Graduate Study at

RICE

GRADUATE STUDY IN BIOENGINEERING

Rice University

WWW.BIOE.RICE.EDU

For admission in 2016

The Rice University Department of Bioengineering has been ranked among the nation's top 10 bioengineering/biomedical engineering graduate programs for the past eight consecutive years. Our graduate program offers innovative training and curriculum to prepare the next generation of leaders in basic, applied and translational research at the interface of biology and engineering.

The cornerstone of our success as a leader in bioengineering is capitalizing on Rice's proximity to the Texas Medical Center (TMC), the largest medical center in the world, which has promoted the development of long-term collaborative efforts with the member institutions of the TMC. In addition to the numerous projects between investigators at Rice's BioScience Research Collaborative and their TMC collaborators, significant new awards include a five-year Armed Forces Institute for Regenerative Medicine (AFIRM-II) grant for the translation of tissue engineering and regenerative medicine technologies and therapies into clinical application, a National Institutes of Health (NIH) exploratory grant to analyze bacterial decision making, a grant from the U.S. Department of Agriculture to develop a new generation of renewable energy and bio-based products, a National Science Foundation (NSF) Brain Initiative grant, and a new training program for pre-and postdoctoral fellows in interdisciplinary translational cancer nanotechnology funded by the NIH's National Cancer Institute.

As a member institution of the TMC and through the university's research centers and institutes, we have built numerous interdisciplinary partnerships in education, research and outreach. Working and learning in this environment fosters cooperation with leaders in every specialty of basic science and medicine while providing our graduate students with hands-on training in cutting-edge bioengineering research.

Total research expenditures for fiscal year 2014 were $14.4 million. Approximately 140 graduate students are enrolled in the program. The department has 27 teaching and research faculty members, 20 multidisciplinary joint appointments within the science and engineering departments at Rice, and approximately 35 adjunct faculty members, who work predominantly in the TMC.

THE PROGRAM

The bioengineering graduate program draws on interdisciplinary skills that reach from the biological sciences to modern materials science, systems modeling, computer science, and bioprocess design. To prepare students for leadership roles in independent or collaborative research and development in industry or academia, our comprehensive curriculum provides a fundamental understanding of basic life and medical sciences, as well as advanced analytical and engineering expertise. Innovative training programs also give our students additional hands-on experience in translational research that transfers bioengineering advances from bench to bedside.

The department offers programs of graduate study leading to a doctor of philosophy (Ph.D.) degree in bioengineering. A joint M.D./Ph.D. is offered between the Rice Department of Bioengineering and Baylor College of Medicine. .

The M.B.E. is a widely recognized, nonthesis professional master's degree. The typical course of study for an M.B.E. is one year and part-time study options are available for individuals who want to continue working. A new track in Global Medical Innovation focuses on project-based design curriculum to prepare students for careers in medical technology though education in innovation, emerging-market design projects based on real-world clinical challenges, and leadership experiences and industry internships.

The typical course of study for a Ph.D. degree in bioengineering is four to five years. In the fall semester of the first year, students select their thesis advisor. A thesis proposal must be completed

by the end of summer of the second year. Throughout their course of study, students complete three teaching assignments, generally requiring six to ten hours/week for a semester. For those students planning an academic career, more involved teaching opportunities are available. An internship in industry, academia, clinical and national or international laboratories provides an opportunity for real-world exposure and/or broadens a student's research tools and teaching techniques.

FACULTY/RESEARCH

Gang Bao. Foyt Family Professor; director, Nanomedicine Center for Nucleoprotein Machines; CPRIT Scholar in Cancer Research. B.S. (1976) Shandong University, M.Sc, (1981) Shandong University, Ph.D. (1987) Lehigh University. Research interests: Specializes in nanomedicine, molecular imaging, and genome editing for broad-based applications in basic biological research toward the understanding of underlying causes of disease, as well as in the translation of nanoscale tools for disease diagnostics and treatment, such as early cancer detection, targeted drug/gene delivery and cell-based therapies.

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Michael W. Deem. John W. Cox Professor in Biochemical and Genetic Engineering; Professor, Physics and Astronomy; Chair, Department of Bioengineering; Founding Director, Ph.D. Program in Systems, Synthetic, and Physical Biology (SSPB). B.S. (1991) California Institute of Technology; Ph.D. (1994) University of California at Berkeley. Research interests: Development and application of theoretical methods of statistical mechanics to study the collective properties of biological systems. Both computational and analytical methods are of interest. Current areas of interest include Newton's laws of biology, theory of personalized critical care, physical theories of pathogen evolution, immune response to viruses and vaccines, and structural and functional properties of zeolites.

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Michael Diehl. Associate Professor of Bioengineering and of Chemistry. B.S. (1997) The College of New Jersey, Ph.D. (2002) University of California at Los Angeles. Research interests: Develops synthetic approaches to engineer macromolecular complexes and mammalian cells to investigate mechanisms underlying intracellular transport and cytoskeletal adaptations during cellular transitions. He combines these synthetic platforms with custom microscopy instrumentation to study principles governing the regulation and dysregulation of these processes in neurodegenerative diseases and cancer.

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Rebekah A. Drezek. Professor of Bioengineering and of Electrical and Computer Engineering. B.S. (1996) Duke University; M.S. (1998), Ph.D. (2001) University of Texas at Austin. Research interests: Interface of basic, applied and translational research in medicine, engineering and nanotechnology to develop minimally invasive photonics-based imaging approaches. This includes new optical spectroscopy and imaging instrumentation and molecular-specific optical contrast agents; experimental studies into the biophysical origins of measured optical signals; and computational modeling of the interaction of light and biological tissue.

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K. Jane Grande-Allen. Isabel C. Cameron Professor of Bioengineering. B.A. (1991) Transylvania University, Ph.D. (1998) University of Washington. Research interests: Understand and fight heart valve disease through engineering analyses such as mechanical testing, biochemical measurements, and cell/microstructural analysis of critical components. Specializes in the extracellular matrix — collagen, elastin, glycosaminoglycans (GAG) and proteoglycans (PG) — and its intricate assembly, function, growth, and abnormalities in numerous connective tissues.

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Oleg Igoshin. Associate Professor of Bioengineering. B.Sc. (1998) Novosibirsk State University, Physics Dept. of Russia; M.Sc. (2000) Chemical Physics Dept., Feinberg Graduate School, Weizmann

Institute of Science, Israel; Ph.D. (2004) University of California at Berkeley. Research interests: Computational systems biology with emphasis in evolutionary design principles and characterization of biochemical networks; pattern formation in bacterial biofilms; and regulatory networks in bacterial and stem cell development.

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Jeffrey G. Jacot. Associate Professor, Bioengineering at Rice University and Director, Pediatric Cardiac Bioengineering Laboratory, Division of Congenital Heart Surgery, Texas Children's Hospital. B.S. (1994) University of Colorado, Ph.D. (2005) Boston University. Research interests: The design of living tissue patches to repair congenital heart defects, with a focus on novel degradable biomaterials and their interactions with human stem cells from amniotic fluid, induced pluripotent stem cells, and cardiac progenitor cells.

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Herbert Levine. Hasselmann Professor of Bioengineering , CPRIT Scholar in Cancer Research. B.S. (1976) Massachusetts Institute of Technology; Ph.D. (1979) Princeton University. Research interests: The physics of nonequilibrium systems, both deterministic and stochastic, with applications in a wide variety of biological systems. Projects focus on combining theoretical approaches and advanced experiments to understand directed cell motion in eukaryotic cells and to elucidate both signal transduction and cellular mechanics aspects of this critical process. Additional areas of research in biological physics include calcium-based cell signaling (most recently at the neuronal synapse), the statistical mechanics of Darwinian evolution, and pattern formation in microorganism colonies. Member, American Academy of Arts and Sciences; Member, National Academy of Science

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Jianpeng Ma. Professor of Bioengineering at Rice University; Lodwick T. Bolin Professor of Biochemistry and Molecular Biology at Baylor College of Medicine. B.S. (1985) Fudan University, P.R. China; Ph.D. (1996) Boston University. Research interests: Structure and function of biological molecules through experimental structural biology, cell biology, and the development of mathematical algorithms for computer simulation; supramolecular complexes; bioinformatics; computer-aided drug designs; and structural refinement strategies.

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Antonios G. Mikos. Louis Calder Professor, Bioengineering, Chemical and Biomolecular Engineering; Professor, Chemistry, Materials Science, and Nanoengineering; Director, Cox Laboratory for Biomedical Engineering; and Director, Center for Excellence in Tissue Engineering. Dipl.Ch.E. (1983) Aristotle University of Thessaloniki, Greece; M.S.Ch.E. (1985), Ph.D. (1988) Purdue University. Research interests: Synthesis, processing and evaluation of new biomaterials for use as scaffolds for tissue engineering, as carriers for controlled drug delivery, and as nonviral vectors for gene therapy. Member, National Academy of Engineering; Member, National Academy of Engineering; member, National Academy of Medicine

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Jordan S. Miller. Assistant Professor of Bioengineering. B.S. (2003) Massachusetts Institute of Technology, Ph.D. (2008) Rice University. Research interests: applications of synthetic chemistry, 3-D printing, microfabrication, and molecular imaging to create and study cellular microenvironments. Particular interests involve solving challenges in large-scale tissue engineering for regenerative medicine.

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Joel L. Moake. Senior Research Scientist; Associate Director, J.W. Cox Laboratory for Biomedical Engineering at Rice University; Professor of Medicine at Baylor College of Medicine. B.A. (1964), M.D. (1967) Johns Hopkins University. Research interests: Platelets, VWF and endothelial cells. First to describe the mechanisms of: (1) platelet aggregation under high shear-stress; (2) platelet-VWF adhesion in thrombotic thrombocytopenic purpura (TTP); and (3) renal platelet thrombosis in the hemolytic-uremic syndrome (HUS).

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Amina A. Qutub. Assistant Professor of Bioengineering. B.S. (1999) Rice University; Ph.D. (2004) University of California, Berkeley/San Francisco. Research interests: Biological systems modeling theory and design to understand and characterize hypoxic response signaling, angiogenesis, and cerebrovascular systems biology; experiment and imaging-coupled modeling. Advances in these interconnected focus areas are leading to discoveries in cancer therapy; treatments for ischemia and Alzheimer's disease; and increased understanding of cellular and sub-cellular organization in vascular biology.

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Robert M. Raphael. Associate Professor of Bioengineering. Director, Neuroengineering IGERT program; B.S. (1989) University of Notre Dame; M.S. Biophysics (1992), Ph.D. Biophysics (1996) University of Rochester. Research interests: Molecular and cellular basis of auditory and neuronal function; mechanical properties of biological membranes. Utilizes advanced optical microscopy, electrophysiology and micromechanical techniques to study the membrane/cytoskeletal organization and dynamics of prestin, a unique membrane protein responsible for high-frequency hearing. Develops systems-level models of inner ear function. Applies expertise to study mechanics of cancer cells and three dimensional cell cultures.

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Rebecca Richards-Kortum. Malcolm Gillis University Professor; Director of Rice 360°: Institute for Global Health; Director of the Institute of Biosciences and Bioengineering (IBB). B.S. (1985) University of Nebraska at Lincoln; M.S. (1987), Ph.D. (1990) Massachusetts Institute of Technology. Research interests: Specializes in designing affordable, robust diagnostic systems for cancer and infectious diseases. Develops high-resolution optical imaging systems for the early detection of precancerous changes, with active clinical trials in China, Brazil, and El Salvador. Develops molecular assays for detection of infectious diseases including HIV and malaria. Develops low-cost equipment to improve neonatal and maternal care, with active clinical trials in Malawi. Member, National Academy of Engineering; member National Academy of Sciences .

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Ka-Yiu San. E.D. Butcher Professor in Bioengineering; Professor of Chemical and Biomolecular Engineering. B.S. (1978) Rice University; M.S. (1981), Ph.D. (1984) California Institute of Technology. Research interests: Various engineering aspects of using biological systems as catalysts to create useful products. Such activities encompass systems biotechnology, metabolic engineering, biochemical engineering and biotechnology.

Junghae Suh. Associate Professor of Bioengineering. B.S. (1999) Massachusetts Institute of Technology, Ph.D. (2004) Johns Hopkins University. Research interests: Use genetic engineering to reprogram viruses into biomolecular information processors. The synthetic viruses are designed to seek out and deliver genetic cargo into target sites of pathology for the treatment of human diseases and disorders.

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Jeffrey J. Tabor. Assistant Professor of Bioengineering and of BioSciences. B.A. (2001) University of Texas, Ph.D. (2006) University of California at San Francisco. Research interests: Synthetic biology, optogenetics, engineering bacterial sensors, human microbiome, engineering 'synthetic probiotics', engineering cell–cell communication, programming cellular differentiation and multicellular pattern formation, 3-D printed hardware for improved optical characterization of living cells. Diverse model organisms, including bacteria, yeast, social amoeba and mammalian cells, are used.

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Tomasz Tkaczyk. Associate Professor of Bioengineering and of Electrical and Computer Engineering. M.S. Eng. specializing in Optical Engineering (1994) Warsaw University of Technology, Warsaw, Poland; Ph.D. (2000) specializing in Optical Engineering and Physical Optics, Optical Engineering Division, Institute of Micromechanics and Photonics, Warsaw University of Technology, Warsaw. Research interests: Biomedical and biological applications using optical engineering. Focus is on early cancer detection and point-of-care technologies, in developing miniature optical and optomechanical systems, and snapshot spectral imaging modalities.

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David Yu Zhang. Ted Law Jr. Assistant Professor of Bioengineering. B.S. (2005) California Institute of Technology, Ph.D. (2010) California Institute of Technology. Research Interests: Nucleic acid bioengineering: the rational design and validation of DNA and RNA molecules and systems for in vitro diseases diagnostics, in situ imaging of gene expression, biomimetic cytosketetal elements, materials scaffolding and modulation, and transcriptional regulation; simultaneously, takes a computational approach to developing next generation nucleic acid folding algorithms.

FACULTY/TEACHING

Bilal Ghosn. Lecturer. B.S. (2002) Louisiana State University, M.S. (2004) Louisiana State University, Ph.D. (2009) University of Texas at Austin. Focus: Teaches undergraduate curriculum and laboratory courses.

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Z. Maria Oden. Professor in the Practice of Engineering Education; Director, Oshman Engineering Design Kitchen (OEDK). B.S.E. (1989), M.E. (1991), Ph.D. (1994) Tulane University. Focus: Orchestrates engineering education initiatives at OEDK and collaborates with Rice faculty members to develop capstone engineering design programs for students in both the bioengineering and Beyond Traditional Borders (BTB) programs.

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Renata Ramos. Lecturer. B.S. (2002) Instituto Tecnológico y de Estudios Superiores de Monterrey, Mexico; Ph.D. (2008) University of Arizona. Focus: Teaches undergraduate curriculum and laboratory courses.

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Eric Richardson. Lecturer and Director, Global Medical Innovation (GMI) track. B.S. (2005) Brigham Young University; Ph.D. (2009) University of Minnesota. Focus: Teaches graduate curriculum, and is an instructor and mentor for all capstone design course sequences.

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Ann Saterbak. Professor in the Practice of Bioengineering Education; Associate Chair for Undergraduate Affairs. B.A. (1990) Rice University, Ph.D. (1995) University of Illinois at Urbana-Champaign. Focus: Teaches undergraduate curriculum and laboratory courses, and advises undergraduates.

FACULTY/EMERITUS

William W. Akers. Professor Emeritus of Bioengineering; Professor Emeritus of Chemical and Biomolecular Engineering. B.S. (1943) Texas Tech University, Ph.D. (1950) University of Michigan.

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J. David Hellums. Professor Emeritus and Research Professor of Bioengineering and Chemical and Biomolecular Engineering. B.S.Ch.E. (1950), M.S. (1957) University of Texas at Austin, Ph.D. (1961) University of Michigan.

FACULTY/JOINT APPOINTMENTS

Matthew Bennett. Assistant Professor, Biochemistry & Cell Biology, and Bioengineering

John Clark, Jr. Professor of Electrical and Computer Engineering, and Bioengineering

Cindy Farach Carson. Looney Professor, Biosciences & Bioengineering; Scientific Dir., BioScience Research Collaborative (BRC); Vice Provost for Translational Biosciences

Fathi Ghorbel. Professor of Mechanical Engineering, Materials Science, and Bioengineering

Ramon Gonzalez. Professor of Chemical and Biomolecular Engineering, and Bioengineering

Naomi Halas. Stanley C. Moore Professor of Electrical and Computer Engineering, Professor of Bioengineering, Chemistry, and Physics

Jeffrey Hartgerink. Professor of Chemistry and Bioengineering

Lydia Kavraki. Noah Harding Professor of Computer Science and Bioengineering

Caleb Kemere. Assistant Professor, Electrical & Computer Engineering, and Bioengineering

Ching-Hwa Kiang. Associate Professor of Physics & Astronomy and Bioengineering

Marek Kimmel. Professor of Statistics and Bioengineering

Angel Martí. Assistant Professor of Chemistry, Bioengineering, and Materials Science and Nanoengineering

Marie Lynn Miranda. Professor, Statistics; and the Howard R. Hughes Provost

Deepak Nagrath. Assistant Professor of Chemical and Biomolecular Engineering and Bioengineering

Jacob Robinson. Assistant Professor, Electrical & Computer Engineering, and Bioengineering

Laura Segatori. Associate Professor of Chemical & Biomolecular Engineering, and Bioengineering

Jonathan (Joff) Silberg. Associate Professor of Biochemistry and Cell Biology, and Bioengineering

Frank Tittel. J.S. Abercrombie Professor of Electrical and Computer Engineering and Professor of Bioengineering

Aryeh Warmflash. Assistant Professor, Biosciences and Bioengineering

Kyriacos Zygourakis. A.J. Hartsook Professor of Chemical and Biomolecular Engineering, Professor of Bioengineering

RESEARCH FOCUS AREAS

The Department of Bioengineering faculty members have diverse

research interests focused on applying engineering principles and developing cutting-edge technologies to solve basic science and medical problems. Applicants are asked to note one or more focus area of interest in their application. Specific research focus areas include:

Biomaterials and Drug Delivery
The Biomaterials and Drug Delivery group focuses on the synthesis, fabrication and evaluation of biomaterials, including nanobiomaterials for important applications in biomedicine. Their research efforts emphasize the development of new or improved biomaterials with exciting physical, chemical and biological properties. These innovative materials are exploited for a variety of technologies, including imaging contrast agents, tissue engineering scaffolds, drug delivery and artificial viruses for gene therapy. *Researchers include*: Drs. Bao, Diehl, Jacot, Ma, Mikos, Miller, Qutub, Suh and Tabor.

Biomedical Imaging and Diagnostics
Biomedical Imaging and Diagnostics faculty conduct research in translational molecular imaging and diagnostics. Their multidisciplinary efforts focus on the development of novel, nanoscale contrast agents for molecular imaging as well as the development of hardware systems to image and monitor cancers and other disease processes in vivo in real time. Their research leverages the department's unique capabilities in nanobiotechnology with application in basic science and translational biomedical application. *Researchers include:* Drs. Bao, Drezek, Miller, Richards-Kortum, Suh, Tkaczyk, and Zhang.

Cellular and Biomolecular Engineering
This area has enormous potential to make truly significant contributions to mankind in both medical and nonmedical fields over the next decades. Much of this group's research is focused at the cellular and molecular scales. They apply the principles and tools derived from engineering to solve a host of problems in cellular and molecular biology, thus enabling new types of studies of biological systems. *Researchers include:* Drs. Bao, Deem, Diehl, Grande-Allen, Igoshin, Jacot, Levine, Ma, Mikos, Miller, Moake, Qutub, Raphael, San, Suh, Tabor, and Zhang.

Computational and Theoretical Bioengineering
Natural systems from our world and engineered systems from biotechnology offer a wide variety of phenomena for study. New field-theoretic techniques, new computer simulation methods and new random energy models have resulted. The Computational and Theoretical Bioengineering group works to explain, model and provide the means to manipulate medically related biological systems. Investigations range from biomechanics to protein–protein interactions to stem cell differentiation and immune system therapies. *Researchers include:* Drs. Deem, Diehl, Grande-Allen, Igoshin, Jacot, Levine, Ma, Mikos, Qutub, Raphael, San, Tabor, and Zhang.

Systems and Synthetic Biology
Research in these areas is tightly related through the use of quantitative experimental and theoretical approaches to characterize biological networks and to understand emergent functional relationships and behaviors. Systems biology attempts to understand how biological processes, within cells, a group of cells, or an entire tissue work at the "network level," and generally seeks to determine how biological components interact to produce physiological responses. Synthetic biology involves reprogramming living cells for novel functions at the level of their DNA. There are broad scientific and engineering applications including the construction of simple cellular networks for detailed analysis and the production of next generation fuels, therapeutics and commodity chemicals. *Researchers include:* Drs. Deem, Diehl, Igoshin, Levine, Ma, Miller, Qutub, Raphael, San, Suh, Tabor, and Zhang.

Tissue Engineering and Biomechanics
Research efforts in this area are focused on the 1) understanding of biochemical, molecular, cellular, and biomechanical characteristics of normal and diseased tissues; 2) design and fabrication of novel scaffolds; and 3) development of optimal culturing conditions for tissue engineered constructs. The effects of mechanical stimulus are being investigated from the level of single-cell gene expression to tissue mechanical properties. Scaffold designs incorporate novel biomaterials, bioactive molecules and combinatorial variations in subunit scaffold micro-architecture. Culture conditions involving biochemical and mechanical cues are being optimized for engineering bone, cartilage, heart valves and small-diameter vascular grafts. *Researchers include:* Drs. Grande-Allen, Jacot, Mikos, Miller, Qutub and Suh.

RESEARCH FACILITIES

The Department of Bioengineering is housed in a 477,000 square-foot research facility called the BioScience Research Collaborative (BRC). Located at the border between the Rice campus and the Texas Medical Center (TMC), the interdisciplinary research facility is a reflection of Rice's Vision of the Second Century and is shared with member institutions of the TMC. The center represents a major investment toward reaffirming our long-term history and positioning as one of the most powerful bioscience and biomedical research efforts in the world.

The BRC facility provides common areas for technical laboratory facilities and includes a broad range of research and computing equipment. A core lab facility called BioSEA has mass spectrophotometers, transmission electron microscopes, a microscopy center and nuclear magnetic resonance spectrometers.

In addition, graduate students have access to campus supercomputing facilities as well as core equipment and facilities via the Rice Shared Equipment Authority program and the Ken Kennedy Institute for Information Technology. State-of-the-art research facilities include: tissue culture, confocal/electron/video microscopy, mass spectrometry, TIRF microscopy, flow cytometry, polymer synthesis, materials characterization and testing, mechanical testing, histology, electrophysiology, biomedical lasers, optical tweezers, micro-CT and many others.

RESEARCH CENTERS AND INSTITUTES

Bioengineering faculty and graduate students benefit from membership in centers and institutes at Rice, including the BioScience Research Collaborative (BRC), Institute of Biosciences and Bioengineering (IBB), the Richard E. Smalley Institute for Nanoscale Science and Technology, the Nanomedicine Center for Nucleoprotein Machines, the Center for Theoretical Biological Physics (CTBP), the Center for Biological and Environmental Nanotechnology (CBEN), Rice 360°: Institute for Global Health, the Center for Excellence in Tissue Engineering (CETE), the Ken Kennedy Institute for Information Technology, and the Keck Center for Quantitative Biomedical Training of the Gulf Coast Consortia (GCC).

ADMISSION

Admission to the graduate program is competitive, and the Graduate Admissions Committee uses both quantitative and qualitative factors in its decision process. In addition to GRE and TOEFL scores, academic records, personal statement and letters of recommendation are included in the evaluation.

STIPENDS AND FELLOWSHIPS

All Ph.D. students in the Rice bioengineering program are supported by competitive stipends through a range of fellowships, scholarships and assistantships. In addition, tuition for Ph.D. students is waived. M.B.E. students are not eligible for financial support through the department.

Students also may apply for competitive fellowships in graduate training programs administered at Rice. The Institute of Biosciences and Bioengineering (IBB) is launching a new training program for pre-and postdoctoral fellows in interdisciplinary translational cancer nanotechnology. The program, which is funded by the NIH's National Cancer Institute, builds upon the success of the previously HHMI-funded Med Into Grad program between the University of Texas MD Anderson Cancer Center and Rice University. The program features an intensive two-year research experience and training in cancer nanotechnology. Additional programs include the NSF IGERT in Neuroengineering from Cells to Systems, and several training programs through the Gulf Coast Consortia's (GCC) W. M. Keck Center for Quantitative Bioscience Training.

To provide Ph.D. students time to learn about ongoing research in the department and to select their thesis advisor, we are pleased to offer stipend support for the first two semesters. The Ph.D. students are supported thereafter through their advisor's research grants or competitive fellowships.

DEGREE REQUIREMENTS

Most students admitted to the Rice graduate program in bioengineering follow a course of study that leads directly to the Ph.D. degree. The graduate degree curriculum has three components: foundation, supporting and advanced topics courses. Collectively, these components afford students broad exposure to their chosen field of research. Students initially reinforce their knowledge through foundation courses in bioengineering. With the help of their thesis advisor, students plan a coherent course of study that is most appropriate to their research work from among the wide range of supporting and advanced topics courses available. A variety of courses available reflect the diverse research interests within the Department of Bioengineering.

Doctor of Philosophy (Ph.D.)

The Ph.D. candidate in bioengineering must:

- Prerequisites: *Fundamentals of System Physiology* (BIOE 322 or equivalent–3 credit hours), *Cell Biology* (BIOC 341 or equivalent–3 credit hours), and *Statistics*. These courses must be taken during undergraduate training, or they will be additional requirements for the Ph.D. degree.
- Complete 30 semester hours of graduate-level 500 or higher in foundation, supporting and advanced topics courses; 15 of these credit hours must be BIOE courses.
- Maintain an average GPA of 3.2 or higher.
- Complete three semesters as a teaching assistant for six to ten hours per week.
- Prepare a thesis proposal and present it to the thesis committee.
- Complete a publishable thesis representing research that is an original and significant contribution to a field of bioengineering.
- Pass a public oral examination in defense of the thesis.

Medical Scientist Training Program (M.D./Ph.D.)

Rice University and the Baylor College of Medicine have collaborated for over 30 years to administer the Medical Scientist Training Program (MSTP). Students in the MSTP program receive their Ph.D. in bioengineering from Rice and their M.D. from Baylor. Many of these students are jointly advised by Rice bioengineering faculty and Baylor clinical faculty. Students must initiate their application through Baylor. To learn more about the MSTP, visit the Baylor College of Medicine Web site at www.bcm.edu/mstp/.

Master of Bioengineering (M.B.E.)

The Master of Bioengineering (M.B.E.) is a nonthesis degree that provides students with greater depth in their bioengineering training to advance their career objectives. The degree has two tracks - the Global Medical Innovation track and the Applied Bioengineering track. Both require 30 credit hours of study, and will result in the M.B.E. degree.

Prerequisites are: *Fundamentals of Systems Physiology* (BIOE 322 or equivalent–3 credit hours), *Cell Biology* (BIOC 341 or equivalent–3 credit hours), and *Statistics*. These courses must be taken during undergraduate training, or they will be additional requirements for the M.B.E. degree.

The Global Medical Innovation (GMI) track is designed specifically for students who want to pursue a career in the global medical technology industry. The GMI track curriculum consists of:

- Two consecutive semesters of innovation education with integrated emerging-market design projects (18 credits);
- An internship, which may be completed during the summer (full-time) or during the fall and spring semesters (part-time). See the

GMI internship blog at gmi.rice.edu (6 credits).
- One graduate-level course in MATH, CAAM, or STAT (3 credits); and
- One elective graduate-level BIOE course (3 credits).

The Applied Bioengineering track, which is designed as a flexible degree for students who want to pursue careers in research, medicine or related fields. The Bioengineering Department offers graduate-level courses in Biomaterials and Drug Delivery, Biomedical Imaging and Diagnostics, Computational and Theoretical Bioengineering, Tissue Engineering and Biomechanics, and Systems and Synthetic Biology.

- Complete 30 semester hours of 500 level courses, including at least 15 bioengineering credit hours at the graduate level or above. A minimum of 24 of the 30 credit hours must be taken at Rice.
  - Graduate-level or above MATH, STAT or CAAM (3 credit hours)
  - Nine elective professional-development credit hours
  - Three general elective credit hours
- Maintain an average GPA of 3.0 or higher.

HOW TO APPLY

Doctor of Philosophy (Ph.D.) Program
The application deadline for the Ph.D. program is December 20. Students are strongly advised to check bioe.rice.edu for official dates. (It is best to start the application process before September of the year applying.) Forms can be found at: http://bioegradapps.rice.edu.

Masters in Bioengineering Program (M.B.E.)
The application deadline for the first round of the GMI track is January 15. A second round will be considered only if space is available. Applications for the Applied Bioengineering track are due by October 30 for spring admission and April 30 for fall admission. Forms can be found at: http://bioegradapps.rice.edu.
Students currently in the bioengineering program at Rice must contact the department (ges2@rice.edu or 713-348-5063) for specific instructions regarding submission of your application.

Students may enroll for the Applied Bioengineering track on a full-time or part-time basis. Students may only enroll on a full-time basis for the GMI track.

In addition to the application, all Ph.D. and M.B.E. candidates must submit the following items to the Graduate Admissions Committee:
- Transcripts from all undergraduate and graduate schools attended;
- At least three letters of recommendation from teachers and advisors;
- GRE scores and TOEFL scores (TOEFL is needed for any student requiring a visa. Make arrangements with the Educational Testing Service at www.ets.org/ or International English Testing Service [IELTS] at www.ielts.org to have official test scores sent to Rice.); and
- An application fee of $85.

Submit all inquiries and application materials to:

Rice University
Graduate Admissions Committee
Bioengineering Department–MS 142
P.O. Box 1892
Houston, Texas 77251-1892
Phone: 713-348-5869 (x5063)
Fax: 713-348-5877
E-mail: bioeng@rice.edu
Web site for more information: www.bioe.rice.edu

Courier deliveries should be sent to:

Rice University
Graduate Admissions Committee
Bioengineering Department–MS 142
6100 Main Street
Houston, TX 77005

ABOUT RICE AND HOUSTON

Rice is a leading American research university—small, private and highly selective—distinguished by a collaborative, interdisciplinary culture and a global perspective. Only a few miles from downtown Houston, it occupies an architecturally distinctive, 285-acre campus shaded by nearly 4,000 trees. State-of-the-art facilities and laboratories, internationally renowned centers and institutes and one of the country's largest endowments support an ideal learning and living environment.

The university attracts a diverse group of highly talented students and faculty with outstanding graduate and professional programs in the humanities, social sciences, natural sciences, engineering, architecture, music and business. With just 2,374 graduate students and 3,708 undergraduates, it offers an unusual opportunity to forge close relationships with eminent faculty scholars and researchers and the option to tailor graduate programs to specific interests.

Houston offers all the expected educational, cultural and commercial advantages of a large urban center, and more. It's home of the Texas Medical Center, the largest concentration of medical schools, hospitals and research facilities in the world, as well as several other universities. Rice has cooperative programs with the University of Houston, Baylor College of Medicine, the University of Texas M.D. Anderson Cancer Center, the University of Texas Health Science Center and the University of Texas Medical Branch at Galveston. Houston is one of the few U.S. cities with resident companies in all four major performing arts—drama, ballet, opera and symphony. It also boasts a museum district featuring exhibits of national and international prominence.

As urban as it is, Houston also is a surprisingly green city. Houstonians enjoy the outdoors in more than 300 municipal parks and 120 open spaces, and many frequent the beach at Galveston Island, only a 45-minute drive away. Other short trips include Austin, the state's capital, and historic San Antonio, both of which are a little more than three hours away.

FOR MORE INFORMATION:

Rice University homepage: www.rice.edu

George R. Brown School of Engineering homepage: www.engr.rice.edu

Department of Bioengineering homepage: www.bioe.rice.edu

Rice University Office of Graduate and Postdoctoral Studies homepage: graduate.rice.edu

Graduate Student Association homepage: gsa.rice.edu

City of Houston homepage: www.houstontx.gov

Houston information from the Houston Chronicle: www.chron.com

Houston information from Microsoft Citysearch: houston.citysearch.com

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