Instructions for Completing Your Bioengineering Study Plan

- All students are expected to complete a minimum of 44 in 200-level courses. A grade point average of 3.0 overall and for all courses listed on the “M.S. Advancement to Candidacy” form is required for graduation.

- Please note that Lower Division courses (i.e. two digit courses 1-99) do not fulfill any requirement for the M.S. degree. If you plan to take lower division undergraduate courses that do not satisfy your M.S. course requirement, please choose the “Satisfactory/Unsatisfactory” grading option, which will not affect your overall grade point average. Note, no more than two courses (eight units) of Upper Division undergraduate courses (100-level) can apply towards the M.S. course requirements.

- Students are encouraged to meet with their Field Advisor soon after matriculating at UCLA to outline a satisfactory course of study. Once the study plan has been approved by the Field Advisor and submitted to the Department, any changes to it will require approval by the Field Advisor and submitting a new form to the Department. There is no limit on the number of times a Study Plan can be approved and submitted.

- During your last quarter of enrollment in the Bioengineering Graduate Program, students are required to file an “Advancement to Candidacy” petition during the first two weeks of the last quarter in residence. In addition, students of the Master Thesis Plan need to nominate a formal Master Thesis Committee using the “Master Thesis Committee Nomination” form.

- Submit the form on the following page to your Field Adviser within the first two weeks of the first quarter of enrollment. Please note that courses taken must be approved or pre-approved in order to count towards your degree requirement. Please turn in the form early to avoid any problems that could delay or prevent your graduation. Students are encouraged to re-evaluate their Study Plan at the beginning of each quarter.

- M.S. Comprehensive Examination Plan: Within the 44 unit minimum, three two-unit courses of “BE 299. Seminar: Bioengineering Topics” and one two-unit course of “BE 495. Teaching Assistant Training Seminar” are required.

- M.S. Thesis Plan: Within the 44 unit minimum, three two-unit courses of “BE 299. Seminar: Bioengineering Topics” and one two-unit course of “BE 495. Teaching Assistant Training Seminar” are required. In addition, two four-unit courses of “598. Research for and Preparation of M.S. Thesis” are also required during the final two-quarters of enrollment.

- Ph.D. Thesis Plan: Subsequent to fulfilling the course requirements, students must enroll in 12-units per quarter of “597C. Preparation for Ph.D. Oral Qualifying Examination” (before passing the Advancement to Candidacy Exam) or “599. Research for and Preparation of Ph.D. Dissertation” (after passing the Advancement to Candidacy Exam). If a thesis advisor has not been chosen, then the student should discuss enrolling under the Field Advisor.

- Further information about the courses listed on the Study Plan can be found at: http://www.registrar.ucla.edu/schedule/catsel.aspx
BIOENGINEERING BSIP STUDY PLAN FOR GRADUATE STUDENTS MATRICULATING IN FALL 2015

Student Name:          Date:

Field:  Imaging, Informatics And Systems Engineering (IIS) Field
Sub-Field:  Biomedical Signals and Image Processing (BISP) Sub-Field

GROUP I: CORE COURSES – Required.

<table>
<thead>
<tr>
<th>Course # (Units) and Quarter Offered</th>
<th>Quarter &amp; Year Enrolled</th>
<th>Course # (Units) and Quarter Offered</th>
<th>Quarter &amp; Year Enrolled</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE CM202† (4)</td>
<td>FALL</td>
<td>BE CM203† (4)</td>
<td>WINTER</td>
</tr>
<tr>
<td>BE C201 –or– BE CM286B (4)</td>
<td>FALL</td>
<td>BE 495 (2)</td>
<td></td>
</tr>
</tbody>
</table>

†BE PhySci166 (Fall) and MCDB144 (Spring) are an acceptable substitute for BE CM202 and CM203.

GROUP II: SUB-FIELD SPECIFIC COURSES – Minimum of three are required from this group.

<table>
<thead>
<tr>
<th>Course # (Units) and Quarter Offered</th>
<th>Quarter &amp; Year Enrolled</th>
<th>Course # (Units) and Quarter Offered</th>
<th>Quarter &amp; Year Enrolled</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBM 209 (4)</td>
<td>FALL</td>
<td>BE M219 (4)</td>
<td>WINTER</td>
</tr>
<tr>
<td>BE M217 (4)</td>
<td>FALL</td>
<td>BE 224A (4)</td>
<td>WINTER</td>
</tr>
<tr>
<td>BE M248 (4)</td>
<td>FALL</td>
<td>BE 226 (4)</td>
<td>SPRING</td>
</tr>
</tbody>
</table>

GROUP III: SUB-FIELD ELECTIVE COURSES – Students are required to fulfill the remainder of their 200-level course unit requirement by enrolling in sub-field elective courses or other courses approved by the Field Adviser. Suggested BE courses are immediately below; a list of non-BE courses is found on the attached pages.

<table>
<thead>
<tr>
<th>Course # (Units) and Quarter Offered</th>
<th>Quarter &amp; Year Enrolled</th>
<th>Course # (Units) and Quarter Offered</th>
<th>Quarter &amp; Year Enrolled</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE 223A (4)</td>
<td>FALL</td>
<td>BE 223B (4)</td>
<td>WINTER</td>
</tr>
<tr>
<td>BE 220 (4)</td>
<td>FALL</td>
<td>BE 233A (4)</td>
<td>WINTER</td>
</tr>
<tr>
<td>BE 221 (4)</td>
<td>FALL</td>
<td>BE M228 (4)</td>
<td>WINTER</td>
</tr>
<tr>
<td>BE 227 (4)</td>
<td>FALL</td>
<td>_____ (4)</td>
<td>†WINTER</td>
</tr>
<tr>
<td>_____ (4)</td>
<td>†FALL</td>
<td>_____ (4)</td>
<td>†SPRING</td>
</tr>
</tbody>
</table>

†Other courses to consider outside of BE are listed under the Group III courses (below).

ETHICS COURSE – Only one ethics course is required.

<table>
<thead>
<tr>
<th>Course # (Units) and Quarter Offered</th>
<th>Quarter &amp; Year Enrolled</th>
<th>Course # (Units) and Quarter Offered</th>
<th>Quarter &amp; Year Enrolled</th>
</tr>
</thead>
<tbody>
<tr>
<td>BioMath M261 (2)</td>
<td>FALL</td>
<td>BE 165EW (4)</td>
<td>WINTER</td>
</tr>
<tr>
<td>MIMG C234 (2) –or– NS 207 (2)</td>
<td>SPRING</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

BIOENGINEERING SEMINAR – Enrollment is required for three quarters.

<table>
<thead>
<tr>
<th>Course # (Units) and Quarter Offered</th>
<th>Quarter &amp; Year Enrolled</th>
<th>Course # (Units) and Quarter Offered</th>
<th>Quarter &amp; Year Enrolled</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE 299 (2)</td>
<td>FALL</td>
<td>BE 299 (2)</td>
<td>WINTER</td>
</tr>
<tr>
<td>BE 299 (2)</td>
<td>FALL</td>
<td>BE 299 (2)</td>
<td>WINTER</td>
</tr>
<tr>
<td>BE 299 (2)</td>
<td>WINTER</td>
<td>BE 299 (2)</td>
<td>SPRING</td>
</tr>
</tbody>
</table>

BIOENGINEERING RESEARCH – Required during the final two quarters for Master Thesis Plan students.

<table>
<thead>
<tr>
<th>Course # (Units) and Quarter Offered</th>
<th>Quarter &amp; Year Enrolled</th>
<th>Advisor</th>
<th>Course # (Units) and Quarter Offered</th>
<th>Quarter &amp; Year Enrolled</th>
<th>Advisor</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE 598 (4)</td>
<td>WINTER</td>
<td>BE 598 (4)</td>
<td>SPRING</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Requirement Checklist: ☐Nine 4-unit 200-level courses (36 units) ☐Three BE 299’s (6 units) ☐One BE 495 (2 units)

Signature of Field Adviser          Date

Signature of Department Chair        Date
GROUP I: Core Courses — Required.

BE C201. Engineering Principles for Drug Delivery. (4) (Formerly numbered Biomedical Engineering C201.) Lecture, four hours; discussion, one hour; outside study, seven hours. Enforced requisites: Mathematics 33B, Physics 1B. Application of engineering principles for designing and understanding delivery of therapeutics. Discussion of physics and mathematics required for understanding colloidal stability. Analysis of concepts related to both modeling and experimentation of endocytosis and intracellular trafficking mechanisms. Analysis of diffusion of drugs, coupled with computational and engineering mathematics approaches. Concurrently scheduled with course C101. Letter grading.

BE CM286. Computational Systems Biology: Modeling and Simulation of Biological Systems. (5) (Formerly numbered Biomedical Engineering CM286.) (Same as Computer Science CM286.) Lecture, four hours; laboratory, three hours; outside study, eight hours. Corequisite: Electrical Engineering 102. Dynamic biosystems modeling and computer simulation methods for studying biological/biomedical processes and systems at multiple levels of organization. Control system, multicompartamental, predator-prey, pharmacokinetic (PK), pharmacodynamic (PD), and other structural modeling methods applied to life sciences problems at molecular, cellular (biochemical pathways/networks), organ, and organismic levels. Both theory- and data-driven modeling, with focus on translating biomodeling goals and data into mathematics models and implementing them for simulation and analysis. Basics of numerical simulation algorithms, with modeling software exercises in class and PC laboratory assignments. Concurrently scheduled with course CM186. Letter grading.

BE CM202. Human Physiological Systems for Bioengineering I. (4) (Formerly numbered Biomedical Engineering CM202.) (Same as Physiological Science CM204.) Lecture, three hours; laboratory, two hours. Preparation: human molecular biology, biochemistry, and cell biology. Not open for credit to Physiological Science majors. Broad overview of basic biological activities and organization of human body in system (organ/tissue) to system basis, with particular emphasis on molecular basis. Modeling/simulation of functional aspect of biological system included. Actual demonstration of biomedical instruments, as well as visits to biomedical facilities. Concurrently scheduled with course CM102. Letter grading.


BE 495. Teaching Assistant Training Seminar. (2) (Formerly numbered Biomedical Engineering 495.) Seminar, two hours; outside study, four hours. Limited to graduate bioengineering students. Required of all departmental teaching assistants. May be taken concurrently while holding TA appointment. Seminar on communicating bioengineering and biomedical engineering principles, concepts, and methods; teaching assistant preparation, organization, and presentation of material, including use of visual aids, grading, advising, and rapport with students. S/U grading.

†BE PhySci166 (Fall) and MCDB144 (Spring) are an acceptable substitute for BE CM202 and CM203.

PhySci 166 (Physiological Science). Animal Physiology (6) Lecture, three hours; laboratory, five hours. Requisites: Chemistry 14B and 14BL, or 20B and 30AL, 153A, Life Sciences 1, 2, 3, 23L, Physics 1C and 4BL, or 6C or 6CH. Not open for credit to students with credit for Ecology and Evolutionary Biology 170 or to Physiological Science majors. Introduction to physiological principles, with emphasis on organ systems and intact organisms. Letter grading.

MCDB 144 (Molecular, Cell, and Developmental Biology). Molecular Biology of Cellular Processes and Experimental Applications of Theory. (5) Lecture, three hours; discussion, one hour. Requisites: Life Sciences 3, 4, 23L. Not open for credit to students with credit for Chemistry 153B. Development of thorough understanding of fundamentals of modern molecular biology both from perspective of known molecular mechanisms for regulating fundamental processes in cells and from theoretical applied perspective for using molecular biology as laboratory tool. Special emphasis on molecular mechanisms that relate to chromatin and histone modifications, DNA replication and repair, transposition, microRNAs, meiosis, and splicing. Application of molecular biology as tool to understand embryonic development, reprogramming, cancer, and stem cells. Development of sophisticated understanding of DNA, RNA, and protein as well as capability of designing experiments to address fundamental questions in biology and interpreting experimental data. Letter grading.
GROUP II: SUB-FIELD SPECIFIC COURSES – Minimum of three are required from this group.

PBM 209 (Physics and Biology in Medicine). Digital Techniques in Radiological Sciences. (4) (Formerly numbered Biomedical Physics 209.) Lecture, three hours; discussion, one hour. Preparation: one course in C or another computer language. Basic principles of digital technology used in radiological sciences. Concepts and experience necessary to undertake radiological research in diverse computing environment. Discussion of relationship between computers and diagnostic equipment with regard to data acquisition, equipment interfacing, and data analysis. C language programming taught. S/U or letter grading.

BE M217. Biomedical Imaging. (4) (Formerly numbered Biomedical Engineering M217.) (Same as Electrical Engineering M217.) Lecture, three hours; outside study, nine hours. Requisite: Electrical Engineering 114 or 211A. Optical imaging modalities in biomedicine. Other nonoptical imaging modalities discussed briefly for comparison purposes. Letter grading.

BE M219. Principles and Applications of Magnetic Resonance Imaging. (4) (Formerly numbered Biomedical Engineering M219.) (Same as Physics and Biology in Medicine M219.) Lecture, three hours; discussion, one hour. Basic principles of magnetic resonance (MR), physics, and image formation. Emphasis on hardware, Bloch equations, analytic expressions, image contrast mechanisms, spin and gradient echoes, Fourier transform imaging methods, structure of pulse sequences, and various scanning parameters. Introduction to advanced techniques in rapid imaging, quantitative imaging, and spectroscopy. Letter grading.

BE 224A. Physics and Informatics of Medical Imaging. (4) (Formerly numbered Biomedical Engineering 219A.) Lecture, four hours; laboratory, eight hours. Requisites: Mathematics 33A, 33B. Designed for graduate students. Introduction to principles of medical imaging and imaging informatics for nonphysicists. Overview of core imaging modalities: X ray, computed tomography (CT), and magnetic resonance (MR). Topics include signal generation, localization, and quantization. Image representation and analysis techniques such as Markov random fields, spatial characterization (atlases), denoising, energy representations, and clinical imaging workstation design. Provides basic understanding of issues related to basic medical image acquisition and analysis. Current research efforts with focus on clinical applications and new types of information made available through these modalities. Letter grading.

BE M226. Medical Knowledge Representation. (4) (Formerly numbered Biomedical Engineering M226.) (Same as Information Studies M226.) Seminar, four hours; outside study, eight hours. Designed for graduate students. Issues related to medical knowledge representation and its application in healthcare processes. Topics include data structures used for representing knowledge (conceptual graphs, frame-based models), different data models for representing spatio-temporal information, rule-based implementations, current statistical methods for discovery of knowledge (data mining, statistical classifiers, and hierarchical classification), and basic information retrieval. Review of work in constructing ontologies, with focus on problems in implementation and definition. Common medical ontologies, coding schemes, and standardized indices/terminologies (SNOMED, UMLS). Letter grading.

BE M248. Introduction to Biological Imaging. (4) (Formerly numbered Biomedical Engineering M248.) (Same as Pharmacology and Biomedical Sciences M248.) Lecture, three hours; laboratory, one hour; outside study, seven hours. Exploration of role of biological imaging in modern biology and medicine, including imaging physics, instrumentation, image processing, and applications of imaging for range of modalities. Practical experience provided through series of imaging laboratories. Letter grading.

PBM 229 (Physics and Biology in Medicine). Advanced Topics in Magnetic Resonance Imaging. (4) (Formerly numbered Biomedical Physics 229.) Lecture, four hours. Enforced requisite: course M219. Designed for students interested in pursuing research related to development or translation of new magnetic resonance imaging (MRI) technique. Basic tools and understanding of recent MRI developments that have had high impact on field, involve novel pulse sequence design or image reconstructions, and enable imaging of anatomy or function in way that surpasses what is currently possible with any modality. Topics include in-depth sequence simulation, RF pulse design, rapid image acquisition, parallel imaging, compressed sensing, image reconstruction and processing, motion encoding and compensation, chemical-shift imaging and understanding, and understanding/avoiding artifacts. Programming exercises in Matlab to provide hands-on experience. Letter grading.

GROUP III: SUB-FIELD ELECTIVE COURSES – Students are required to fulfill the remainder of their 200-level course unit requirement by enrolling in sub-field elective courses or other courses approved by the Field Adviser. Suggested BE courses are below.

BE 220. Introduction to Medical Informatics. (2) (Formerly numbered Biomedical Engineering 220.) Lecture, two hours; outside study, four hours. Designed for graduate students. Introduction to research topics and issues in medical informatics for students new to field. Definition of this emerging field of study, current research efforts, and future directions in research. Key issues in medical informatics to expose students to different application domains, such as information system architectures, data and process modeling, information extraction and representations, information retrieval and visualization, health services research, telemedicine. Emphasis on current research endeavors and applications. S/U grading.

BE 221. Human Anatomy and Physiology for Medical and Imaging Informatics. (4) (Formerly numbered Biomedical Engineering 221.) Lecture, four hours; outside study, eight hours. Designed for graduate students. Introduction to basic human anatomy and physiology, with particular emphasis on understanding and visualization of anatomy and physiology through medical images. Topics relevant to acquisition, representation, and dissemination of anatomical knowledge in computerized clinical applications. Topics include chest, cardiac, neurology, gastrointestinal/genitourinary, endocrine, and musculoskeletal systems. Introduction to basic imaging physics (magnetic resonance, computed tomography, ultrasound, computed radiography) to provide
context for imaging modalities predominantly used to view human anatomy. Geared toward nonphysicians who require more formal understanding of human anatomy/physiology. Letter grading.

**BE 223A-223B-223C. Programming Laboratories for Medical and Imaging Informatics I, II, III. (4-4-4)** (Formerly numbered Biomedical Engineering 223A-223B-223C.) Lecture, two hours; laboratory, two hours; outside study, eight hours. Designed for graduate students. Programming laboratories to support coursework in other medical and imaging informatics core curriculum courses. Exposure to programming concepts for medical applications, with focus on basic abstraction techniques used in image processing and medical information system infrastructures. Letter grading. **223A.** Requisites: Computer Science 31, 32, Program in Computing 20A, 20B. Course 223A is requisite to 223B, which is requisite to 223C. Integrated with topics presented in course M227 to reinforce concepts presented with practical experience. Projects focus on understanding medical networking issues and implementation of basic protocols for healthcare environment, with emphasis on use of DICOM. Introduction to basic tools and methods used within informatics. **223B.** Requisite: course 223A. Integrated with topics presented in courses 223A, M227, and M228 to reinforce concepts presented with practical experience. Projects focus on medical image manipulation and decision support systems. **223C.** Requisite: course 223B. Exposure to programming concepts for medical applications, with focus on basic abstraction techniques used to extract meaningful features from medical text and imaging data and visualize results. Integrated with topics presented in courses 224B and M226 to reinforce concepts presented with practical experience. Projects focus on medical information retrieval, knowledge representation, and visualization.

**BE M227. Medical Information Infrastructures and Internet Technologies. (4)** (Formerly numbered Biomedical Engineering M227.) (Same as Information Studies M254.) Lecture, four hours; outside study, eight hours. Designed for graduate students. Introduction to networking, communications, and information infrastructures in medical environment. Exposure to basic concepts related to networking at several levels: low-level (TCP/IP, services), medium-level (network topologies), and high-level (distributed computing, Web-based services) implementations. Commonly used medical communication protocols (HL7, DICOM) and current medical information systems (HIS, RIS, PACS). Advances in networking, such as wireless health systems, peer-to-peer topologies, grid/cloud computing. Introduction to security and encryption in networked environments. Letter grading.

**BE M228. Medical Decision Making. (4)** (Formerly numbered Biomedical Engineering M228.) (Same as Information Studies M255.) Lecture, four hours; outside study, eight hours. Designed for graduate students. Overview of issues related to medical decision making. Introduction to concepts of evidence-based medicine and decision processes related to process of care and outcomes. Basic probability and statistics to understand research results and evaluations, and algorithmic methods for decision-making processes (Bayes theorem, decision trees). Study design, hypothesis testing, and estimation. Focus on technical advances in medical decision support systems and expert systems, with review of classic and current research. Introduction to common statistical and decision-making software packages to familiarize students with current tools. Letter grading.

**BE M233A. Medtech Innovation I: Entrepreneurial Opportunities in Medical Technology. (4)** (Formerly numbered 233A.) (Same as Management M271A.) Lecture, three hours; discussion, three hours; outside study, six hours. Designed for graduate and professional students in engineering, dentistry, design, law, management, and medicine. Focus on understanding how to identify unmet clinical needs, properly filtering through these needs using various acceptance criteria, and selecting promising needs for which potential medtech solutions are explored. Students work in groups to expedite traditional research and development processes to invent and implement new medtech devices that increase quality of clinical care and result in improved patient outcomes in hospital system. Introduction to intellectual property basics and various medtech business models. Letter grading.

**BE M233B. Medtech Innovation II: Prototyping and New Venture Development. (4)** (Formerly numbered 233B.) (Same as Management M271B.) Lecture, three hours; discussion, three hours; outside study, six hours. Enforced requisite: course M233A. Designed for graduate and professional students in engineering, dentistry, design, law, management, and medicine. Development of medtech solutions for unmet clinical needs previously identified in course M233A. Steps necessary to commercialize viable medtech solutions. Exploration of concept selection, business plan development, intellectual property filing, financing strategies, and device prototyping. Letter grading.

**BE M296D. Introduction to Computational Cardiology. (4)** (Formerly numbered Biomedical Engineering M296D.) (Same as Computer Science M296D.) Lecture, four hours; outside study, eight hours. Requisite: course CM186. Introduction to mathematical modeling and computer simulation of cardiac electrophysiological process. Ionic models of action potential (AP). Theory of AP propagation in one-dimensional and two-dimensional cardiac tissue. Simulation on sequential and parallel supercomputers, choice of numerical algorithms, to optimize accuracy and to provide computational stability. Letter grading.

Other non-BE courses to consider include the following:


**EE 210A. (Electrical Engineering). Adaptation and Learning. (4)** Lecture, four hours; outside study, eight hours. Preparation: prior training in probability theory, random processes, and linear algebra. Recommended requisites: courses 205A, 241A. Mean-square-


212B. (Electrical Engineering). Multirate Systems and Filter Banks. (4) Lecture, three hours; outside study, nine hours. Requisite: course 212A. Fundamentals of multirate systems; polyphase representation; multistage implementations; applications of multirate systems; maximally decimated filter banks; perfect reconstruction systems; paraunitary filter banks; wavelet transform and its relation to multirate filter banks. Letter grading.

PMB 227 (Physics and Biology in Medicine) 227. Human Disease: Current and Future Role of Biomedical Physics. (4) (Formerly numbered Biomedical Physics 227.) Lecture, three hours; discussion, one hour. Present and future roles of biomedical physics in diagnosis and treatment of human disease, with focus on interdisciplinary nature of this field. Exploration of two diseases in depth with detailed description of roles of physics-based diagnostic imaging and therapeutic options for each disease. Description of current and future technologies, as well as techniques that exploit interaction between diagnosis and therapy. Letter grading.


PMB 218 (Physics and Biology in Medicine). Radiologic Functional Anatomy. (2) (Formerly numbered Biomedical Physics 218.) Lecture, two hours. Introduction to human anatomy, cell biology, and physiology as visualized through microscopy, molecular imaging, radiography, CT, MRI, ultrasonography, PET, and SPECT. Letter grading.

CS CM224 (Computer Science), Computational Genetics (4) (Same as Bioinformatics M224 and Human Genetics CM224.) Lecture, four hours; discussion, two hours; outside study, six hours. Enforced requisites: course 32 or Program in Computing 10C with grade of C- or better, and one course from Biostatistics 100A, 110A, Civil Engineering 110, Electrical Engineering 131A, Mathematics 170A, or Statistics 100A. Designed for engineering students as well as students from biological sciences and medical school. Introduction to computational analysis of genetic variation and computational interdisciplinary research in genetics. Topics include introduction to genetics, identification of genes involved in disease, inferring human population history, technologies for obtaining genetic information, and genetic sequencing. Focus on formulating interdisciplinary problems as computational problems and then solving those problems using computational techniques from statistics and computer science. Concurrently scheduled with course CM124. Letter grading.

BioMath M231 (Biomathematics). Statistical Methods for Categorical Data. (4) (Same as Biostatistics M210.) Lecture, three hours; discussion, one hour. Requisites: Biostatistics 100B or 110B, Statistics 100B. Statistical techniques for analysis of categorical data; discussion and illustration of their applications and limitations. S/U or letter grading.
ETHICS COURSE – Only one ethics course is required.
BE 165EW Course Name (4) Lecture, four hours; discussion, three hours; outside study, five hours. All professions have ethical rules that derive from moral theory. Bioethics is well-established discipline that addresses ethical problems about life, such as when do fertilized eggs become people? Should ending of life ever be assisted? At what cost should it be maintained? Unlike physicians, bioengineers do not make these decisions in practice. Engineering ethics addresses ethical problems about producing devices from molecules to bridges, such as when do concerns about risk outweigh concerns about cost? When are weapons too dangerous to design? At what point does benefit of committing to building devices outweigh need to wait for more scientific confirmation of their effectiveness? Bioengineers must be aware of consequences of applying such devices to all living systems. Emphasis on research and writing within engineering environments. Satisfies engineering writing requirement. Letter grading.


MIMG C234 (Microbiology, Immunology, and Molecular Genetics). Ethics and Accountability in Biomedical Research. (2) Seminar, two hours. Designed for graduate students and undergraduates who have credit for life sciences or biomedical individual studies 199 course. Responsibilities and ethical conduct of investigators in research, data management, mentorship, grant applications, and publications. Responsibilities to peers, sponsoring institutions, and society. Conflicts of interest, disclosure, animal subject welfare, human subject protection, and areas in which investigational goals and certain societal values may conflict. Concurrently scheduled with course C134. S/U grading.

NS 207 (Neuroscience). Integrity of Scientific Investigation: Education, Research, and Career Implications. (2) Discussion, two hours. Designed for graduate students. Debate on topics related to ethical conduct of scientific investigation, with emphasis on critical thinking. Topics include scientific misconduct, mentoring, data ownership, authorship, peer review, use of animals and humans in biomedical research, conflicts of interest, technology, and scientific integrity. S/U grading.

BIOENGINEERING SEMINAR – Enrollment is required for three quarters.
BE299. Seminar: Bioengineering Topics. (2) (Formerly numbered Biomedical Engineering 299.) Seminar, two hours; outside study, four hours. Designed for graduate bioengineering students. Seminar by leading academic and industrial bioengineers from UCLA, other universities, and bioengineering companies such as Baxter, Amgen, Medtronics, and Guidant on development and application of recent technological advances in discipline. Exploration of cutting-edge developments and challenges in wound healing models, stem cell biology, angiogenesis, signal transduction, gene therapy, cDNA microarray technology, bioartificial cultivation, nano- and micro-hybrid devices, scaffold engineering, and bioinformatics. S/U grading.

BIOENGINEERING RESEARCH – Required during the final two quarters for Master Thesis Plan students.
BE598. Research for and Preparation of M.S. Thesis. (2 to 12) (Formerly numbered Biomedical Engineering 598.) Tutorial, to be arranged. Limited to graduate bioengineering students. Supervised independent research for M.S. candidates, including thesis prospectus. S/U grading.