observe or affect a biopotential from a living system.	4.6
2. Understand the operating principles of basic circuits as well as those involving operational amplifiers in the processing of physiologic signals.	4.4
3. Gain familiarity with Fourier analysis of physiological signals.	4.5
4. Be able to systematically analyze the operating principles of bioinstruments	4.2

5. Be able to schematically design bioinstrumentation.	4.6
6. Gain familiarity with ethical and safety considerations in the design and use of bioinstrumentation.	4.6
7. Gain familiarity with modern biomedical devices.	4.6

Faculty Assessment Course Number: BIEN 130L
Term offered: Spring 2009
Instructor: Anvari

1. Any changes made in course since last taught in 2007-2008 Academic Year:

LabView demo was dropped. Mechanical testing using non-biological samples (PDMS) was replaced with biological samples (chicken bone and skin).

2. Course Assessment for 2008-2009 AY
Emphasis on developing skills to carry out the experiments in an independent manner and gain ability to trouble shoot.

3. Recommendations for 2009-2010 AY

BIEN 130L Student Course Assessment

Spring 2009

Eight students responded 5=Best

1. I understand the physical principles that underlie the operation of a strain gauge.	4.9
2. I can build a circuit to filter appropriate frequencies.	5.0
3. I can record and amplify a biological signal.	4.5
4. I understand the concept of Fourier analysis and can characterize the frequency response of a circuit element, as well as a bioelectric signal.	4.3
5. I can assess my measurements against relevant theories.	4.5
5. I can use commercially available instruments to make biomechanical and physiological measurements.	4.8
6. I can extract relevant parameters from my data obtained from a biological system.	4.5
7. I feel confident to write an engineering report and meet appropriate deadlines.	4.8

Faculty Assessment   Course Number: BIEN 135
Term offered Fall
Instructor   Morikis

1. Any changes made in course since last taught in 2007-2008 Academic Year
- Increased time spent on material on molecular and statistical thermodynamics. These were areas where students showed weaknesses.
- Reduced material on spectroscopy.
2. Course Assessment for 2008-2009 AY
- Homework problems were a significant medium for the comprehension of sometimes abstract concepts.
- Discussion sessions were taught by the professor and were highly interactive.
- Introduction of clickers with assessment of each question during discussion contributed to class interactions.
3. Recommendations for 2009-2010 AY
- Change the textbook from van Holde, Johnson and Ho to Jackson.
- Since the incoming class is bigger, introduce weekly quizzes for better student assessment.
- Add a second in-class midterm exam.
- Request a Teaching Assistant.

Faculty Assessment   Course Number_BIEN 140A
Term offered__Spring 2009
Instructor_Vullev

The principal change in BIEN 140A was an addition of topics in statistics related to materials analysis.

Addition of statistics topics to the course

Due to the requirement for the students not only to comprehend statistics but also to efficiently apply it to a broad variety of problems, I introduced it in BIEN 140A in a form of homework.

The pre-requirements for homework 2 ware based on the assumption that the students have taken a course in statistics. They needed to examine data related to mechanical properties of biologically relevant materials and determine the identities of unknown samples with a certain confidence level. The problems required: (1) understanding of the limitations of examining small sample sizes; (2) employing Student t-tests; and (3) using ANOVA for discerning different samples.

After the homeworks were turned in, I briefly reviewed the material during a lecture hour.

From the homework results and from the feedback from the students, it was clear that it was quite a steep learning curve for them to deal with the assigned problems. Nevertheless, most of them did satisfactory well and demonstrated appreciation for correct and reliable data analysis.

Recommendation for the next year

The introduction of the practical aspects of statistics in biomaterials should be gradual and through the whole quarter, not only for a few week homework assignment.
It should not be assumed that all students are up to speed for designing and conducting statistical analyses form their previous course work.
Topics in statistics in biomaterials should be introduced as independent reading assignments and in a form of discussion of research papers that heavily use statistical analyses.

BIEN 140A Student Course Assessment

Spring 2009

Students responding 29 5 = best

1. Given a specific biomaterial, you are able to develop strategies for characterization of its bulk and surface properties.	4.1
2. Given a specific biological or medical application you are able to select the most appropriate material (s) for it.	4.2
3. Given a specific biological or medical application you are able to develop a strategy (surface derivatization, passivation) for producing biocompatible material interfaces.	4.0
4. Given a biomaterial design problem, you are able to outline all parameters needed to optimize the design.	3.8
5. Given a specific materials design project, to survey the literature and the available data bases for gathering the key information for their materials design projects.	4.4
6. Given a specific material and potential medical application, you are able to design a strategy for in vivo examination of the biocompatibility of the material.	4.1
7.Given a specific materials project, you have the skills to educate . yourself by finding the necessary information in the published literature	4.4
8. You have developed a critical approach when evaluating publication and data regarding biomaterials science and engineering.	4.2

Faculty Assessment   Course Number: BIEN 155
Term offered: Fall 2008
Instructor: Liao
Faculty Assessment

1. Any changes made in course since last taught in 2007-2008 Academic Year
    - To reduce the overtime of labs and still maintain the understanding the procedure of biotechnology production, the preparation work have been increased by TA and followed by more explanations
    - The final presentation include the value calculation of product the made more close to industrial reality
2. Course Assessment for 2008-2009 AY
    - High quality of equipments in the lab is appreciated by students
    - Modern molecular engineering techniques attract a lot of interests
    - Competition among different groups increase their efforts
    - Challenges of obtaining large quantity of interferon proteins overwhelmed the student capabilities
    - The whole procedure of interferon production seems overloaded within the course hours (four hours per week). It often required second volunteer session
3. Recommendations for 2009-2010 AY
    - Change the lab expression product from interferon to fluorescent proteins
    - Change the biological activity measurements from cell reporter gene assay to fluorescence energy transfer assay
    - To maintain and improve the course quality, large incoming student population will require more TAs
    - Because large body of student population, two sessions/group will be reduced to one session/group.
    - Because large body of student population, one more session will be added for second group

Faculty Assessment Course Number_BIEN 175 A&B
Term offered__Winter and Spring
Instructor_Schultz

Assessment

1. Any changes made in course since last taught in 2007-2008 Academic Year

a. Started planning of student design projects in Fall Quarter so that the student teams could be formed and faculty advisors assigned before the course officially started in the Spring Quarter.
b. Requested faculty design project ideas in the Fall Quarter to give the students a head start in pursuing their projects.
c. Included new topics and guest lecturers for: Intellectual Property, Quality Assurance, Industrial Innovation, Product Development, Regulatory Affairs.

2. Course Assessment for 2008-2009 AY

a. Many of the projects turned out to be more of a research nature than design.

b. Athough procedures for several of the projects were adapted from published research papers, it was found that the materials and methods in these papers were not detailed enough for the students to be able to reproduce the protocols.

c. In general scope of the projects as initially planned was too extensive to be completed in the 20 week period for this course. This resulted in redefining the project after the first quarter so that the modified goals could be achieved by the end of the course. Most teams successfully completed the modified project goals.

d. Costs for materials for some of the projects exceeded expected levels

3. Recommendations for 2009-2010 AY

a. In developing the definition and goals of the design project be sure that the methods are well established so that the students are not side-tracked into research efforts.

b. Carefully evaluate costs for the proposed projects

c. Contact guest speakers in the Fall Quarter so that their presentations can be properly timed in the Winter Quarter.

d. Plan visits to industrial sites in the Fall Quarter so that students get a first hand appreciation of industrial practices for design

BIEN 175 A & B Student Course Assessment

15 students responded 5=best	
1. Identify new products or processes.	4.4
2. Generate and evaluate several design concepts.	4.2
3. Generate design specifications.	4.2
4. Utilize engineering principles to create and prototype.	4.4
5. Utilize software (e.g. Comsol, Matlab) in developing the design.	3.4
6. Create the finalized design.	4.3
7. Build and test a prototype.	4.3
8. Provide full documentation of the design.	4.6
9. Marketing, commercialization, patents.	3.9
10. Regulations - FDA, IRB, other.	4.1

11. Maintain a time-line for the project.	4.7
12. Create a Web site for the project.	4.7
13. Present project reports using Microsoft Powerpoint.	4.9
14. Prepare periodic reports on design progress and changes.	4.9
15. Participate in a team project.	4.9
16. Ability to design and conduct experiments, analyze and interpret data.	4.7

General Comments to improve the course:

Good course. Very fun. Would have liked to have other options in the bioengineering fields, such as biomechanics and medical devices, otherwise very good class.