The thrust of the biomedical engineering graduate program is centered around a clinical and translational focus on patients and outcomes and spans five thematic areas: medical diagnostics/theranostics, regeneration, telemedicine and health IT, augmentation, and precision intervention. Research themes are carried out in several disciplines, including biomedical sensing and imaging, biomedical optics, biomechanics, biomaterials, tissue engineering, and biomolecular and cellular engineering. Faculty members are presently involved in research from the macroscopic to the nanoscale in the areas of diagnostic and therapeutic systems, imaging systems, soft and hard tissue biomechanics, tissue characterization, biomaterials used in the human body, orthopedic and injury biomechanics, FDA regulatory practices, bioinstrumentation, measurement and analysis of human body signals, and analysis of the interaction between humans and medical devices.

**Faculty**

Alge, Daniel L, Assistant Professor  
Biomedical Engineering  
PHD, Purdue University, 2010

Applegate, Brian E, Associate Professor  
Biomedical Engineering  
PHD, The Ohio State University, 2000

Bishop, Corey J, Assistant Professor  
Biomedical Engineering  
PHD, Johns Hopkins University School of Medicine, 2015

Biswa, Saurabh, Associate Professor of the Practice  
Biomedical Engineering  
PHD, Texas A&M University, 2011

Cosgriff-Hernandez, Elizabeth M, Associate Professor  
Biomedical Engineering  
PHD, Case Western Reserve University, 2005

Cote, Gerard L, Professor  
Biomedical Engineering  
PHD, University of Connecticut, 1990

Criscione, John C, Professor  
Biomedical Engineering  
PHD, Johns Hopkins University School of Medicine, 2005

Gaharwar, Akhilesh K, Assistant Professor  
Biomedical Engineering  
PHD, Purdue University, 2011

Gibbs, Holly C, Lecturer  
Biomedical Engineering  
PHD, Texas A&M University, 2015

Grunlan, Melissa A, Professor  
Biomedical Engineering  
PHD, University of South Carolina, 2004

Guiseppi Elie, Anthony, Professor  
Biomedical Engineering  
PHD, Massachusetts Institute of Technology, 1983

Huang, Shuning, Lecturer  
Biomedical Engineering  
PHD, Massachusetts Institute of Technology, 2009

Hwang, Wonmuk, Associate Professor  
Biomedical Engineering  
PHD, Boston University, 2001

Jafari, Roozbeh, Associate Professor  
Biomedical Engineering  
PHD, University of California, Los Angeles, 2006

Jain, Abhishek, Assistant Professor  
Biomedical Engineering  
PHD, Boston University, 2012

Jo, Javier A, Associate Professor  
Biomedical Engineering  
PHD, University of Southern California, 2002

Kaunas, Roland R, Associate Professor  
Biomedical Engineering  
PHD, University of California, San Diego, 2003

Keller, Brandis K, Lecturer  
Biomedical Engineering  
PHD, Politecnico di Milano, 2013

Madigan, Michael L, Professor  
Biomedical Engineering  
PHD, Virginia Commonwealth University, 2001

Maitland, Duncan J, Professor  
Biomedical Engineering  
PHD, Northwestern University, 1995

Maitland, Kristen D, Associate Professor  
Biomedical Engineering  
PHD, The University of Texas at Austin, 2006

McDougall, Mary P, Associate Professor  
Biomedical Engineering  
PHD, Texas A&M University, 2004

McShane, Michael J, Professor  
Biomedical Engineering  
PHD, Texas A&M University, 1999

Monroe, Mary Beth, Lecturer  
Biomedical Engineering  
PHD, Texas A&M University, 2013

Ober, Raimund J, Professor  
Biomedical Engineering  
PHD, Cambridge University, 1987
Masters

- Master of Engineering in Biomedical Engineering (http://catalog.tamu.edu/graduate/colleges-schools-interdisciplinary/engineering/biomedical/meng)
- Master of Science in Biomedical Engineering (http://catalog.tamu.edu/graduate/colleges-schools-interdisciplinary/engineering/biomedical/ms)

Doctoral

- Doctor of Philosophy in Biomedical Engineering (http://catalog.tamu.edu/graduate/colleges-schools-interdisciplinary/engineering/biomedical/phd)

Certificates

- Engineering Therapeutics Manufacturing Certificate (http://catalog.tamu.edu/graduate/colleges-schools-interdisciplinary/engineering/biomedical/engineering-therapeutics-manufacturing-certificate)
- Quality Engineering for Regulated Medical Technologies Certificate

Courses

**BMEN 604 FDA Good Laboratory and Clinical Practices**

Credits 3.3 Lecture Hours.

Implementation of Good Laboratory Practices (GLP) for the submission of preclinical studies and use of Good Clinical Practices (GCP) in clinical trials in accordance with Food and Drug Administration (FDA) regulations; includes similarities and differences in GLP and GCP critical for the introduction of new drugs and medical devices.

*Prerequisite:* Graduate classification or approval of instructor.

**BMEN 605 Virtual Instrumentation Design for Medical Systems**

Credits 3.2 Lecture Hours. 3 Lab Hours.

Design of medical systems using graphics programming language of LabVIEW including the designing and programming of three virtual systems: cardiac monitor, electromyogram system for biomechanics, and sleep stage analyses for electroencephalograms.

*Prerequisite:* Approval of instructor.

**BMEN 606 Medical Device Path to Market**

Credits 3.3 Lecture Hours.

Path to market for a medical device with specific attention to the regulatory affairs to enable the development of an appropriate regulatory strategy due to the highly regulated global environment.

*Prerequisite:* Graduate classification or approval of instructor.

**BMEN 607 Clinical Engineering**

Credits 3.3 Lecture Hours.

Responsibilities, functions and duties of the hospital based biomedical engineer including program organization, management, medical equipment acquisition and use, preventive maintenance and repair and hospital safety.

*Prerequisite:* Approval of instructor.

**BMEN 608 Biophotonics II**

Credits 3.3 Lecture Hours.

Photon transport in tissue; photon scattering and absorption; Mie scattering; Monte Carlo; optical spectroscopy, including absorption, fluorescence, and Raman scattering; multiphoton processes; plasmonics.

*Prerequisite:* BMEN 625 or approval of instructor.

**BMEN 609 Optical Therapeutic and Interventional Principles**

Credits 3.3 Lecture Hours.

Study of mechanical and thermal processes of radiation interaction with biological tissue; issues and objectives in therapeutic, surgical, and diagnostic applications; basic engineering principles used in developing therapeutic with a focus on the use of lasers and optical technology.

*Prerequisites:* MATH 308; PHYS 208.

**BMEN 611 Biomedical Imaging Systems**

Credits 3.3 Lecture Hours.

The physics behind the major medical imaging systems including CT, MRI, Ultrasound and X-Ray will be introduced and described; a linear systems approach will be used along with basic diffraction theory.

*Prerequisites:* BMEN 322; MATH 308.

**BMEN 620 Bio-Optical Imaging**

Credits 3.3 Lecture Hours.

Optical imaging techniques for detection of structures and functions of biological tissues; basic physics and engineering of each imaging technique.

*Prerequisite:* MATH 308.

**BMEN 621 Microscale Bio-Optical Applications**

Credits 3.3 Lecture Hours.

Introduction to the biomedical application of lasers to manipulation, detection and visualization on (sub)cellular length scales, with emphasis on governing principles on which applications are founded; applications from recent literature (state-of-the-art) presented.

*Prerequisites:* Approval of instructor.

**BMEN 622 Bioelectromagnetism**

Credits 3.3 Lecture Hours.

Electric, magnetic and electromagnetic phenomena in association with biological tissues; source modeling based on physiological current including line and volume conductor models as well as electromagnetic-based stimulation, sensing and imaging.

*Prerequisite:* Graduate classification or approval of instructor.

**BMEN 624 Biomedical Sensing and Imaging at the Nanoscale**

Credits 3.3 Lecture Hours.

Introduction to nanotechnology with an emphasis on biomedical techniques and medical applications; material covered ranges from the basic physics of contrast agents to the engineering of current sensing and imaging systems applied at the nanoscale.

*Prerequisites:* PHYS 208, MATH 308.
BMEN 625 Biophotonics
Credits 3.3 Lecture Hours.
Theory and application of optical instrumentation, including light sources, lasers, detectors, and optical fibers; instrumentation and engineering in biomedical applications of optics in therapeutics, diagnostics, and biosensing.
Prerequisite: Graduate classification or approval of instructor.

BMEN 652 Cell Mechanobiology
Credits 3.3 Lecture Hours.
Focuses on how mechanical forces influence cell behavior through physical and biochemical mechanisms; objectives include integrating engineering and cell biology to solve biomedical problems, which includes developing models for applying forces to cultured cells and tissues and measuring changes in cell biochemistry, structure, and function.
Prerequisite: Graduate classification or approval of instructor.

BMEN 626 Optical Biosensors
Credits 3.3 Lecture Hours.
Introduction to biosensing principles and detailed analysis of optical methods for transduction; fluorescence-based transduction; molecular recognition of targets; immobilization of sensing reagents; quantitative analysis of sensing systems; design and characterization of sensing assays and associated measurement systems; review of historical and current trends in optical biosensors.
Prerequisite: Approval of instructor.

BMEN 630 Global Medical Device Regulation
Credits 3.3 Lecture Hours.
Overview of applicable U.S. and international regulations and regulatory processes for the design, approval and marketing of medical devices.
Prerequisite: Approval of instructor.

BMEN 631 Biomolecular Engineering
Credits 3.3 Lecture Hours.
Foundations for understanding the experimental approaches for measuring and manipulating biomolecules; proteins, nucleic acids, and carbohydrates; thermodynamics and kinetics of biomolecular reactions.
Prerequisite: Graduate classification or approval of instructor.

BMEN 632 Molecular and Cellular Biomechanics
Credits 3.3 Lecture Hours.
Introduces biomolecules and their assemblies that play structural and dynamical roles in subcellular to cellular level mechanics, with emphasis on quantitative/theoretical descriptions, and discussions of the relevant experiment approaches to probe these nano to micro-scale phenomena; including topics in (1) self-assembly of cytoskeleton and biomembranes, (2) molecular motors, (3) cell motility, and mechanotransduction.
Prerequisites: BMEN 240 and MATH 308.

BMEN 635 Biomaterials Compatibility
Credits 3.3 Lecture Hours.
Relevance of mechanical and physical properties to implant selection and design; effect of the body environment on metallic, ceramic and plastic materials; tissue engineering, rejection mechanisms used by the body to maintain homeostasis regulatory requirements.
Prerequisites: Approval of instructor.

BMEN 636 Pathophysiology of Systemic Diseases Augmented with Implantable Devices
Credits 3.3 Lecture Hours.
Clinical presentation of patients with systemic diseases and the pathophysiologic interrelationship with therapeutic implantable devices; processes of inflammation/repair as it applies to challenges of therapeutic augmentation with implantable devices; systems covered include cardiovascular, central nervous system, eye, dental, gastrointestinal, musculoskeletal, endocrine, reproductive/urogenital, skin/soft tissue; implantable device intervention as a therapeutic adjunct in systemic diseases.
Prerequisites: Graduate classification or approval of instructor.

BMEN 640 Design of Medical Devices
Credits 3.3 Lecture Hours.
Overview of the multiple issues in managing the design of a marketable medical device, including the design process from clinical problem definition through prototype and clinical testing to market readiness; includes FDA pre- and post-market regulation, human factors and system safety considerations, and medical product liability.
Prerequisite: Approval of instructor.

BMEN 641 Numerical Methods in Biomedical Engineering
Credits 3.3 Lecture Hours.
Application of numerical analysis to analyze molecular, cellular and physiological systems; general techniques used to analyze steady and dynamic systems; techniques will be applied in a MATLAB programming environment.
Prerequisite: Graduate classification or approval of instructor.

BMEN 650 Biomedical Optics Laboratory
Credits 3.2 Lecture Hours. 3 Lab Hours.
Biomedical optics technology; basic engineering principles used in developing therapeutic and diagnostic devices; a series of hands-on labs will be performed including optical monitoring, diagnostic and therapeutic experiments.
Prerequisite: Graduate classification or approval of instructor.

BMEN 652 Cell Mechanobiology
Credits 3.3 Lecture Hours.
Focuses on how mechanical forces influence cell behavior through physical and biochemical mechanisms; objectives include integrating engineering and cell biology to solve biomedical problems, which includes developing models for applying forces to cultured cells and tissues and measuring changes in cell biochemistry, structure, and function.
Prerequisite: Graduate classification or approval of instructor.
BMEN 657 Orthopedic Biomechanics
Credits 3. 3 Lecture Hours.
Fundamental course in orthopedic biomechanics designed to develop competencies in biomechanical principles using practical examples and clinical case studies of how biomechanical knowledge is applied to the evaluation of musculoskeletal tissues and structures, and treatment options for musculoskeletal dysfunction.
Prerequisite(s): Admitted into the major degree sequence in Biomedical Engineering and graduate classification.

BMEN 658 Motion Biomechanics
Credits 3. 3 Lecture Hours.
Skeletal anatomy and mechanics; muscle anatomy and mechanics; theory and application of electromyography; motion and force measuring equipment and techniques; inverse dynamics modeling of the human body; current topics in musculoskeletal biomechanics research.
Prerequisites: Graduate classification or approval of instructor.

BMEN 660 Vascular Mechanics
Credits 3. 3 Lecture Hours.
Application of continuum mechanics to the study of the heart arteries; on the measurement and quantification of material properties, and the calculation of vascular stresses; analysis of several cardiovascular devices to reinforce the need for careful analysis in the device design.
Prerequisites: BMEN 240 and BMEN 341 or equivalents.

BMEN 661 Cardiac Mechanics
Credits 3. 3 Lecture Hours.
Application of continuum mechanics and computational solid mechanics to the study of the mammalian heart; utilization of continuum mechanics and finite element analysis in solving non-linear boundary value problems in biomechanics.
Prerequisite: Graduate classification or approval of instructor.

BMEN 662 Vascular Fluid Mechanics
Credits 3. 3 Lecture Hours.
Bio-fluid mechanics of the human circulatory system including examination of disease development and medical treatments.
Prerequisites: BMEN 240 or equivalent.

BMEN 663 Soft Tissue Mechanics and Finite Element Methods
Credits 3. 3 Lecture Hours.
Application of continuum mechanics and finite element methods to the study of the mechanical behavior or soft tissues and associative applications in biomedicine.
Prerequisite: Graduate classification or approval of instructor.

BMEN 666 Entrepreneurial Issues in Biomedical Engineering
Credits 3. 3 Lecture Hours.
Description and analysis of issues associated with initiating business ventures to transfer biomedical technologies into the health care sector, including intellectual engineering technology area; and utilizing recent case studies of previous ventures.
Prerequisite: Approval of instructor.

BMEN 672/NUEN 672 Introduction to Diagnostic Radiology Physics
Credits 3. 2 Lecture Hours. 3 Lab Hours.
This course presents the concepts of radiation physics used in diagnostic radiology by providing an introduction to the theory behind the different imaging modalities as it relates to mammography, planar X-ray imaging, computed tomography (CT), single photon emission tomography (SPECT), and positron emission tomography (PET).
Prerequisite(s): NUEN 611, NUEN 613 or approval from academic advisor.
Cross Listing: NUEN 672.
BMEN 685 Directed Studies  
Credits 1 to 12. 1 to 12 Other Hours.  
Allows students the opportunity to undertake and complete, for credit, limited investigations not included within thesis or dissertation research and not covered by other courses. May be repeated for credit.  
Prerequisites: Approval of designated instructor and approved project proposal.

BMEN 686 Biomedical Nanotechnology  
Credits 3. 3 Lecture Hours.  
Introduction to nanotechnology applications in biomedicine; concepts of scale; unique properties at the nanoscale; biological interaction, transport, and biocompatibility of nanomaterials; current research and development of nanotechnology for medical applications, including sensors, diagnostic tools, drug delivery systems, therapeutic devices, and interactions of cells and biomolecules with nanostructured surfaces.  
Prerequisites: BMEN 343, approval of instructor.

BMEN 687 Drug Delivery  
Credits 3. 3 Lecture Hours.  
Mechanisms for controlled release of pharmaceutically active agents and the development of useful drug delivery systems; controlled release mechanisms including diffusive, convective and erosive driving forces by using case studies related to oral, topical and parenteral release in a frontier interdisciplinary scientific research format.  
Prerequisite: Graduate classification in biomedical engineering or approval of instructor.

BMEN 689 Special Topics in...  
Credits 1 to 4. 1 to 4 Lecture Hours. 0 to 4 Lab Hours.  
Selected topics in an identified area of biomedical engineering. May be repeated for credit.  
Prerequisite: Approval of instructor.

BMEN 691 Research  
Credits 1 to 23. 1 to 23 Other Hours.  
Research for thesis or dissertation.