

KU Bioengineering Graduate Program

Guidelines for Graduate Study

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Graduate Handbook

KU Bioengineering Graduate Program

Guidelines for Graduate Study at the University of Kansas

Preface

University Policy

As a premier learning and research institution, the University of Kansas must continuously address issues of diversity and multiculturalism. Every member of the university community is expected to engage in action that leads towards the development of a more democratic and inclusive community. Proactive efforts towards increasing diversity and the elimination of discrimination are necessary in our university.

The University of Kansas prohibits discrimination on the basis of race, color, religion, sex, national origin, age, ancestry, disability, and veterans status in accordance with Titles VI and VII of the Civil Rights Act of 1964, the Equal Pay Act of 1963, the Age Discrimination in Employment Act of 1967, Executive Order 11246, Title IX of the Education Amendments of 1972, Section 503 and 504 of the Rehabilitation Act of 1973, The Americans with Disabilities Act, the Vietnam Veterans Readjustment Assistance Act of 1974, the Kansas Acts Against Discrimination and all other applicable civil rights and nondiscrimination statutes.

The University of Kansas is committed to the full participation of previously excluded or neglected classes of people. Thus, it is also the policy of the university to prohibit discrimination on the basis of sexual orientation, marital status, and parental status. The university's nondiscrimination policy extends to employment practices, conditions of employment, personnel actions and all other educational programs and activities of the university and its affiliates. Leaders in the university community continuously examine all areas of the institution, make policy decisions, and implement strategies to eliminate and prevent discrimination wherever necessary. Reports of discrimination shall be evaluated promptly and acted upon in the manner deemed necessary by the appropriate faculty and administrators and as prescribed by the appropriate grievance procedure.

For additional information or assistance on the equal opportunity, affirmative action and harassment policies of the University, please contact: Ola Faucher, Director, The University of Kansas Dept. Human Resources & Equal Opportunity, 1246 W. Campus Road, Room 103, Lawrence, KS 66045-7505, (785) 864-7411.

Academic Integrity

Academic integrity is a central value in higher education. It rests on two principles: first, that academic work is represented truthfully as to its source and its accuracy, and second, that academic results are obtained by fair and authorized means. "Academic misconduct" occurs when these values are not respected. Academic misconduct at KU is defined in the University Senate Rules and Regulations [www.ku.edu/~unigov/usrr.html#art2sect6]. A good rule of thumb is "if you have to ask if this is cheating, it probably is." Academic integrity is based on five fundamental values: honesty, trust, fairness, respect, and responsibility [www.vpss.ku.edu/academic.shtml].

The KU Bioengineering Program expects all faculty, students and staff to maintain academic integrity at all times while conducting their academic work in educational, research and service programs in accordance with the highest ethical standards of the engineering profession. Students are expected to maintain academic integrity by refraining from academic misconduct, refraining from behavior which aids others in academic misconduct or which leads to the suspicion of academic misconduct. Academic misconduct will result in disciplinary actions ranging from a failing grade on assignment(s) and/or course(s) to academic probation, suspension, or dismissal from the University.

Graduate Handbook

I. Introduction

This manual provides details of the degree requirements as well as procedures to be followed in completing each degree program. If questions arise that are not answered by this handbook or the graduate catalog, please contact your BioE graduate advisor, the staff in the BioE graduate office, or the Academic Director for the BioE Graduate Program.

II. Mission Statement

Our mission is to be a national leader in bioengineering research, educational activities, and technology transfers. Students work together with bioengineering faculty from a wide variety of technical backgrounds on some of the most perplexing and challenging problems in the field.

III. Program Organizational Structure and Governance

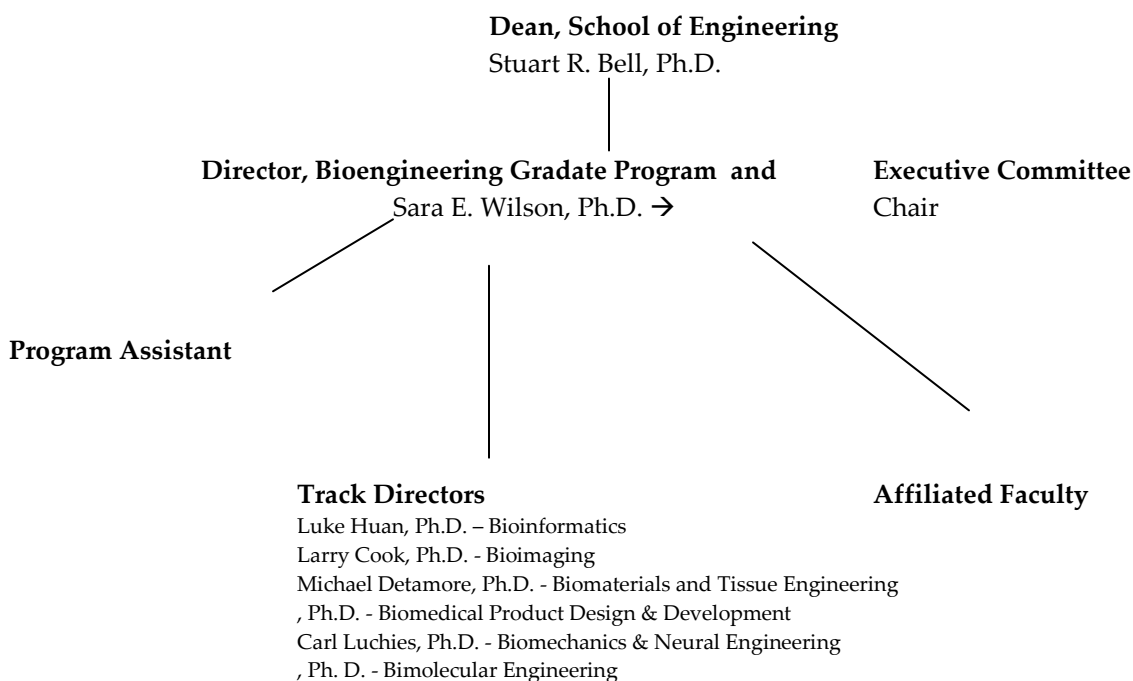
Serving in an advisory capacity to the Academic Program are:

1-Bioengineering Advisory Board

Arvin Agah, Ph.D. Associate Professor Electrical Engineering and Computer Science KU-Lawrence
 William Brooks, Ph.D. Professor, Neurology
 Director, Hoglund Brain Imaging Center KU – Medical Center
 Paul Cheney, Ph.D., Professor and Chair Molecular & Integrative Physiology KU – Medical Center
 Mike Insana, Ph.D. , Professor and Chair Bioengineering University of Illinois Urbana-Champaign
 Carl W. Luchies, Ph.D.(Chair) Associate Professor, Mechanical Engineering Director,
 Bioengineering Graduate Program KU – Lawrence
 Terence McIff, Ph.D., Research Assistant Professor, Orthopedic Surgery KU – Medical Center
 Mark Richter, Ph.D., Professor, Molecular Biosciences KU-Lawrence
 Bob Spilker, Ph.D., Professor, Bioengineering Rensselaer Polytechnic Institute
 Elizabeth Topp, Ph.D., Professor, Pharmaceutical Chemistry KU-Lawrence
 Gary Yamaguchi, Ph.D., Senior Managing Engineer, Exponent
 ex officio Paulette Spencer, Ph.D., D.D.S. Distinguished Professor, Mechanical Engineering;
 Director, Bioengineering Research Center KU – Lawrence

2-Bioengineering Research Center

Director, Paulette Spencer, Ph.D. D.D.S.



IV. Unique Features of KU Bioengineering State and Institutional Focus on Biosciences

The Oread. April 23, 2004. Vol. 28, No. 15

\$500 Million for Biosciences

A bill that Chancellor Robert Hemenway calls “the most significant nonbudget issue for KU this spring” received final approval on Monday, April 19, 2004 from Gov. Kathleen Sebelius.

The Kansas Economic Growth Act (KEGA) was signed into law during a ceremony in Lenexa attended by KU faculty and administrators. Under the act, the state’s public research universities stand to benefit from a potential infusion of \$500 million over 10 years into biosciences research, facilities and new staff.

While KEGA incorporates six related bills, the centerpiece legislation creates an 11-member authority with independent power to invest future biosciences industry tax revenue in biosciences research. The goal of this investment is to double employment in this field.

Kansas currently has 160 biosciences companies statewide employing 11,000 to 13,000 people. Another 8,500 people work in biosciences research and related areas at the state’s universities.

KEGA “may well be the most memorable landmark of this session for public higher education,” Hemenway said, comparing this week’s bill to the bonding bill in 2002 that funded laboratory space and equipment in Lawrence and the new Biomedical Research Center at KU Medical Center.

KU will benefit under the new law, he added, “since we are already the state’s leading research university and a strong partner in the Kansas City Area Life Sciences Institute.”

“Bold, ambitious plan”

Rep. Kenny Wilk, R-Lansing, was the principal supporter for KEGA during the legislative session, which should adjourn next week.

Wilk spoke about KEGA April 14 at the Dole Institute of Politics before an audience of KU students, staff and the public.

“Kansans are ready for a bold, ambitious plan,” Wilk said.

He outlined his vision for a stronger Kansas economy, one that relies less on three industries—agriculture, aviation, and oil and gas—that are in decline. That future economy will feature a new, major segment—biosciences—that depends on strong research universities.

KEGA “is about job creation,” Wilk said, and “reaches across Kansas—north to south, east to west.” The overall act “has something for everybody, no matter where they live.”

Wilk said biosciences were identified as the cornerstone of the proposal for four reasons:

- Kansas has tremendous existing research resources at KU and Kansas State University.
- The Kansas City region has three private groups (Stowers Institute, Kauffman Foundation and Hall Family Foundation) that have made substantial commitments to biosciences research and technology transfer.
- Economists project that the biosciences industry will make up 15 percent to 18 percent of the gross domestic product within 20 years, comparable to where the health care industry is today.
- The biosciences industry is in an early stage of development and is growing rapidly, equivalent to where computer technology was 40 years ago.

Positive reaction to KEGA

Wilk acknowledged that KEGA involves some risks for Kansas, including investments that don't pay off. "This will not be easy, and there will be some failures," he said.

However, Wilk said the risk of doing nothing was greater than the risk of moving forward. Kansas doesn't have the luxury of waiting decades to implement a major structural change in its economy.

Wilk said he was "stunned" by the positive reaction to KEGA among young Kansans, as well as those who want their children to return to Kansas to work in the biosciences industry.

Wilk introduced the KEGA legislation in January, with co-sponsorship by Sen. Nick Jordan, R-Shawnee, and strong support from Sebelius, Lt. Gov. John Moore and the Kansas Technology Enterprise Corp. Other active supporters of the legislation included the Kansas Board of Regents, KU and other universities, the Kansas City Area Life Sciences Institute and the Kansas Farm Bureau.

For more information about KEGA, visit the University Relations Web site for governmental relations, www.govrelations.ku.edu/.

Breadth of Faculty Areas of Specialization

At KU, there is current research in many disciplines that has relevance to Bioengineering students. From joint mechanics to brain imaging, from genomics to tissue scaffolding; from finding cures for diseases to designing products that can be used in clinical practice; from nanotechnology to bioinformatics -- students can do just about anything within the field of bioengineering at KU. We draw our strength from strong programs in the Medical School, Allied Health fields, Chemistry, the Biological Sciences, Physics, Pharmacy, Pharmaceutical Chemistry, and the Engineering disciplines. We strongly encourage students to thoroughly investigate the plethora of specializations of KU's diverse faculty. If you need help finding faculty pursuing research in your area of interest, please contact the Program Staff.

Research Facilities & Opportunities

Although the Lawrence campus and the Medical Center have separate leadership and administrative structures, their mission statements reflect complementary research objectives. The entire research portfolio at the Medical Center is related to the life sciences. While research on the Lawrence campus is more diverse, life sciences research accounts for 49% of all sponsored project expenditures. Because of this shared focus, collaborations are widespread and increasing. These collaborations are facilitated by major equipment and services available to researchers on all campuses.

Bioengineering students are uniquely positioned to take advantage of the myriad research opportunities offered at KU. Below is a partial listing of potential research centers or units available:

Centers, Groups, and Facilities

- Bioengineering Research Center
- Bioinformatics Core Facility
- Center for Biobehavioral Neurosciences in Communication Disorders
- Center for Environmentally Beneficial Catalysis
- Higuchi Biosciences Center
- Høglund Brain Imaging Center
- Landon Center on Aging
- Molecular Structures Group
- Orthopedic Research Center
- Kansas IDeA Network of Biomedical Research Excellence –K-INBRE

Research Laboratories

- Biodynamics Research Laboratory
- Bioinformatics and Computational Life Sciences Laboratory
- Biofluids Research Laboratory
- Biomaterials, Biomedical Product Design and Testing
- Bio-separations and Bioprocessing, Intensification
- Brain Control of Movement and Movement Disorders
- Controlled Release and Drug Delivery
- Diabetes Research Laboratory
- Drug Transport and Bioavailability Enhancement
- Experimental Joint Biomechanics Research Laboratory
- Functional Performance Laboratory
- Homogeneous Catalysts
- Hydrogels and Protein Polymers
- Human Motion Control Laboratory
- Laboratory for Macromolecular and Vaccine Stabilization
- Microscopy & Analytical Imaging Laboratory
- Molecular Simulation and Design
- Neuromuscular Research Laboratory
- Orthopedic Tissue Mechanics Research
- Protein Structure and Function
- Therapeutic Particles and Biomaterials Technology

- Tissue Engineering Laboratory

Distinguished Speaker Series

The Bioengineering Graduate Program is in the process of developing the **Bioengineering Distinguished Speaker Series** to assist in bringing outstanding researchers to KU for scientific discussions and presentations. The purpose is twofold:

1. To allow faculty to invite colleagues and potential collaborators to present their research and to hold discussions regarding possible future collaborations; and
2. To expose the university community to cutting edge research taking place in bioengineering and to allow students to interact with these distinguished researchers.

Bioengineering is by definition interdisciplinary. Therefore, we will work with departments across the KU-Lawrence and KU-Medical Center campuses to identify relevant speakers. The Distinguished Speaker Series will be a significant part of the Bioengineering Colloquium course, which is required for all BioE graduate students. The students will not only be exposed to a wide range of research, they will also have the opportunity to interact with leaders in their field and to learn about research being conducted at other academic institutions and in industrial settings.

The Speaker Series will bring in highly-regarded bioengineers from academia and industry to a wider KU audience by presenting research, new applications, and products, etc. This series facilitates networking and connectivity among KU's research faculty; fosters external collaborations between KU researchers, researchers from other academic institutions and industry; and increases awareness of KU's Bioengineering and Bioscience research. The Speaker Series will be a significant part of the Bioengineering Colloquium course, which is required for all BioE graduate students.

V. Degree Programs

The Bioengineering program offers Master of Science (MS) and Doctor of Philosophy (PhD) degrees in Bioengineering, and the M.D./Ph.D. degree in conjunction with the University of Kansas School of Medicine. The Bioengineering Program provides knowledge breadth in engineering and the biological sciences, and knowledge depth in a particular research area. The degrees will prepare students for careers in private and public firms, and a university setting.

M.S. Degree Requirements

The M.S. bioengineering degree program provides knowledge breadth in engineering and the biological sciences, and knowledge depth in a particular research area. The degree will

prepare students for careers in private and public firms, and a university setting. A thesis is required.

The M.S. BIOE is evidence of an ability to work as an engineer and researcher, who is capable of some independent investigation, and who can present the results of that investigation cogently. The holder of the Master's degree will have completed significant course work, a thesis that describes an independent investigation, and will have passed a final examination on the research underlying the thesis.

The program is rigorous, and places high demands on the student. Students must demonstrate that they understand interdisciplinary concepts, are able to generate testable hypotheses, design experiments, and collect and analyze data, both independently and within team and interdisciplinary environments.

The degree aspirant works with an advisor from his or her selected track area to develop a formal Plan of Study. The track areas encompass the major research and educational themes within the BIOE degree program; each track has a director and affiliated faculty. The student selects from among track courses offered under the track areas to construct a comprehensive educational and research program that takes (a) advantage of the student's background, (b) demonstrates academic and research skills, and (c) capitalizes on the strengths of the affiliated faculty.

Goals and Objectives

The general goals and objectives for the BIOE Master's degree are to:

1. Provide students with an in-depth understanding of mathematics, engineering principles, physics, chemistry, physiology, and modern biology;
2. train students to apply basic sciences to biological problems, using engineering principles;
3. train students to do bioengineering research; and,
4. train students to apply bioengineering research to commercially viable problems.

The Plan of Study

The student's Advisor will help the student develop his/her "Plan of Study", which must be approved by the student's Advisory Committee. The Plan of Study must consist of the following components: CORE, RESEARCH, DEPTH and BREADTH courses. Details regarding the list of approved courses are available on the Track Advising Sheets.

CORE (6 hours)

- CPE 756 Introduction to Bioengineering (3).
- ENGR 800 Bioengineering Colloquium (0.5 hrs/semester, 4 semesters required).
- ENGR 801 Issues in Scientific Integrity (1).

RESEARCH (6 hrs)

The student's research will lead to the Master's thesis, which demonstrates that its author has completed an original and independent investigation of a significant problem. The thesis provides evidence that the student can recognize an important problem, acquire the data to answer the questions posted within that problem, and extend the results of the answered questions to other problems of significance. Defense of the thesis is scheduled when the Advisory Committee listed on the Plan of Study agrees that the research is complete.

DEPTH and BREADTH Courses (18 hrs min)

Students must complete at least 18 approved hours in their selected track and 6 hours of thesis. A minimum of 30 total hours is needed to fulfill degree requirements. The detailed list of approved courses within each track is available from the bioengineering program director.

Credit Hours Required by Track**MS (30 hrs min)**

	Bioimaging	Bioinformatics	Biomaterials	Biomechanics	BioProducts	Biomolecular
CORE	6	6	6	6	6	6
RESEARCH	6	6	6	6	6	6
DEPTH	9	9	6	9	9	0
BREADTH	9	9	12	9	9	18

Ph.D. Degree Requirements

The Ph.D. bioengineering is evidence of ability to work as an engineer and researcher who demonstrates excellence in scientific research and continued intellectual leadership as an independent researcher. The holder of a Ph.D. degree will have completed a rigorous set of track courses and, courses outside of the track department, and pursue a focused research project. A dissertation is required.

The program is rigorous, and places high demands on the student. Students must demonstrate that they understand interdisciplinary concepts, are able to generate testable hypotheses, design experiments, and collect and analyze data, both independently and within team and interdisciplinary environments.

The Doctor of Philosophy bioengineering degree program provides knowledge breadth in engineering and the biological sciences, and knowledge depth in a particular research area. The degree will prepare students for careers in private and public firms, and a university setting.

The aspirant works with an advisor from his or her selected track area to develop a formal Plan of Study. The track areas encompass the major research and educational themes within the bioengineering degree program; each track has a director and affiliated faculty. The

student selects from among track courses offered under the track areas to construct a comprehensive educational and research program that takes (a) advantage of the student's background, (b) demonstrates academic and research skills, and (c) capitalizes on the strengths of the affiliated faculty.

Goals and Objectives

The general goals and objectives for the bioengineering Ph.D. degree are to:

1. provide students with an in-depth understanding of mathematics, engineering principles, physics, chemistry, anatomy and physiology, computation, and modern biology;
2. train students to apply basic sciences to medical and biological problems, using engineering principles;
3. train students to recognize and provide engineering solutions to clinical problems;
4. train students to research bioengineering problems;
5. train students to apply bioengineering research to commercially viable problems; and,
6. train students to teach bioengineering at the graduate and undergraduate levels.

The Plan of Study

The student's Advisor will help the student develop his/her "Plan of Study", which must be approved by the student's Advisory Committee. The Plan of Study must consist of the following components: CORE, RESEARCH, DEPTH, BREADTH and ELECTIVES. Details regarding the list of approved courses are available on the Track Advising Sheets.

CORE (6 hours)

- CPE 756 Introduction to Bioengineering (3).
- ENGR 800 Bioengineering Colloquium (0.5 hrs/semester, 4 semesters required).
- ENGR 801 Issues in Scientific Integrity (1).

RESEARCH (18 min – 24 max)

The student's research will lead to the PhD's dissertation, which demonstrates that its author has completed an original and independent investigation of a significant problem. The dissertation provides evidence that the student can recognize an important problem, acquire the data to answer the questions posted within that problem, and extend the results of the answered questions to other problems of significance. Defense of the dissertation is scheduled when the Advisory Committee listed on the Plan of Study agrees that the research is complete.

DEPTH, BREADTH and ELECTIVES (30 -36 hours)

Students must complete the number of hours required in the respective track that they have chosen. The total number of hours for degree completion will vary by track; with a minimum is 60 hrs.

Credit Hours Required by Track

PhD (60 hr min)

	Bioimaging	Bioinformatics	Biomaterials	Biomechanics	BioProducts	Biomolecular
CORE	6	6	6	6	6	6
RESEARCH	18	18	18	18	18	18
DEPTH	9	18	9	15	18	9
BREADTH	12	18	18	18	15	12
ELECTIVES	15	0	9	3	3	15

Examinations

There are three examinations that are part of the Ph.D. curriculum. Successful completion of the qualifying and comprehensive exams will admit the student to Ph.D. candidacy. The defense is the final exam.

1. The Qualifying Examination

The qualifying examination is normally taken following completion of the majority of the track coursework (typically within the first year). The qualifying exam can serve as an entrance exam to the Ph.D. exam. This exam can be taken a maximum of two times.

2. The Comprehensive Examination

The major examination in a doctoral student's career is the comprehensive examination. It is intended to assure that the student has potential to become an independent investigator. The skills demonstrated in this examination include those necessary to obtain funding for research and development in academia, government, and industry; these skills are expected to be highly developed. The comprehensive examination is used to determine the soundness, significance, and originality of the student's research project, as well as test the clarity and thoroughness of the student's understanding. It provides an opportunity for the student to justify his or her research vision, describe the initial research plan, and present preliminary data demonstrating feasibility of the project. The comprehensive examination affords an opportunity to correct deficiencies in the student's overall educational program that become evident during the course of the exam. As an open examination, the comprehensive exam also reflects on the quality of research. Passing the examination advances the student to doctoral candidacy status.

3. The Dissertation Defense

The doctoral dissertation demonstrates that its author has completed an original and independent investigation of a significant problem. The dissertation provides evidence that the student can define an important problem, develop a viable research plan to investigate

the problem and generalize the results to other problems of significance. Defense of the doctoral dissertation is scheduled when the Advisory Committee agrees that the research is complete.

VI. Bioengineering Tracks of Study & Prerequisites

Bioimaging

Track Director: Larry Cook, Ph.D.

Bioengineering brings together engineers, physicists, biologists and chemists engaged in the development of methodology for the examination of biological structure and function through imaging. Research encompasses magnetic resonance imaging, magnetic resonances spectroscopy, and image processing and analysis. Biomedical imaging methods open new ways to see the body's inner workings, measure biological functions, and evaluate cellular and molecular events using less invasive procedures.

Bimolecular imaging can record multiple molecules in cellular processes in three dimensions over time — an n-dimensional view that eclipses the capabilities of traditional microscopy and test-tube assays. Diagnostic imaging of tissues and organs has been a field of rapid advances, especially with the modalities of ultrasound, nuclear medicine, nuclear magnetic resonance and spectroscopy, X ray/CT, bioelectric, optical, endoscopic, and visualization strategies.

Emphasis continues to be on minimizing invasiveness, image and processing time, costs, and patient discomfort, and maximizing and easily interpreting data display. It requires exceptional collaborations of bioengineers, physicians, physiologists, physicists, chemists, biologists, mathematicians, and computer scientists.

Track Specific Prerequisites - Bioimaging

The prospective student should have the following track specific undergraduate preparation prior to entering the program:

Students with deficiencies in areas critical to the program may be required to complete additional courses in preparation for the qualifying exam. These include deficiencies in any of the program prerequisites for admission. Depending on the research project and the student's background, the advisor may also recommend additional remedial courses.

Bioinformatics

Track Director: Xue-Wen Chen

Bioinformatics generally describes the science of computational approaches to biological problems below the cellular level. Bioinformatics includes biological sequence

analysis, the structure and function of proteins and nucleic acids, genetic networks and gene expression, molecular evolution, and hypothesis generation from large-scale data sources.

Through modeling and analysis of systems, bioinformatics provides a rationalization for hypothesis formation, thereby reducing the problem space confronted by experimental approaches in traditional biology. Methodologies employed are derived from probability and statistics, signal processing, algorithms and their analysis, linguistics, graph theory, linear algebra, differential equations and optimization theory, database theory, and data mining. The bioengineering bioinformatics core at KU provides the student with formal course work in methodologies and applications with an emphasis on research.

Track Specific Prerequisites -- Bioinformatics

The prospective student should have the following track specific undergraduate preparation prior to entering the program:

1. Proficiency in at least one applied programming language and Software Engineering concepts: EECS 448 (or equivalent) (3).
2. Algorithms, Data Structures, Fundamentals of Analysis of Algorithms: EECS 560 (or equivalent) (3).
3. Automata Theory, Grammars, Theory of Computability: EECS 510 (or equivalent) (3).
4. Probability and Statistics: Math 526 (or equivalent) (3).

Biomaterials and Tissue Engineering

Track Director: Michael Detamore, Ph.D.

Biomaterials science is the study of materials and their interaction with biological environments, and tissue engineering is the application of engineering and life sciences toward development of a biomaterial to restore, maintain and improve tissue function. Research in this inter- and multidisciplinary field involves collaborations among engineers, surgeons, materials scientists, biological scientists, chemists, dentists, and veterinarians in academics, industry, government and the clinic.

Research in the Biomaterials and Tissue Engineering track involves the investigation and development of materials and structures to improve the quality of life for patients. These materials—which may be synthetic, natural, or cell-based—are intended to assist in the diagnosis of pathology or injury, monitor condition, and improve or restore normal physiological function in the human body.

Students in this track are trained in structure-function-property relationships, which are built on a foundation in biology, materials science, and engineering. As a part of their coursework, students learn to independently develop a plan of research.

Specific research areas available at KU include drug delivery devices, tissue engineering, soft tissue biomechanics, biosensors, diagnostics and therapeutics, combination products, biocompatible materials, injury biomechanics, hydrogels, microparticle fabrication, gene and protein delivery, mass transport, polymer science, biocatalysis,

biofluids, and dental materials. Graduates are prepared to enter into industry, government, or academics, where they will be able to assist in research programs in biomaterials.

Track Specific Prerequisites -- Biomaterials and Tissue Engineering

The prospective student should have the following track specific undergraduate preparation prior to entering the program:

1. Science of Materials: ME 306 (or equivalent) (3).

Biomechanics and Neural Engineering

Track Director: Carl Luchies, Ph.D.

Biomechanics is the scientific discipline that studies biological systems, such as the human body, using the methods of Mechanical Engineering. The purpose is to create new and innovative approaches, advance fundamental concepts, and apply knowledge to the improvement of the mechanics of biological systems. The biomechanics research focus at KU is on the human musculoskeletal system.

Our mission is to provide a quality graduate research and educational experience with emphasis on understanding and analyzing the mechanics of the human body through experimental measurement, mathematical modeling and computer simulations. This effort includes studies of the mechanics of the whole-body as a system, a group of body parts as a sub-system, and an individual body part as a component.

Collaborative research is underway among researchers in engineering, mathematics, the sciences and in various areas at the KU Medical Center.

Track Specific Prerequisites--Biomechanics and Neural Engineering

The prospective student should have the following track specific undergraduate preparation prior to entering the program:

1. Statistics: MATH 365 or MATH 465 (or equivalent) (3).
2. Statics, Mechanisms and Mechanics of Materials: ME 201/CE 201, ME 420 and ME 311 (or equivalent); or ME 633 Basic Biomechanics (as part of the graduate program) (3).
3. Science of Materials: ME 306 (or equivalent) (3); or ME 765 Biomaterials (as part of the graduate program) (3).
4. Computer Programming: ME 208/EECS 138/CPE 121 (or equivalent) (3).
5. Circuits and Electronics Lab: EECS 316 & EECS 318 (or equivalent) (3).
6. Instrumentation: ME 455 (or equivalent) (3).
7. Fluids: ME 510/CPE 511 (or equivalent) (3) or ME 756 Biofluids (as part of the graduate program) (3).

Biomedical Product Design and Development

Track Co-Directors: Elizabeth Friis, Ph.D. and Sara Wilson, Ph.D.

The Biomedical Product Design and Development Track combines graduate-level research and coursework with practical exposure to these clinical, business and regulatory processes in a professional, collaborative environment.

Design and development of new medical products requires advanced bioengineering expertise as well as an understanding of clinical applications, business considerations and regulatory aspects of the medical field. Advanced engineering skills interface with clinical needs and requirements.

Medical products to be developed can include diagnostic tools, interventional and therapeutic devices, imaging equipment and methods, and biomaterials. This track includes a course in biomedical product development to introduce basic concepts of design, quality system regulations, regulatory aspects and entrepreneurship.

Students use their new understanding of market-driven forces to plan and execute their research with end-driven methods and an understanding of how their research results could be applied to development of a biomedical product. They not only work with their own basic and applied research, but also with other researchers in the KU Bioengineering community.

Required courses in engineering design methods teach students how to successfully complete applied research. A clinical or industrial preceptorship is required to give students practical exposure to applied biomedical research and development. Students completing this track will be prepared to apply their product-driven education either in industrial research and development, in a regulatory agency, or in academia interfacing with industry.

Track Specific Prerequisites--Biomedical Product Design and Development

The prospective student should have the following track specific undergraduate preparation prior to entering the program:

1. Science of Materials: ME 306 (or equivalent) (3) or ME 765 Biomaterials (as part of the graduate program) (3).
2. Computer Programming: ME 208, EECS 138, CPE 121 (or equivalent) (3).
3. Engineering Design: ME 501, CPE 613, EECS 501 (or equivalent) (3).
4. Circuits: EECS 316 or ME 455 Instrumentation (or equivalent) (3).
5. Fluids: ME 510 or CPE 511 (or equivalent) (3); or ME 756 Biofluids (as part of the graduate program) (3).

At least one of the following three areas as required by the advisor:

1. Statics: ME 201 or CE 201 (or equivalent) (3).
2. Mechanisms: ME 420 or CE 300 (or equivalent) (3).
3. Mechanics of Materials: ME 311 (or equivalent) (3); or Basic Biomechanics: ME 633 (as part of the graduate program) (3).

Biomolecular Engineering

Track Director: Marylee Southard, Ph.D.

Biomolecular engineering research integrates the fundamentals of biology, chemistry and mathematics with engineering problem-solving methods to prepare students for careers in industry, academia and public service. Program faculty solve biological problems to increase understanding of a variety of biological systems.

Chemical and biological systems are studied to ultimately provide solutions — in the form of measurement of properties and function, imaging, diagnosis or therapeutics. Research in this area involves collaborations among engineers, biological scientists, chemists, physicians and pharmaceutical scientists in industry, academia, surgery and clinical settings.

Students in this track use a core background of mathematics, basic sciences and therapeutics and engineering courses to conduct interdisciplinary research. Elective courses are selected to prepare each student for their unique problem in such areas as drug design or development, biological materials design, characterization of cellular function or malfunction, transport in biological systems or analysis of complex data.

Track Specific Prerequisites--Biomolecular Engineering

The prospective student should have the following track specific undergraduate preparation prior to entering the program:

PhD Students with deficiencies in areas critical to the program may be required to complete additional courses in preparation for the qualifying exam. These include deficiencies in any of the Ph.D. prerequisites for admission. Depending on the research project and the student's background, the advisor may recommend additional deficiency courses. Examples of such courses include:

1. Organic Chemistry: CHEM 622/624/625 (or equivalent) (3).
2. Science of Materials: ME 306 (or equivalent) (3).

VII. Graduate Admission

Admission Criteria

Admission to the KU BioE Graduate Program is granted to students who have a superior record of achievement in their previous studies and demonstrate a strong potential for success in advanced level studies. The GRE is required (verbal, quantitative and analytical sections), and a GPA of 3.0 or better is expected. In order to make admissions determinations, the students entire file is considered. For example, strong test scores and personal statement may offset a GPA lower than 3.0; or a very high GPA may counterbalance a weaker GRE score. Along with letters of recommendation, the student's

academic preparation and a well-written personal statement will help us to determine the potential fit between KU Bioengineering and the prospective student.

Applicants normally have a Bachelors of Science degree or a Masters of Science degree in an engineering discipline, physical sciences (e.g. Chemistry, Physics, etc.), the life sciences (e.g. Biology, Biochemistry, etc.), or a closely related field. Successful applicants will have strong academic credentials, some formal research experience, and demonstrated potential for advanced study by performance at the baccalaureate level.

Direct Admission to the Ph.D. Program

Admission to the Bioengineering Graduate Program is granted to students who have a superior record of achievement in their previous studies and show strong potential to succeed in studies at the advanced level. Applicants normally have a Bachelors of Science degree or a Masters of Science degree in an engineering discipline, physical sciences (e.g. Chemistry, Physics, etc.), the life sciences (e.g. Biology, Biochemistry, etc.), or a closely related field.

Highly qualified undergraduate students may apply for admission directly into our Ph.D. program after completing their B.S. degree. Applicants who qualify will have:

- a degree in an Engineering discipline,
- an outstanding academic record,
- some experience with research during their undergraduate career,
- and a good idea of research to be pursued for the Ph.D.

In addition to the above, excellent letters of recommendation and a well-articulated personal statement will highly benefit applicants.

Conditional Admission

Students may enter the Bioengineering Graduate Program prior to meeting all the prerequisites **if approved by the Admissions Committee**. These students must plan to complete the prerequisites during their enrollment in the program **in addition** to the requirements for the MS and PhD degrees in Bioengineering. See the Academic Director or a Track Director for information on courses which would satisfy the requirements. Course credits from prerequisites are not applied toward the graduate degree.

Early Application M.S./Ph.D. for KU Students

General Preparation and Background Requirements

1. Mathematics: Mathematics through differential equations and linear algebra:

- Calculus I, MATH 121 (5 credits) or equivalent
 - Calculus II, MATH 122 (5 credits) or equivalent
 - Applied Differential Equations, MATH 220 (3 credits) or equivalent
 - Elementary Linear Algebra, MATH 290 (2 credits) or equivalent
2. Physics: One year of calculus-based physics:
 - General Physics I, PHSX 211 (4 credits) or equivalent
 - General Physics II, PHSX 212 (4 credits) or equivalent
 3. Chemistry: One course in general chemistry
 - College Chemistry, CHEM 125 (5 credits), OR
 - Foundations of Chemistry, CHEM 184 (5 credits) or equivalent
 4. Biology: One course in molecular/cell/human biology:
 - Principles of Biology, BIOL 100 (3 credits), OR
 - Principles of Molecular and Cellular Biology, BIOL 150 (4 credits), or equivalent

Application for Scholarships, Fellowships and Assistantships

In order to receive full consideration for fellowships and other awards, a complete application package should be submitted by the following deadlines:

- **Fall Admissions:** December 15 for the following fall semester.
- **Spring Admissions:** September 30th for the following spring semester.

The Bioengineering graduate admissions committee nominates applicants for University and School of Engineering scholarships and fellowships based on academic merit and other selection criteria, as specified by the fellowship selection committees.

How to Apply

Application for graduate studies in bioengineering at the University of Kansas consists of two steps. The first step requires completion of the graduate application and submission of a non-refundable application processing fee, which must be sent to the Graduate School. To begin the application, visit the Graduate School's website.

The supplemental materials must be sent to School of Engineering graduate office for evaluation, as described below.

Graduate School Materials

The following items must be sent directly to the University of Kansas Graduate School:

- A completed graduate application form: You may complete their graduate application forms online or they may download PDF versions of these forms and submit paper applications by mail. A link to application forms and the online application system is: <http://www.graduate.ku.edu/~graduate/GAPC/>
- The application processing fee must be sent along with the application. This non-refundable fee may be paid by check from a U.S. bank payable to "The University of Kansas" or it may be paid electronically during the online application process. According to Graduate School policy, applications sent without application processing fees will not be forwarded to the School of Engineering until application fees are received. The application processing fee is: \$45 (online domestic); \$55 (paper domestic); \$55 (online international); and \$60 (paper international).

Supplemental Materials

The following items must be sent to the Bioengineering Graduate office for evaluation (see address below):

- A completed bioengineering graduate application checklist.
- Three letters of recommendation on official university/company letterhead: A completed recommendation form must be included with each recommendation.
- A copy of your Graduate Record Exam (GRE) scores. The official scores are sent directly to the department by the Graduate Record Exam Board. The institution code for the University of Kansas is 6871. The program/department code is 1603. You may submit Medical College Admission Test (MCAT) or Dental Admission Test (DAT) scores instead of GRE scores. (Note that the School of Engineering uses these scores as an additional evaluation tool, but no specific score is required for consideration of an application or for admission.)
- A statement of your academic objectives: It is very important that you indicate which bioengineering tracks you are interested in. If you have identified an area of focus, or faculty members you would like to work with, please include this information in your letter. This will help with the assignment of potential GRA or GTA assignments.
- One copy of official transcripts of all undergraduate and graduate studies.

International students must also provide the following materials:

- A copy of your TOEFL scores: The official scores are sent to the department by the Test of English as a Foreign Language Exam Board (TOEFL). The departments require a *minimum* score of 530 (paper based test) or 200 (computer based test).
- A financial statement: The U.S. Department of State mandates that evidence of financial resources, such as an official bank statement, be provided in order to issue an I-20 and student visa.

Upon receipt of your application materials, Bioengineering Graduate office staff will send an email acknowledgement to you, which will include a list of items received and any items that may be missing. A graduate admissions committee will review

your academic credentials and forward an admission recommendation to the Graduate School. Both will send official notification of an admission status.

Mailing Addresses

University of Kansas Graduate School

Graduate Applications
1450 Jayhawk Blvd, Room 300
Lawrence, KS 66045-7535

Bioengineering Graduate Office

Attn: Program Assistant
1520 West 15th Street
Room 1, Eaton Hall
Lawrence, KS 66045-7621

Transfer Credit

Scholarships and Fellowships

The School of Engineering offers BioE students scholarships under the names of **Strobel Scholarship, Chaffee Scholarship, and the Constant Fellowship**. Students are nominated by Bioengineering for these funds during the annual School of Engineering (SoE) Scholarship/Fellowship Competition in February and the SoE is responsible for allocating and distributing the funds. The amount for all awards varies, usually between \$2,000 and \$10,000.

The **Thomas and Madeleine Turpin Bioengineering Scholarship Fund** is under the administration of the SoE. The School will work with the Bioengineering Program to identify a student for the award annually and funds will be allocated to the chosen student by the School of Engineering.

The **Graduate Engineering Ambassador Fellowship** is a new fellowship to which the student applies directly. This Fellowship requires the student to participate in School of Engineering activities such as recruitment events, conferences, Engineering Expo, etc.

There are other University-wide scholarships/fellowships that students may be eligible for, including:

Self Fellowship (<http://www2.ku.edu/~selfpro/>)

Melik Scholarship/Fellowship (<http://www.graduate.ku.edu/funding/internal/melik.shtml>)

Graduate Research Assistantships (GRAs)

Bioengineering Graduate Research Assistantship at the University of Kansas Medical Center (KUMC)

Purpose:

The University of Kansas Medical Center (KUMC) Bioengineering Graduate Research Assistantship (GRA) Program is designed to support highly capable students pursuing Ph.D. graduate study in the University of Kansas School of Engineering Bioengineering (BioE) Graduate Program with their dissertation research based at KUMC. The goal is to attract BioE graduate students into the research laboratories located at KUMC.

Eligibility:

The program is only open to those students who have been admitted into the KU-BioE graduate program and will be in his/her first or second year of Ph.D. level graduate studies during the one year KUMC-BioE GRA.

Terms & Conditions of Appointment:

KUMC BioE GRA Program provides tuition and stipend support to students seeking a doctoral degree. During the GRA period, the student is expected to be registered and enrolled as a full-time graduate student, conducting full-time research related to the completion of his/her degree within the objectives of the GRA program, or be on practicum assignments. This consists of full time enrollment during the Fall, Spring and summer semesters (6 to 9 credit hours for Fall & Spring, 1 to 3 credit hours for Summer) with appointments of 50% during the Fall & Spring semesters and 100% during the Summer. In the Fall term, the student will begin by participating in three KUMC practicum experiences (approximately six weeks each) done in basic science, clinical and bioengineering research laboratories, after which the student will select and then begin working on his/her dissertation in a KUMC research laboratory. It is expected that the selected laboratory will fund the remaining BioE student's dissertation program at the end of the one year KUMC BioE GRA.

The KUMC BioE GRA Program is not available to terminal M.S. candidates or to postdoctoral students.

Departments may, at their discretion, supplement stipends beyond the KUMC BioE GRA Program amount and may fund additional tuition or other benefits.

Annual Stipend:

- \$24,000 yearly stipend (subject to change annually)
- A \$1,000 academic allowance to be used for duplication expenses, conferences, copies of conference proceedings, travel, or other expenses incurred while doing research or activities directly related to professional development
- Tuition and fees

Application Deadline:

The applicant should complete the standard application process for the KU-BioE graduate program. The application for the KUMC BioE GRA consists of an additional letter stating the applicant's specific interest in pursuing his/her dissertation research at KUMC.

Other GRA Opportunities

During the first term at KU, it is the student's responsibility to investigate potential track(s) of interest, to select a track of study, to ask questions of the Program Director, to arrange meetings with potential faculty advisors, and to talk to our current graduate students about their experiences and insights. This is the right time to find out about funding opportunities available (e.g. Graduate Research Assistants, Scholarships, Fellowships, etc). Students should NOT be shy about asking prospective advisors whether or not he/she will have financial support available. By the end of the first semester in the BioE program, students will have identified a research advisor and with his/her help, have developed an initial draft of the Plan of Study.

Graduate Teaching Assistantships (GTAs)

Currently, the Office of the Provost provides funding for ten (10) GTAs in Bioengineering. Because we are a "program" and not a "department," our students serve in teaching capacities in departments and units throughout the School of Engineering and in certain other departmental class or lab situations for which they are qualified.

The GTA is designed to support students through their first year of the BioE Program. Students who do not win full fellowships or scholarships should follow the Seven Steps for New Students (see section VII. Student Life) and should work with their advisor or Program Staff to obtain funding to support their studies through the subsequent years in the program.

All students who accept offers of a GTA are **required** to go through both University and Departmental (or Programmatic) GTA training before their contract is valid. International students must score a 26 or higher on the iBT spoken section and a 50 or higher on the SPEAK test in order to be considered for a GTA position.

If you would like more information on benefits and responsibilities for GTAs, please see the following webpage: <http://www.provost.ku.edu/policy/graduate/>

The Campus Visit

The Bioengineering Graduate Program staff is happy to work with all prospective students in determining the fit between the student and the Program. In order to determine this, we feel that visiting our campus in Lawrence and the Medical Center campus in Kansas City is a very important step. In order to facilitate the campus visit, there are two main options:

The first, and most preferred, option entails simply applying for Fall admission to the program. Once admitted, our top students will be invited to participate in Visitation Days in late February prior to the Fall semester of your intended matriculation. Your travel and most of your meals will be paid if you choose to participate in Visitation Days. This organized visitation opportunity will allow you time to gather a great deal of first-hand information which we hope will help you in making a final decision about whether to attend KU.

The second option is for the student to make arrangements to visit us on their own, outside of organized events. With early notification, we will do our best to work with each student to provide information and schedule appointments with faculty when possible. Students should contact the Program Staff if this is the best option for them.

VIII. Student Life

Initial Orientation, Advising and Enrollment

Seven Steps for New Students:

Step 1:

FIRST TERM ENROLLMENT: At the BioE New Student Orientation, the BioE Director will discuss details about our program. You will then be advised by the program director, a track director, or your advisor (if you already have identified your advisor) regarding your deficiencies and course requirements for the track in which you are most interested. Your class schedule will be set for the current term, and tentative options will be discussed for the following term. This will be recorded on an advising sheet, which will be retained in your Advising file. After you have gone through Orientation & Advising, you will be shown how to use the KU Enroll & Pay System to complete your enrollment and the academic hold will be removed from your account. You will use this system each semester to enroll and to manage all your personal, academic and financial information while you are at KU.

Step 2:

SELECT TRACK & ADVISOR: During your first term at KU, it is your responsibility to investigate your track(s) of interest, to select your track of study, to ask questions of the Program Director, to arrange meetings with potential faculty advisors, and to talk to our current graduate students about their experiences and insights. This is the right time to find out about funding opportunities available (e.g. Graduate Research Assistants, Scholarships, Fellowships, etc). Don't be shy about asking prospective advisors whether or not he/she will have financial support for you as a graduate student. We expect that by the end of your first semester in the BioE program, you will have identified your research advisor and have developed an initial draft of your plan of study with your advisor.

Step 3:

SECOND TERM ENROLLMENT: There will be an enrollment hold placed on your account until you have submitted the draft of your plan of study which you and your advisor have established. Email your draft plan of study to the BioE program assistant and the academic hold will be removed for your second semester at KU. You do not need to specify your committee members nor does the draft plan of study need any approvals.

Step 4:

CREATE PLAN OF STUDY & SELECT COMMITTEE: During your second semester at KU and with the help of your advisor, you will select your committee (3 for MS, 5 for PhD). Please talk to each prospective committee member before including him/her as a committee member. Also, please review to the guidelines on BioE website regarding the make-up of the research committee. You will then request approval for your plan of study from your advisor, research committee and program director, which is done completely on-line. Please see the following website for more information about how the Plan of Study on-line system works: <https://gradplan.engr.ku.edu/> . (Your log-in is the same as your KU e-mail log in.) It is your responsibility to make sure that your Plan of Study is reviewed and approved by your advisor, your committee, and program director.

Step 5:

THIRD TERM ENROLLMENT: There will be an enrollment hold placed on your account until you have submitted your Plan of Study and it has met with final approval. Your Plan of Study must be complete, posted, and have met with final approval from the Program Director, your Advisor/Committee Chair, and all Committee members in order for your enrollment hold to be removed. Once your plan of study has been approved, please email the BioE program assistant or stop by BioE program office (3135A) and your enrollment hold will be removed.

Step 6:

FINAL & APPROVED PLAN OF STUDY: Once your Plan of Study has met with final approval, enrollment holds will no longer be placed on your account.

Step 7:

EXECUTE YOUR PLAN – HAVE ANY NECESSARY CHANGES APPROVED: At this point, any changes to your Plan of Study must be approved by your Advisor, all members of the Committee and the Program Director.

Student Organizations and Participation

Bioengineering Student Council (BioESC)

The Bioengineering Student Council was registered as a student organization in Fall 2008.

Conferences and Travel

School of Engineering (SoE) Graduate Student Travel Funds Policy

Graduate students attending a national or regional meeting may apply for funds through the School of Engineering differential fee account. Students must be presenting a paper or attending sessions that will enhance research or KU employment, and indicate how their

attendance benefits the University. Students must show proof that a paper has been accepted for presentation or attach an agenda of workshops that they will be attending. This request and supporting materials must be submitted at least two weeks prior to the date of the meeting.

Policy

Administration policy, specific funding criteria and procedures for application and administration are subject to the following constraints:

- The funds may be used only for travel related to the graduate student's research or KU employment.
- All funds will be allocated on the basis of the potential of the proposed travel to advance the graduate student's development, and on the graduate student's record of accomplishment. Preference will be given to Ph.D. students.
- Only degree-seeking graduate students may receive funding.
- There is no entitlement to a minimum annual amount of travel funding for any graduate student; the School will consider applications for funds up to a maximum of \$300 total per fiscal year.
- Travel expenses paid from this fund may not exceed the amount approved; furthermore, any excess between the amount approved and the amount expended cannot remain in any departmental account for subsequent use. Departmental budgeteers will process the travel request and all reimbursement documents after the travel is completed. Transfer of funds will only be processed for expenses submitted within 30 days of travel.
- The final reimbursement document will be sent to the SoE Budget Services Office so that any funds not utilized can be recaptured for use by other graduate students in the School.
- All university/state restrictions on travel apply (ticket purchase, per diem, etc.; student development) travel fund requests cannot supersede the required out-of-state travel request and travel deadlines (see http://www.comptroller.ku.edu/central_accounting_services, and/or contact departmental budgeteers for additional information and assistance). Note: graduate students traveling internationally must complete any paperwork required by the KU Office of International Programs (<http://www.oip.ku.edu/~oip/travel/dangerous.shtml>), and must adhere to 'travel warning' policies.
- Graduate students must use the attached form for submission of travel requests.

Instructions

Step One:

Graduate student submits Travel Request Form to Engineering Graduate Student Services, located in 1 Eaton Hall.

Step Two:

Engineering Graduate Student Services reviews and approves/denies submitted travel requests; approved requests are forwarded to the SoE Budget Services

Step Three:

Departmental Accounting Representative submits a Travel Authorization request form to obtain travel approval.

Step Four:

The SoE Budget Services Office transfers travel funds to the department upon verification of departmental payment.

Based upon reported expenditures versus the original request, unused funds will be returned to the travel pool for use by other SoE graduate students.

Insurance: Employees are covered by evacuation/repatriation insurance by virtue of being on the KU payroll. More information is available at:

http://www.hreo.ku.edu/benefits_pay/benefits_info/travel_insurance

The required ravel forms can be found on the School of Engineering website:

<http://enr.ku.edu/graduate/pdfs/travel.pdf>

IX. Earning the Degree**The M.S. Degree Program**

Credit Requirements

The Masters Committee

M.S. Paperwork

M.S. Plan of Study

Change of Plan

Change of Major

M.S. Thesis Defense

Time Limitations

The M.S./Ph.D Option**The Ph.D. Degree Program**

Credit Requirements

Ph.D. Paperwork

Ph.D. Plan of Study

Course of Progress

Year 1

Year 2

Years 3 and 4

Subsequent Years

The Doctoral Committee
Admission to Ph.D. Candidacy
Qualifying Examination
Overview
The Qualifying Examination Committee
Format and Content of the Exam
Results of the Examination
Research Skill Requirement
Teaching Requirement
Residency Requirement
Comprehensive Examination
Ph.D. Dissertation Defense
Time Limitations

X. Other Academic Issues

Annual Review of Students (Satisfactory Academic Progress)

Thesis & Dissertation Committees

Definitions

Affiliate Faculty – An affiliate faculty member is one who agrees to participate with the Bioengineering (BioE) Graduate Program in a *minimum of one of the following* ways:

- **Teach courses** that are of interest to Bioengineering students
- **Mentor** Bioengineering students through serving as an Advisor or by supporting BioE research efforts
- **Serve on committees** –
 - Student M.S. or Ph.D. research committees
 - Administrative Program committees (admissions, executive, qualifying exams, etc.)

An Affiliate Faculty member may also be asked to participate in recruiting graduate students. Such efforts will generally include making brief presentations about current research to visiting/prospective students or delivering such presentations at selected recruiting events and fielding requests for more detailed academic/research information from students accepted into the Bioengineering Graduate Program.

External Committee Member – The External Committee Member can be any member of the Graduate Faculty whose primary research area lies outside of the Bioengineering track that the student has chosen for his/her plan of study.

M.S. and Ph.D. Committee Make-up

Master’s Thesis Committee – Composed of three members of the KU Graduate Faculty:

- a minimum of one member with a primary appointment within the School of Engineering
- a minimum of one member with a primary appointment outside the School of Engineering, and
- the Advisor, who must be an Affiliate faculty member, serves as the committee chair

Doctoral Dissertation Committee – Composed of five members of the KU Graduate Faculty:

- a minimum of two members with primary appointments within the School of Engineering
- a minimum of one member with a primary appointment outside the School of Engineering
- one External Member (see definition above)
- the Advisor, who must be an Affiliate faculty member, serves as the committee chair.

Students wishing to be enrolled in both M.S and Ph.D.:

Process: With consent of Advisor and Program Director, students must fill out the “Do-All” form indicating a switch from M.S. to M.S./Ph.D. The form is completed, signed and submitted to Research and Graduate Programs (RGP) for School of Engineering Approval.

Requirements: Students must be making timely progress toward M.S. degree completion, and be in good academic standing. They must have an Advisor, a Committee and a completed and approved Plan of Study for the M.S. At the time students desire to switch to the M.S./Ph.D. program, he or she must have a clear topic and research agenda for the Ph.D. dissertation, which is supported by the Advisor/Chair. Students may begin taking Ph.D. course requirements, and upon successful defense of the Master’s Thesis may proceed to the Qualifying Examination for official Candidacy for the doctorate.

Students wishing switch from the M.S. to the Ph.D.:

Students wishing to switch from the M.S. to the Ph.D. degree will likely fall into two categories 1) the student applied, was accepted, and began the M.S. program but decided to pursue the Ph.D.; or 2) the student applied for the Ph.D., but the admissions committee recommended admittance into the M.S. instead.

Requirements: A current BioE MS candidate may request that the Graduate Studies Committee change his/her status to a PhD aspirant. Before making the request, the student is required to have competed all general and track deficiencies and a minimum of two semesters (Fall and Spring) as a full time KU BioE graduate student with a minimum 3.5 GPA (graduate courses only).

Process: The following is required to be submitted to the Graduate Studies Committee: 1) the student's letter of intent for his/her PhD program of study and 2) the advisor's letter of evaluation on the student's level of preparation to begin his/her PhD program of study. The committee's decision will be based on the student's letter of intent, the advisor's letter of evaluation, and the student's academic performance as a KU BioE graduate student. Generally, a student without an undergraduate degree in an engineering discipline will be required to finish the BioE MS degree before pursuing the BioE PhD degree. Exception to this policy must be approved by the Graduate Studies Committee.

Course Waivers:

Transfer/International Students: The student's academic transcript will be evaluated by the Program Director. If necessary, the student may need to provide additional information about the course(s) to be waived, i.e. course description, copies of completed assignments or tests taken in the course, etc. Once the course has been evaluated as having sufficiently prepared the student for further study at KU, or as having equally met the academic standards of a similar course at KU, the course may be waived. A **Course Waiver Petition** completed and signed by the Advisor and the Program Director may be submitted. Once signed, it will be retained in the student's academic file.

M.D./Ph.D. Students: To facilitate timely degree completion in the M.D./Ph.D. program, a certain set of courses will be waived from the Ph.D. The waived courses are those that will facilitate the merging of the BREADTH component to allow the student maximum flexibility to pursue research in their area of specialization. Course waivers for the M.D./Ph.D. program will be examined on a case-by-case basis, but can be expected to follow these general guidelines:

CORE: Hours

DEPTH: Hours

BREADTH: Hours

RESEARCH: Hours

BioE Colloquium Requirement

Ethics and Professionalism