UNIVERSITY OF CALIFORNIA, IRVINE
DEPARTMENT OF BIOMEDICAL ENGINEERING

GRADUATE STUDENT SURVIVAL HANDBOOK 2011

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I. FOREWORD

Welcome to the Biomedical Engineering Graduate Program at UCI! This manual provides specific information on policies, procedures, and timelines that will assist you in your career as a graduate student. The goal of the UCI Biomedical Engineering Program is to train 21st century biomedical engineers for jobs in the biomedical and biotechnology industries, healthcare professions, and academia. Located at a world-class research university deep in the heart of the nation's "biomedical device and technology capital," we are uniquely positioned to build upon our existing strengths in nanoscale systems, biophotonics, bio-opto-electronics, biomedical computation, biomedical signal processing, biomechanics, neuro-engineering and tissue engineering to achieve this goal. Furthermore, the collaborative integration of The Henry Samueli School of Engineering, the College of Medicine, the School of Biological Sciences, the School of Physical Sciences, and the Donald Bren School of Information and Computer Sciences, all with unique individual strengths, provide a "new millennium" approach to biomedical engineering.

KEY MILESTONES FOR A MASTERS DEGREE

YEAR 1

Complete core and elective courses
Match with a faculty research advisor

YEAR 2

Complete focused research project
Submit written thesis

KEY MILESTONES FOR A Ph.D. DEGREE:

YEAR 1

Complete core and some elective courses
Complete at least two laboratory rotations
Pass preliminary examination
Match with a faculty research advisor

YEAR 2

Complete depth courses (two graduate level elective courses with approval of advisors)
Research
Form graduate advisory committee
Pass qualifying exam

YEAR 3

Research
Present preliminary results in our seminar series

YEARS 4 & 5

Research
Complete dissertation
Pass final examination

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II. THE MISSION

The graduate program in biomedical engineering is an interdisciplinary program with participating faculty from the Department of Biomedical Engineering, The Henry Samueli School of Engineering, the School of Biological Sciences, the School of Physical Sciences, the College of Medicine, and the School of Information & Computer Science. A successful biomedical engineer is able to describe and analyze biomedical and biological systems in a quantitative fashion, and communicate effectively with physicians to solve biomedical problems. Thus, at a minimum, a biomedical engineer must demonstrate competence in quantitative analysis, and biological and biomedical structure and function. The degrees awarded are either the M.S. in Biomedical Engineering or the Ph.D. in Biomedical Engineering.

III. ENTRANCE REQUIREMENTS

Because of its interdisciplinary nature, biomedical engineering attracts students with a variety of backgrounds. Thus, the requirements for admission are tailored to students with either an engineering or science background. The requirements are as follows:

1. A bachelor's degree either in engineering, physical sciences, or biological sciences discipline.
2. Coursework: Minimum coursework requirements for admission to the program include the following: a) four quarters of calculus, b) three quarters of calculus-based physics, c) three quarters of chemistry, and d) two quarters of biology (equivalent to UCI's BioSci 98 & 99 or BME 50A & 50B). Students without an engineering undergraduate degree may be required to take additional relevant undergraduate engineering courses. Any additional course requirements will be specifically determined by the BME Graduate Committee on a case by case basis. Any course deficiencies should be completed before enrollment in the fall entrance quarter.
3. Standardized Tests: Submission of the General Test of the Graduate Record Examination (quantitative plus verbal), or minimum combined MCAT scores in Physics, Quantitative Methods, and Science Problems are required. In addition, a minimum score of 94 or higher on the TOEFL iBT is required of all foreign students whose native language is not English.
4. Grade Point Average (GPA): Minimum overall GPA of 3.20 (on a 4.0 scale).
5. Letters of Recommendation: At least three (3) letters of recommendation are required.
6. If an applicant has a non-quantitative undergraduate background (i.e., Humanities, Business, etc.), yet shows great promise of success in BME graduate studies, the Chair of the Graduate Committee will devise a plan of study for the applicant upon recommendation of the faculty committee and formal interview.

Exceptionally promising UCI undergraduates with a cumulative grade point average of 3.5 or above, or participants in the Campuswide Honors Program in their junior, senior or fifth year of undergraduate study, may apply for admission through The Henry Samueli School of Engineering's accelerated M.S. and M.S./Ph.D. program. An Accelerated Admissions Program Application can be obtained from the HSSoE Graduate Counselor. However, these students must satisfy the coursework and letters of recommendation requirements as described above.

Our application process is online: for more information, refer to http://www.eng.uci.edu/bme/admissions. Please be advised that our deadlines and admission criteria are strict.

The Department of Biomedical Engineering considers any act of academic dishonesty as a very serious issue. We reserve the right to rescind admission if there is evidence of dishonesty. Academic dishonesty applies equally to electronic media and print, and involves text, images and ideas. It includes but is not limited to: Cheating, Dishonest Conduct, Plagiarism. For a complete definition of these terms, go to: (http://www.editor.uci.edu/catalogue/appx/appx.2.htm).

IV. GETTING STARTED

Getting to Irvine: Irvine is located in Orange County, approximately 40 miles south of Los Angeles and 70 miles north of San Diego. The closest airports are Los Angeles International (LAX) and John Wayne/Santa Ana/Orange County (SNA). John Wayne Airport is small with easy access and is only 10 minutes from campus. The airfares tend to be a bit more expensive and the airport does not offer international flights. LAX is a much larger airport with many international flights. LAX is about a 60 minute drive to UCI. There are shuttles available at the airport that can take you to the UCI campus or to John Wayne Airport.

Upon arriving in Irvine one of the first things you should do is to check in with the staff at the Department of Biomedical Engineering. Contact information and location of these individuals is found in Section IX of this handbook. When you check in you will be asked to fill out an information sheet with your local address and contact information.

Housing: Once you arrive on campus, you may need assistance to find housing. On-campus housing is limited. Students who have not applied for on-campus housing before arrival may encounter a lengthy wait depending upon personal preferences and the housing complex requested. However, the housing office can help you begin looking for off-campus housing. The general information number for the housing office is (949) 824-7247.

Establishing Residency: All students planning to attend graduate school at UC Irvine, whether they are United States citizens, US permanent residents, or foreign nationals, must file a *Statement of Legal Residence* (SLR) with the Registrar's Office. You must complete a new Statement even if you attended UCI as an undergraduate student. The *Statement of Legal Residence* is available on-line through the Registrar's Office web site: http:www.reg.uci.edu. Please file your residency statement electronically through the web page. **You must complete a *Statement of Legal Residence* in order to register for classes.**

If you are a citizen or permanent resident of the United States but not currently a resident of the State of California, you will want to acquire this status as soon as possible. It is expected that all full time graduate students who are eligible for California residency will have established this by the beginning of the second year of enrollment. Once residency is established your Zotbill will indicate fees only and not tuition. Moreover, time spent in California as a student may be used to meet State residency requirements. You should contact the Residence Office (215 Aldrich Hall, 949/824-6129, regres@uci.edu) for information about residency reclassification.

Register for Classes: It is the student's responsibility to check when their enrollment window is open for each quarter. This information can be found at: http://www.reg.uci.edu, where the Academic & Administrative Calendar is posted with enrollment window dates. The deadlines to enroll and pay fees are September 15, 2011, December 15, 2011 and March 15, 2012 for the upcoming fall, winter and spring quarters respectively.

Students who do not enroll in classes during the published registration period are subject to a late service fee. Students enrolled in zero (0) units at the close of business at the end of the second week of classes are assessed a $50 late enrollment fee. The signature of the HSSoE Associate Dean is required for late enrollment after the second week of classes.

Mail, Email, Computer Accounts: Campus and US mail is delivered daily. All students will have a mailbox assigned to them in the BME Business Office (Natural Sciences II, Room 3120). Hours of operation for the BME Business Office are 8:00 a.m. - 5:00 p.m.

UCI is well equipped with computer resources. The Network and Academic Computing Services (NACS, (949) 824-2222) offers seminars on topics associated with computing. NACS can also help you establish a central computer account as well as your UCINET identification, which will be needed to establish an

email account. You can activate your UCINetID (see http://activate.uci.edu) at the beginning of Summer Session I.

Keys, Desks, etc.: After completing a lab safety course, you will be eligible to be issued keys to the building(s) and lab(s) where you will be conducting your research**.**

V. COURSE REQUIREMENTS

You should become familiar with the descriptions of academic policies and graduate degrees in the Research and Graduate Studies section of the UCI general catalogue. **As a full-time student, you are required to maintain full time enrollment status of 12 units each quarter.** You are expected to satisfactorily complete at least 12 units of academic credit applicable to the graduate program in each regular academic quarter (fall, winter and spring) and satisfy all requirements of the academic program according to a schedule approved by the graduate advisor of biomedical engineering. Only grades A, A-, B+, B, and S represent satisfactory progress and may be applied toward advanced degree requirements. Graduate students are not permitted to take courses as a Pass/No Pass Option. One UCI elective course in which a grade of B- was earned may be accepted toward the degree requirements. The B- exception will not be granted for BME core classes. You may not apply courses graded pass or not pass toward any degree or satisfactory progress requirements. A grade point average below the B level (3.0) is not satisfactory, and a student whose grade point average is below that level is subject to academic disqualification by the Dean of Graduate Division.

Note: A graduate student who has not demonstrated satisfactory progress is not eligible for paid appointments, such as a Graduate Student Researcher or Teaching Assistant, and may not hold a fellowship or other award, which is based upon academic merit. This includes appointment as a pre-doctoral trainee on federal training grants. Academic merit is set at an overall GPA greater than 3.5, passing the required examinations within the time specified for the graduate program, matching with a research advisor, and maintaining overall progress toward completion of the program.

Part-Time Study Program: Part-time study for credit leading to a graduate degree is available if good educational reason exists, as determined by the academic unit. To take advantage of reduced fees for part-time status, quarterly course enrollment is limited to eight units or less for graduate students. Students enrolled in excess units after the Friday of the third week of instruction are liable for full fees. In addition to all other required fees, students approved for part-time status pay one-half of the Educational Fee and, if applicable, one-half of the Nonresident Tuition Fee. Graduate students should refer to the Research and Graduate Studies section of the UCI General catalogue.

Core Courses: Both the M.S. and Ph.D. degrees require the students to complete 36 course units. These units include 26 core units, two elective course units (6 units), and four units of independent research. The four independent research units (BME 296, 297, 299) can be arbitrarily distributed over the quarters (See Special Courses section). The core courses cover the basics of cells, tissues, and physiology at the microscopic and macroscopic scale, engineering mathematics, and clinical theory. The core courses and descriptions are:

Fall

1. BME 210 Cell and Tissue Engineering (4 units): A biochemical, biophysical, and molecular view of cell biology. Topics include the biochemistry and biophysical properties of cells, the extracellular matrix, biological signal transduction, and principles of engineering new tissues. Prerequisite: consent of instructor. (Instructor: Hui) [If BME 160 was taken in our undergraduate program, it may be substituted for BME 210, with a qualifying grade]
2. BME 220 Quantitative Physiology: Sensory Motor Systems (4 units): A quantitative and systems approach to understanding physiological systems. Systems covered include the nervous and musculoskeletal systems. Prerequisite: consent of instructor. Concurrent with BME 120. (Instructor: Reinkensmeyer) [If BME 120 was taken in our undergraduate program, it may be substituted for BME 220, with a qualifying grade]

3. BME 230A Applied Engineering Mathematics I (4 units): Analytical techniques applied to engineering problems in transport phenomena, process dynamics and control, and thermodynamics. (Instructor: Chen)
4. BME 298 Seminars in Biomedical Engineering (1 unit, F,W,S): Presentation of advanced topics and reports of current research efforts in biomedical engineering. Designed for graduate students in the biomedical engineering program. May be repeated for credit. (Instructor: Botvinick)
5. Elective course (3/4 units)

Winter

1. BME 221 Quantitative Physiology: Organ Transport Systems (4 units): A quantitative and systems approach to understanding physiological systems. Systems covered include the cardiopulmonary, circulatory, and renal systems. Same as CBEMS 204. (Instructor: George)) [If BME 121 was taken in our undergraduate program, it may be substituted for BME 221, with a qualifying grade]
2. BME230B Applied Engineering Mathematics II (4 units): Advanced engineering mathematics for biomedical engineering. Focuses on biomedical system identification. Includes fundamental techniques of model building and testing such as formulation, solution of governing equations (emphasis on basic numerical techniques), sensitivity theory, identifiability theory, and uncertainty analysis. (Instructor: Kruggel)
3. BME 298 Seminars in Biomedical Engineering (see Fall quarter).
4. Elective course (3/4 units)

Spring

1. BME 240 Introduction to Clinical Medicine for Biomedical Engineering (3 units): An introduction to clinical medicine for graduate students in biomedical engineering. Divided between lectures focused on applications of advanced technology to clinical problems and a series of four rotations through the operating room, ICU, interventional radiology/imaging, and endoscopy. (Instructors: Gupta and Wong)
2. BME 298 Seminars in Biomedical Engineering (see Fall quarter).
3. Elective course (3/4 units)

As students rotate in faculty laboratories, they should also register for at least four independent research units. (Descriptions are listed under Special Courses). Contact Karen Stephens if you do not see a course code in the Schedule of Classes for the professor with whom you want to enroll in research units.

Elective Courses: The two elective courses (6 units) required to fulfill the course requirements for the M.S. and Ph.D. degrees are offered within the Department of Biomedical Engineering, The Henry Samueli School of Engineering, School of Biological Science, School of Physical Science, or School of Medicine. The courses should be chosen to meet the specific needs of the student. The electives must provide breadth in biomedical engineering, but also provide specific skills necessary to the specific research the student may undertake as part of the degree requirements. Upper division undergraduate courses may be selected upon approval of the BME Graduate Advisor however, these courses will only count as ½ credit towards degree requirements. Approval for any course not listed below must be obtained from the BME Graduate Advisor, prior to enrolling in the course. The criteria for approval of these courses are: 1) the knowledge provided in these courses is necessary for the student's thesis, and 2) no similar graduate course exists. Below are the elective courses to be offered in 2011/12 by the BME Department:

Fall

1. BME 233 Dynamic Systems in Biology and Medicine (4 units): Introduces elements of system theory and application of these principles to analyze biomedical, chemical, social and engineering systems. Students will use analytical and computational tools to model and analyze various dynamic systems such as population dynamics, Lotka-Volterra equation, etc. (Instructor: Nenadic)
2. BME 261 Biomedical Microdevices (3 units): In-depth review of microfabricated devices designed for biological and medical applications. Studies of the design, implementation, manufacturing, and marketing of commercial and research bio-MEMS devices. (Instructor: Brody)
3. BME 295/EECS 202A/Physics 233A Principles of Imaging (4 units): Linear systems, probability and random processes, image processing, projection imaging, tomographic imaging. Prerequisite: Physics 51B or 61B or equivalent. (Instructor: Chanan)

Winter

1. BME 213/DevBio 232 Systems Cell & Developmental Biology (4 units): Introduces concepts needed to understand cell and developmental biology at the systems level, i.e., how the parts (molecules) work together to create a complex output. Emphasis on using mathematical/computational modeling to expand/modify insights provided by intuition. (Instructor: Lander)
2. BME 236 Engineering Optics for Biomedical Applications (3 units): Fundamentals of optical systems design, integration, and analysis used in biomedical optics. Design components: light sources, lenses, mirrors, dispersion elements, optical fibers, detectors. Systems integration: microscopy, radiometry, interferometry. Optical system analysis: resolution, modulation transfer function, deconvolution, interference, tissue optics, noise. (Instructor: Tromberg)
3. BME 263 Microsystem Technologies for Biomolecular Assays (3 units): Introduction to state-of-the-art micro Total Analysis Systems (mTAS) for biomolecular assays, device design principles for microscale sample preparation, flow transport, biomolecular manipulation/separation/detection, technologies for integrating these devices into microsystems. Applications include clinical medicine, health monitoring, biotechnology, biodetection. (Instructor: Lee)
4. BME 295/EECS 202B/Psych 233B Medical Techniques I (4 units): Ionizing radiation, planar and tomographic radiographic and nuclear imaging, magnetism, NMR, MRI imaging. Prerequisite: EECS202A. (Instructors: Su & Gulsen)
5. BME 295/PSYCH 236 Multivariate Time Series Analysis (4 units): Introduces multivariate time series analysis theory and methods emphasizing computational methods in spectral analysis, autoregressive modeling, information theory, principal and independent components analysis, and nonlinear dynamics. Applications to human neuroimaging data are extensively discussed. Prerequisite: PSYCH 205A or consent of instructor. (Instructor: Srinivasan)
6. BME 295/MAE 295 Biofluid Mechanics (4 units) (Instructor: Kheradvar)

Spring

1. BME 248 Microimplants (4 units): Essential concepts of biomedical implants at the micro scale. Design, fabrication, and applications of several microimplantable devices including cochlear, retinal, neural, and muscular implants. (Instructor: Tang)
2. BME 295 Neuroimaging Data Analysis (3 units): An advanced course on recent techniques for analyzing brain structure and function. Covers modalities MRI, EEG, MEG, optical imaging and their combination, experimental design and strategies for data analysis. (Instructor: Kruggel)
3. BME 295 Bio-Spectroscopy (3 units) (Instructor: Gratton)
4. BME 295/EECS 202C/Psych 233C Medical Techniques II (4 units): Sound and ultrasound, ultrasonic imaging, physiological electromagnetism, EEG, MEG, ECG, MCG, optical properties of tissues, fluorescence and bioluminescence, MR impedance imaging, MR spectroscopy, electron spin resonance and ESR imaging. (Instructors: Nalcioglu & Gulsen)
5. BME 295 Special Topics TBD: (Instructor: Grosberg)

Special Courses: Besides the formal lecture oriented courses that comprise the core and elective requirements, there are a series of special courses for which you will enroll in at various times during your study. These special course titles are listed below.

1. BME 295 Special Topics in Biomedical Engineering (1 to 4 units F,W,S).
2. BME 296 Masters of Science Thesis Research (1 to 12 units F,W,S): Individual research or investigation conducted in the pursuit of preparing and completing the thesis required for the M.S. in Engineering. Prerequisite: consent of instructor. May be repeated for credit.
3. BME 297 Doctor of Philosophy Dissertation Research (1 to 12 units F,W,S): Individual research or investigation conducted in the pursuit of preparing and completing the dissertation required for the Ph.D. in engineering. Prerequisite: consent of instructor. May be repeated for credit.
4. BME 298 Seminars in Biomedical Engineering (1 unit F,W,S): Presentation of advanced topics and reports of current research efforts in biomedical engineering. Designed for graduate students in the biomedical engineering program. May be repeated for credit.
5. BME 299 Individual Research (1 to 12 units F,W,S): Individual research or investigation under the direction of an individual faculty member. Prerequisite: consent of instructor. May be repeated for credit.

Lab Rotations: Ph.D. students are required to rotate in a minimum of two labs during the first year. The purpose of the rotations is to offer an opportunity to become more familiar with the research performed by BME faculty and affiliated faculty that the students are considering as their doctoral advisors. It is during these rotations that you will experience first-hand the research environment in these laboratories and also have the opportunity to discuss the potential for matching and financial support with the faculty. It is important that you take advantage of the lab rotations in order to increase your chances of finding a match and securing your financial support for the duration of your dissertation research. Master's students are encouraged to stay in one lab to focus on their thesis research and are not required to rotate.

International students who are matched with a research advisor prior to coming to UCI will remain in the same lab over the duration of the first year. They are expected to continue to be matched with their advisor for the second year and beyond unless there is a compelling reason to switch. For domestic students, only in the event where a student has a strong desire to remain in one lab and they have already discussed funding and matching with the professor(s), will the student be allowed to remain in that lab for the duration of their rotations. These arrangements must be approved by the Graduate Advisor.

VI. DEGREE REQUIREMENTS

For course requirements, see Section V. For links to various forms, see Section XI.

Master's Degree: The M.S. degree requires completing designated course work and conducting a focused research project. Students must successfully complete a minimum of 36 units of course work beyond the bachelor's degree, at least 28 of which must be at the 200 level including the 26 units of core course requirements. A maximum of eight M.S. research units (i.e., BME296) may be applied toward the 36-unit requirement. If you were a UCI BME undergraduate student, you most likely took some core classes with graduate students. As a master's student, you have the option to substitute other courses for the coursework you have already completed, with the permission (email is sufficient) of the graduate advisor and only if you received a grade of B+ or better in these core courses. However, you will still need to complete 36 units for your M.S. degree. If you took an elective course as an undergraduate, you are not eligible to take the graduate equivalent and receive course credit (i.e., BME 136/BME 236 Engineering Optics for Biomedical Applications). Master's students are encouraged to stay in one lab to focus on their thesis research and are not required to rotate.

In addition, students must select a thesis advisor and complete an original research investigation including a written thesis. A thesis project may be conducted during an internship in the local biomedical industry. Feel welcome to contact the Graduate Advisor to learn more about this option.

The thesis committee is comprised of three members, with your thesis advisor serving as the chair of your committee. The majority of the members must be BME core or affiliated faculty. The approved thesis must be filed electronically at the UCI Thesis/Dissertation Submission Site (www.etdadmin.com/uci). The degree will be granted upon the recommendation of the Chair of the Department of Biomedical Engineering and the HSSoE Associate Dean of Student Affairs. The normal time-to-degree for the Master's degree is one to two years, with the maximum allowable time of three years.

Doctoral Program: The Ph.D. requires an original and significant body of research that advances the discipline and culminates with the oral and written presentation of a dissertation. You may enter the Ph.D. program directly with a B.S. in engineering or related science such as biology, chemistry, or physics provided you have met the course requirements previously described. The graduate committee will handle applicants on a case-by-case basis, and any specific additional courses required of you will be made explicit at the time of admission.

You must match with a faculty advisor (BME core or affiliated faculty) after passing the preliminary exam. You and your faculty advisor will agree upon an individual program of study. There are no additional core course requirements beyond that of the M.S. degree. However, two depth courses are required in Year Two, in preparation for the qualifying exam.

Six milestones are required for students in the Ph.D. program:

1. Successful completion of 36 units of coursework beyond the bachelor's degree (see Section V): If you were a UCI BME undergraduate student, you most likely took some core classes with graduate students and may ask to have these grad core course requirements waived. As a Ph.D. student, you have the option to substitute other courses for the coursework you have already completed, with the permission (email is sufficient) of the graduate advisor and only if you received a grade of A- or better in these core courses. However, you will still need to complete the 36 unit requirement. If you took an elective course as an undergraduate, you are not eligible to take the graduate equivalent and receive course credit (i.e., BME 136/BME 236 Engineering Optics for Biomedical Applications).

2. Successful completion of the preliminary exam: The preliminary exam will be given before the end of the Spring quarter of the first year. It is designed to test your overall knowledge of the core subjects as taught in the BME core courses. A passing grade in all core courses (BME 210, BME 220, BME 221, BME 230A and BME 230B) offered in the Fall and Winter quarters is required to be eligible to sit for the preliminary exam. The preliminary exam cannot be taken in sections in the instance where a student did not receive a passing grade in one of the core courses

   The exam is given both in written form and orally. There are three major subject areas that you will be tested on: Systems Physiology (BME220/BME221), Cell and Tissue Engineering (BME210), and Mathematics (BME230A/BME230B). The exam works on a point system. During the written exam, a student can receive 0 (fail), 1 (conditional pass), or 2 (pass) points. If the student has a point total of 4-5 points, he/she is offered the opportunity to take the oral exam to demonstrate their proficiency in the deficient area(s) with points less than 2. If the student fails to receive a total of 4 points, they automatically fail and cannot take the oral exam. If the student fails to pass the preliminary exam on the first attempt, he/she will be offered a second and final chance the following year to retake the exam. During this second chance, only subject areas that the student didn't pass are required. It is department policy that there is no re-grading of the written exam, nor are students allowed to see their exams.

   Students who do not pass the preliminary exam on their second attempt will not be allowed to continue in the Ph.D. program. However, they may receive a Master's degree upon completion of an original research investigation including a written thesis (refer to Master of Science Degree requirements). In the event a student decides not to continue in the PhD program, the thesis requirement for the MS degree is still enforced.

3. Area of Specialization: During the second year, the student is expected to take at least two graduate elective courses (depth courses as mentioned above) related closely to the research topic he/she will be working on (area of specialization). These courses will be selected jointly with the research advisor. The purpose of the specialization courses is to further strengthen the depth of fundamental understanding in the subject area needed to perform the doctoral research topic of choice. Depth areas could include possible disciplines such a fluid dynamics, cell & tissue engineering, biophotonics, bioMEMS, biocomputation, biomechanics, drug delivery, etc. If you choose a non-BME course, an approval must be obtained from the BME Graduate Advisor, prior to enrolling in the course. These

courses must be taken prior to the qualifying exam. The student will be expected to master this area of specialization and be prepared to be questioned during the qualifying exam.

4. Formal advancement to candidacy by successfully passing the qualifying exam: You must select a committee for the advancement process. The committee must be approved by the BME Graduate Advisor, and The Henry Samueli School of Engineering Graduate Student Affairs Office. There is a form that must be filled out for this approval. Please see BME Graduate Academic Counselor, Karen Stephens to receive this form.

   Advancement to candidacy must be completed by the end of the summer of your second academic year. Special exceptions can be made, but a formal request with justification must be supplied in writing to the BME Graduate Advisor. Advancement to candidacy occurs upon passing the qualifying exam. The qualifying exam will consist of an oral and written presentation of original work completed thus far, and a coherent plan for completing a body of original research. The qualifying exam will be presented to your graduate advisory committee. The graduate advisory committee will be selected by you and your faculty advisor and must have a minimum of five (5) faculty members (including the faculty advisor). Of these five (5) faculty members, three (3) must be biomedical engineering faculty with at least one (1) being core BME faculty. In addition, one (1) faculty member must have his/her primary appointment within HSSoE, but outside BME and can be a BME-affiliated faculty. The fifth member must have his/her primary appointment outside HSSoE and cannot be a BME-affiliated faculty. Professors with adjunct appointments cannot serve as the chair of a committee, however, they can serve as a co-chair, with a core or affiliated BME faculty serving as the second co-chair. As stated above, the BME Graduate Advisor, in conjunction with the HSSoE Graduate Student Affairs Office, reserves the right for final approval of your qualifying committee membership.

   The qualifying exam must be taken by the end of the summer of your second year to stay on track and to demonstrate satisfactory progress towards the Ph.D. The exam has two parts: 1) a written proposal, and 2) an oral presentation. On the day of your exam, you must fill out and present the Ph.D. Form I for your committee to sign at the completion of the exam. On this form you will need to place an asterisk (*) next to the names of the faculty whom you designate as the members of your final dissertation committee (minimum of three). Please note that the majority of these final members must come from the BME department with one (1) being a core BME faculty. For instance, if you composed a committee of three, then two members must be from BME; if you composed a committee of four, then three need to be from BME; and if you composed a committee of five, then three must be from BME. There is no exception to this rule: the majority must always come from the BME department. This committee must be approved by the BME Graduate Advisor.

   a. Written proposal: The written portion of the exam should accomplish the following goals: i) demonstrate proficiency in written expression of scientific and engineering methods and results, ii) demonstrate satisfactory progress in an original research area, and iii) demonstrate a firm and well thought-out plan for completing the remaining features of the dissertation research. The proposal plan must articulate the overall objectives of the research dissertation and outline detail methodologies, experimental procedures, and/or designs of new devices/instrumentation to complete the work. The student must receive approval from his/her research advisor before proceeding to take the exam. Prior to providing the written proposal to the committee, it is expected that the research advisor has read through it and provided feedback to the student to make appropriate revisions.

      The following guidelines apply: The research plan of the proposal should be approximately 30 pages (double-spaced, 12 point font). The organization of the written document (or individual sections of the document) should be roughly as follows:

      1. Abstract (1 pg)
      2. Research plan (~25 pgs)
         2.1. Introduction (2 pages)
         2.2. Hypotheses/objectives/specific aims/goals (1-2 pages)
         2.3. Background information (3-4 pages)

2.4. Significance of work (1/2 page)
2.5. Preliminary results (5-6 pages)
2.6. Research design and methods (10-12 pages)
2.7. Anticipated timetable (1 page)

3. Summary (1 page)
4. References
5. Appendix (can include publications in review, in press, or published)

The written document should be given to the faculty committee one week before the date of the oral presentation.

b. Qualifying Exam Format: i) The oral presentation demonstrates proficiency in oral expression of scientific and engineering methods and results and the ability to explain and elaborate on details of the project in a spontaneous fashion. Plan for the presentation to be approximately 30 minutes in length. The presentation should follow roughly the outline of the written document, but specifically elaborating on any difficult methods or interpretation of preliminary results. ii) Testing of proficiency in specialty graduate courses. As mentioned above, after the first year, an area of specialization (depth) will be designated for students to take a minimum of two additional graduate courses during the second year. The students will be expected to be proficient in these subjects during the qualifying exam to go along with the proposal defense. If you passed the qualifying exam, the written proposal is considered as equivalent to a MS thesis, and your MS degree in BME will be conferred. Those students qualifying in the summer will receive a Fall Master's degree. iii) It is the requirement of the HSSoE that the Qualifying Exam take place on one day at one time, with all committee members in attendance. If it is not possible for all members to be physically in attendance, one member (maximum) can be present via video conference with the use of Skype or another similar application. However, original signatures of all committee members are required on the PhD I form.

5. Students in their 3rd or 4th year must present results of their current research in the BME seminar series (20-25 min seminar with 5-10 min discussion): The advisor and at least one member of the graduate committee are required to attend, and a brief written assessment of the student's academic progress is retained in the department records.

6. Completion of a significant body of original research and the submission of a written and an oral defense of an acceptable dissertation: The Ph.D. will be awarded upon submission and oral defense of an acceptable written dissertation. It is the requirement of the HSSoE that a dissertation defense take place on one day at one time with all members of the Doctoral Committee in attendance. The defense must be open to the public. At the defense, you must present Ph.D. Form II to your doctoral committee to have them sign off on the successful passing of your examination. Remember that your final doctoral committee members must be the same members who you selected by placing an asterisk next to their names on Ph.D. Form I. If you plan to deviate from the original membership, notify Karen Stephens so an exceptional request can be submitted to Graduate Division prior to your defense date. You will need your committee to sign the cover page of your dissertation before submitting it to the University Archives. The degree will be granted upon the recommendation of the dissertation committee and the Dean of Graduate Studies. Completion of the Ph.D. is expected in four to five years following completion of the B.S. degree, although a maximum of seven years is allowed.

Suggested Doctoral Degree Plan

First year

Classes: Your first year will be spent primarily taking classes to fulfill the course requirements previously described, and preparing for the Spring preliminary examination. You must enroll in at least 12 units each quarter to be a full-time student. See Section V for a sample program. It is important to note that the course offerings are subject to change.

Faculty Advisor Matching: You are required to register for a minimum of two quarters of BME 299 (independent study) for a total of at least four units (you may register for three different quarters if you so choose) with a faculty member of your choice. You are responsible for arranging this by contacting the faculty with whom you would like to rotate (except for international students – see "Lab Rotations" on page 9). These lab rotations allow students to find out more details about a particular lab and potential thesis advisors. Once you pass the preliminary exam, formal faculty advisor matching will take place. Beginning in the summer of your first year, financial support may come from your advisor. During the summer, you can be paid up to 100% but not less than 49%; during the academic year you are paid at 49%. It is very important that you begin the matching process early in your first year, so you have your financial support in place once you pass the preliminary exam.

Second year

Classes: In addition to BME 297 and BME 298, classes in the second year will be primarily elective courses that are needed to complete the course requirements for the degree. As mentioned above, an area of specialization is designated and at least two graduate elective "depth" courses are required for the student to take during this second year.

Research: A major portion of your time in the second year will be to begin your independent research project in the laboratory of your faculty advisor. Generally, this consists of substantial background research and learning of new experimental and theoretical techniques that are relevant to your new project. Your goal should be to gather enough preliminary results to establish a firm plan to complete your dissertation, which will be presented during the qualifying exam. The qualifying exam should be taken by the end of the summer of your second year and a doctoral committee should be identified to guide and direct the ensuing dissertation research.

Third year and beyond

Classes: You will most likely not be taking any formal lecture courses beyond the second year. In order to maintain full time status you should register for 12 units of BME 297.

Research: Once the qualifying exam is completed, you will spend the remaining time in the third, fourth and fifth (if necessary) years completing your proposed research. You will present results of your research in the BME seminar series once, either in the third or fourth year. Your work will culminate with the completion and defense of the dissertation.

Dissertation and final examination: Your dissertation must present basic research on an original experimental problem in Biomedical Engineering. The research will demand an intensive concentration of your time, effort and energy, and your faculty advisor will encourage you to work with greater independence as progress is achieved. You are encouraged to seek consultation with faculty members and other scientists and professionals outside the university to make the research experience as enriching as possible.

When you and/or your advisor feel you have learned how to do original and independent research and have produced publishable results, you should present your results to your doctoral committee in the form of a written dissertation and final oral defense. The doctoral committee supervises a final examination, the focus of which is proficiency in all aspects of the dissertation research topic. Ordinarily, the final examination will be given just before the completion of the dissertation and while you are in residence during a regular academic session. However, you can be on filing fee and still complete and defend your dissertation. Please see the Graduate Division website on current students and current student forms for more information. At least two weeks prior to your defense, you must send the abstract of your dissertation to the BME Graduate Academic Counselor, so the announcement of your defense can be sent to all members of the academic community. The defense is usually conducted in the same format as a seminar and is subject to final approval by the committee.

The doctoral committee certifies that the completed dissertation is satisfactory through the signatures of all committee members on the signature page of the completed dissertation. The final copy must meet the

university's requirements for style, format, and appearance before the degree can be conferred. For the thesis and dissertation manual refer to: http://www.lib.uci.edu/libraries/collections/special/uci_td/td6.html

After the dissertation has been approved by the doctoral committee, it must be filed electronically at the UCI Thesis/Dissertation Submission Site (www.etdadmin.com/uci).. Go to http://www.grad.uci.edu/current/thesis_elect.htm for complete details. You must also provide one copy of the dissertation for each member of your doctoral committee. Upon submission of the PhD II form and approval of the dissertation by Library Archives, the PhD degree will be conferred by Graduate Division.

A student who expects to complete all requirements for an advanced degree in a given quarter must be advanced to candidacy for that degree before the first day of the quarter in which the degree will be conferred. Students must complete the graduate student diploma and commencement form and are responsible for providing accurate information that will be printed on their diploma and in the commencement program. Questions regarding eligibility to participate in spring commencement and the logistics of commencement exercises should be directed to the Graduate Division.

Change of Degree Level from M.S. to Ph.D.: If you were admitted to the BME Department as a terminal Master's student and during your first year of study, you decide that you would like to remain at UCI to pursue a Ph.D. degree, this option is available providing the following requirements are met.

First, you would be required to pass the Preliminary Exam. With written support from the faculty member(s) with whom you wish to match, you may take the exam (written and oral if necessary) to demonstrate proficiency in the core courses. Second you would be required to submit a new Statement of Purpose, current transcript, and three letters of recommendation to the BME Graduate Admissions Committee. One of these recommendation letters should be from the faculty with whom you intend to match. This faculty member must be willing to provide your financial support for the duration of your thesis research. Once the Admissions Committee approves your change of degree level, the official form must be submitted to Graduate Division. Under no circumstances will a student be permitted to change their degree level without the approval of the BME Graduate Admissions Committee and the Associate Chair of Graduate Studies.

Change of Major from MCB or MD/PhD to Biomedical Engineering: Students admitted into the Math and Computational Biology Gateway Program (MCB) or the Medical Scientist Training Program (MSTP), can transfer into the Department of Biomedical Engineering to pursue a PhD degree. The requirements are that you must be in good academic standing within your home department and submit a new Statement of Purpose, current transcript, and letter of recommendation/support from the BME faculty who will be your advisor. Once this is approved by the Associate Chair of Graduate Studies, the Change of Major form can be submitted to Graduate Division. Some coursework taken in the student's home department may be transferable to BME, which will be approved on a case-by-case basis by the BME Graduate Advisor.

The deadline for transferring into the BME program is August 15. This will ensure the process is complete and all approvals have been received, prior to the registration deadlines for the Fall quarter. Students will not be permitted to take the preliminary exam prior to transferring into the BME program.

VII. FINANCIAL SUPPORT

First Year Support

The Department of Biomedical Engineering provides financial support for first year Ph.D. or M.S./Ph.D. students. This support package includes a stipend and full tuition and fees for students while they complete the course requirements in the first academic year. Continued funding for year two and beyond can be in the form of a TAship, Graduate Student Researcher, or fellowship, and is contingent upon satisfactory progress in the program, which includes passing all core courses, passing the preliminary exam and matching with a thesis advisor. It is the responsibility of the student to match with a thesis advisor in order to make satisfactory progress towards the degree objective. Once a student passes the preliminary exam, he/she is expected to match with a faculty advisor and pursue research full time in order to maintain satisfactory progress. If the student does not pass the preliminary exam, the BME Department and faculty advisor are under no obligation to continue financial support. Matching with an advisor will not be considered official until the student has passed the preliminary exam**.**

Graduate Student Researchers

A graduate student researcher performs research related to his or her degree program in an academic department or research unit under the direction of a faculty member. Appointment as a graduate student researcher, in combination with other university appointments, may not exceed 49% during the academic quarters. During the summer recess, appointments maybe increased to 100%. This type of appointment will likely comprise the bulk of your financial support and will be through individual research grants from your faculty advisor.

Student fees (including graduate student health insurance fee) and nonresident tuition, if applicable, may be paid for graduate student researchers with an appointment of 25% time or more by the hiring funding source, including federal grants and contacts. Students eligible for appointments as student researchers are so notified at the time of acceptance into the graduate program.

As a minimum, Biomedical Engineering graduate student researchers must be employed at the 49% level year round. The Department of Biomedical Engineering strongly recommends that graduate student researchers are employed at levels higher than 49% during the summer months.

Teaching Assistantships

The Biomedical Engineering Department will be allocating teaching assistantships in proportion to undergraduate enrollments. A limited number of these assistantships will be available each year to faculty members who are involved in teaching undergraduate courses. The final decision of TA allocations lies with the department chair. Students in the program may be eligible for additional teaching assistantships in the School of Biological Sciences, the School of Physical Sciences, and the HSSoE, and should contact these schools about potential opportunities if interested.

VIII. MISCELLANEOUS INFORMATION

Work-related Injuries

Any work-related injury must be immediately reported to your supervisor/faculty advisor. In addition, you must also inform Karen Stephens in the BME Business Office.

IX. BIOMEDICAL ENGINEERING FACULTY AND AFFILIATES

BME FACULTY

ABRAHAM P. LEE, Ph.D., William J. Link Professor & Chair, Biomedical Engineering, Professor, Mechanical and Aerospace Engineering, Director, Micro/Nano Fluidics Fundamentals Focus (MF3) Center
Research Interests: integrated micro and nano fluidic chips (pumps, valves, sensors) for the following applications: point-of-care diagnostics, "smart" nanomedicine for early detection and treatment, automated cell sorting based on electrical signatures, tissue engineering and stem cells, micro/nano particles for drug delivery, and biosensors to detect environmental and terrorism threats
aplee@uci.edu — http://biomint.eng.uci.edu/ - http://www.inrf.uci.edu/mf3/

MICHAEL W. BERNS, Ph.D., Professor, Biomedical Engineering, Surgery, and of Developmental and Cell Biology
Research Interests: photomedicine, laser microscopy, and biomedical devices
mwberns@uci.edu — http://www.bli.uci.edu/ - http://www.robolase.ucsd.edu/

ELLIOT BOTVINICK, Ph.D., Assistant Professor, Biomedical Engineering, Beckman Laser Institute
Research Interests: cellular and tissue biomechanics, cellular mechanotransduction, vascular mechanobiology, tissue function
elliot.botvinick@uci.edu - http://botvinick.bli.uci.edu/

JAMES P. BRODY, Ph.D., Associate Professor, Biomedical Engineering
Research Interests: single molecule dynamics, bioinformatics, functional genomics, surface plasmon resonance
jpbrody@uci.edu - http://brodylab.eng.uci.edu/

ZHONGPING CHEN, Ph.D., Professor, Biomedical Engineering and of Electrical Engineering and Computer Science
Research Interests: microfabrication and fiber optic based biomedical imaging systems development
z2chen@uci.edu — http://chen.bli.uci.edu/

BERNARD CHOI, Ph.D., Associate Professor, Biomedical Engineering, Beckman Laser Institute
Research Interests: in vivo research, optical imaging, microvasculature, therapy monitoring, neurosurgery, dermatology, instrumentation development
choib@uci.edu - http://choi.bli.uci.edu/

STEVE C. GEORGE, M.D., Ph.D., Director, Edwards Lifesciences Center for Advanced Cardiovascular Technology; Professor of Biomedical Engineering and Chemical Engineering & Materials Sciences
Research Interests: tissue engineering, prevascularization of implantable tissues, epithelial-mesenchymal cell communication, airway remodeling, wound healing, physiological systems modeling, and computational methods
scgeorge@uci.edu — http://georgelab.eng.uci.edu

ENRICO GRATTON, Ph.D., Professor, Biomedical Engineering, Physics and Astronomy, and School of Physical Sciences
Research Interests: fast-relaxation in enzymes, fluorescence properties, hydration of proteins, IR spectroscopy of biological substances, nucleic acids-fluorescent probe interactions
egratton@uci.edu - http://www.lfd.uci.edu

JERED HAUN, Ph.D., Assistant Professor, Biomedical Engineering
Research Interests: nanotechnology, molecular engineering, computational simulations, targeted drug delivery, clinical cancer detection
jered.haun@uci.edu

ELLIOT HUI, Ph.D., Assistant Professor, Biomedical Engineering
Research Interests: biological microtechnology, spatial cell biology, microscale tissue engineering, global health diagnostics, microfluidic computing
eehui@uci.edu - http://hui.bme.uci.edu

TIBOR JUHASZ, Ph.D., Professor, Biomedical Engineering and School of Medicine
Research Interests: laser tissue remodeling and laser-cell interactions with particular interest in ophthalmic applications
tjuhasz@uci.edu

ARASH KHERADVAR, M.D., Ph.D., Assistant Professor, Biomedical Engineering
Research Interests: cardiovascular engineering with emphasis on cardiac mechanics, cardiac imaging and cardiovascular devices
arashkh@uci.edu - http://kheradvar.eng.uci.edu

MICHELLE KHINE, Ph.D., Assistant Professor, Biomedical Engineering
Research Interests: single cell electroporation, shrinky-dink microfluidics, microsystems for stem cell differentiation, canary on a chip, quantitative single-cell analysis of receptor dynamics and chemotactic response on a chip
mkhine@uci.edu - http://shrink.eng.uci.edu/

FRITHJOF KRUGGEL, .M.D., Professor, Biomedical Engineering
Research Interests: signal and image processing for analysis of neurofunctional data (MRI, fMRI, PET, ERP, ERF), relation between structure and function in the human brain
fkruggel@uci.edu — http://sip.eng.uci.edu

WENDY LIU, Ph.D., Assistant Professor, Biomedical Engineering
Research Interests: cell and tissue engineering, biomaterials, microfabricated technologies, mechanotransduction
wendy.liu@uci.edu

ZORAN NENADIC, D.Sc., Assistant Professor, Biomedical Engineering
Research Interests: adaptive biomedical signal processing, control algorithms for biomedical devices, brain-machine interfaces, modeling and analysis of biological neural networks
znenadic@uci.edu - http://cbmspc.eng.uci.edu

WILLIAM C. TANG, Ph.D., Associate Dean for Research, Professor, Biomedical Engineering and Electrical Engineering and Computer Science; Director, Microbiomechanics Laboratory
Research Interests: micro-and nano-scale technology for biomedical implants and micro-scale biomechanics.
wctang@uci.edu — http://wctgroup.eng.uci.edu

BRUCE TROMBERG, Ph.D., Director of the Beckman Laser Institute and Professor, Biomedical Engineering and Surgery
Research Interests: lasers, near infrared spectroscopy, non-invasive diagnostics, photomedicine, biomedical optics, photodynamic therapy
bjtrombe@uci.edu — http://www.bli.uci.edu/

BME AFFILIATED FACULTY

For a complete list of BME Affiliated Faculty go to: http://www.eng.uci.edu/dept/bme/faculty

X. IMPORTANT PEOPLE AND CONTACT INFORMATION

ABRAHAM P. LEE, PH.D.
Chair
(949) 824-8155
aplee@uci.edu

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Graduate Advisor
(949) 824-3729
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KAREN STEPHENS
Graduate Academic Counselor
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kstephen@uci.edu

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Academic Personnel/Payroll Analyst
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NATALIE IMONDI
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JAMES SHYU
Course Lab Manager
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HSSOE GRADUATE STUDENT AFFAIRS STAFF

SONJA DIETRICH
Director
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JEAN BENNETT
Academic Counselor
(949) 824-6475
jean.bennett@uci.edu

XI. IMPORTANT FORMS

Below is a list of several important forms required during your study here at UCI. **You are responsible for completing your own forms.** Submit all forms to Ms. Karen Stephens in the BME Business Office and she will obtain signatures for you. Most of these forms can be obtained on-line at: http://www.grad.uci.edu/forms/

PLAN OF STUDY FORM

To be completed by the first month in the biomedical engineering program. Complete the first section and return to Karen Stephens.

ADVANCEMENT TO CANDIDACY / FINAL REPORT FOR THE MASTERS DEGREE

Necessary for obtaining the Master's degree. Please note that you must advance at least one quarter before completion of your M.S. degree

GENERAL PETITION FOR GRADUATE STUDENTS

Submit this form when you want to petition for transfer of courses into a program, when you want to substitute a course for another required course, or for a B- to count towards your degree requirements (you are allowed one B- to be used toward your M.S. degree for a non-core course).

NOMINATION OF PH.D. QUALIFYING EXAMINATION COMMITTEE

The Nomination of Ph.D. qualifying examination committee form must be reviewed in the student's department and submitted at least two weeks before the date of the Ph.D. Qualifying Examination.

REPORT OF THE PH.D. CANDIDACY COMMITTEE (PH.D. FORM I)

On the day of your qualifying exam, complete Ph.D. Form I and obtain signatures from your chair and committee members. (See previous sections for committee composition) After the final signatures have been obtained, submit the form with the $90 Advancement to Candidacy Fee to Graduate Division, 120 Aldrich Hall.

REPORT ON THE FINAL EXAMINATION FOR PH.D. DEGREE (PH.D. FORM II)

Upon completion of your defense and approval of the dissertation, the Doctoral Committee recommends the conferral of the Ph.D. degree. This form must be signed by the committee members and the dissertation is filed with the University Archives.

ACADEMIC LEAVE OF ABSENCE

A Leave of Absence can be granted for up to one year (3 quarters) for temporary interruption of a student's academic program.

FILING FEE PETITION

Students who have completed all requirements for a M.S. or Ph.D. degree except for the official submission of their thesis or dissertation, are eligible to submit this petition. A Filing Fee Petition can be submitted for one quarter only and is a reduced fee in lieu of other student fees.