SIU CARBONDALE Southern Illinois University

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Biomedical Engineering

The School of Electrical, Computer, and Biomedical Engineering (ECBE) offers programs of study and research leading to i) the Master of Engineering (M.E.) degree in Biomedical Engineering, and ii) the Master of Science (M.S.) degree (thesis/non-thesis) in Biomedical Engineering (BME).

The School provides a rich environment for educational and professional advancement in the following areas:

- **Medical Engineering**: Medical devices, medical instrumentation, biomechanics, medical and optical imaging, medical electronics and sensors, surgical technologies, healthcare software, and biophotonics.
- **Bioengineering**: bio-MEMS, bioinformatics, electrophysiology, molecular and cellular mechanics, neural engineering, and tissue engineering.

The BME programs provide a balance between formal classroom instruction and research and are tailored to the individual student's academic and professional goals. Graduates of the programs enjoy excellent employment opportunities and are highly recruited worldwide in industry, government, and academia.

Safety glasses are required for some of the courses. Note that only 3 credit hours from each eligible 400-level course (listed in the graduate catalog) will be counted towards the graduate degree.

Academic Objectives

The program, consistent with the mission and priorities of the University, is designed to achieve the following academic objectives:

- To provide high quality education in the field of biomedical engineering and to prepare the graduates for successful and rewarding employment as engineers or for continuing their education through the doctoral level.
- To provide the students with the training necessary to successfully apply the fundamental concepts and methods of biomedical engineering to selected areas of employment or research and development.
- To enhance the research environment and productivity of the School for the benefit of the students.

Master of Engineering (M.E.) in Biomedical Engineering

Admission

Individuals holding a Bachelor's degree or equivalent in engineering, science, or related field may apply. Qualified applicants with Bachelor's degrees in other areas may be able to enroll in the program with additional preparation (approved by the School on a case-by-case basis). The applicants must indicate whether they are pursuing the degree online or on campus.

Admission to the M.E. in Biomedical Engineering program is based on the following factors: grade point average of 2.75 or higher on a scale of 4.0 on approximately the last 60 credit hours of undergraduate coursework, class ranking, and faculty recommendation letters.

GRE scores are not required for admission. However, out-of-state or international students whose GRE Verbal score or Quantitative score percentile is 80% or higher will have the advantage of paying in-state graduate tuition rates.

See https://tuition.siuc.edu/highachievers2.html. Also, GRE scores, especially Quantitative, may be considered for fellowships, assistantships, or scholarships. The minimum TOEFL score requirement for international applicants is 550 (paper based) or 80 (computer based). The application fee and any other documentation specifically required for international students will be in accordance with the requirements of the Graduate School.

Curriculum

The Master of Engineering (M.E.) in Biomedical Engineering program requires the completion of 30 credit hours of graduate level credit. The degree does not require a thesis. At least 18 credit hours must be selected from the core BME courses. BME 592 and ECE 580 (seminar) will not count towards the degree. A maximum of 6 credit hours of non-engineering courses offered by the University and approved by the School could be applied to the degree. Online/distance education credit hours offered by the University and approved by the School can be applied towards the degree. The degree can be completed in 3 semesters.

Students enrolled in the program are required to complete a comprehensive assessment that may include topics related to their graduate work as well as engineering ethics, communication skills, and professional development as determined by the School.

A student pursuing the M.E. in Biomedical Engineering degree could switch to the corresponding M.S. in Biomedical Engineering program upon recommendation of ECBE faculty and with the approval of the School, provided admission requirements to the M.S. in Biomedical Engineering degree are met.

Retention

Any student whose cumulative grade point average falls below 3.0 on courses that count towards the degree will be placed on academic probation. Any graduate student on academic probation whose grade point average remains below 3.0 on courses that count towards the degree for two consecutive semesters in which they are enrolled, excluding summer sessions, will be permanently suspended from the program, unless the School grants an exception.

Master of Science (M.S.) in Biomedical Engineering

Objectives

The Master of Science (M.S.) in Biomedical Engineering program has two tracks: i) The non-thesis track is coursework-oriented; ii) The thesis track is research-oriented. The applicants must indicate whether they are pursuing the thesis or the non-thesis track degree option.

Admission

Individuals holding a Bachelor's degree or equivalent in engineering, science, or related field may apply. Qualified applicants with Bachelor's degree in other areas may be able to enroll in the program with additional preparation (approved by the School on a case-by-case basis). The applicants must indicate whether they are pursuing the thesis or the non-thesis track degree option.

Admission to the M.S. in Biomedical Engineering program is based on the following factors: grade point average of 3.0 or higher on a scale of 4.0 on approximately the last 60 credit hours of undergraduate coursework, class ranking, and faculty recommendation letters.

GRE scores are not required for admission. However, out-of-state or international students whose GRE Verbal score or Quantitative score percentile is 80% or higher will have the advantage of paying in-state graduate tuition rates.

See https://tuition.siuc.edu/highachievers2.html Also, GRE scores, especially Quantitative, may be considered for fellowships, assistantships, or scholarships. The minimum TOEFL score requirement for international applicants is 550 (paper-based) or 80 (computer-based). The application fee and any other

documentation specifically required for international students will be in accordance with the requirements of the Graduate School.

Curriculum

The Master of Science (M.S.) in Biomedical Engineering program requires a total of 30 hours of graduate-level credit. For the non-thesis track, at least 6 credit hours must be in BME 500-level courses that do not have significant overlap/similarity with BME 400-level courses, as stated in their catalog description. At least 18 credit hours must be selected from the BME courses. BME 592 and ECE 580 (seminar) will not count towards the degree. The remaining courses can be selected from the BME or ECE 500-level courses. Six credit hours of thesis (BME 599) are required for the thesis track. At least 18 credit hours must be selected from the BME courses. The remaining courses can be selected from the BME or ECE 500-level courses. A maximum of three credit hours of BME 592 could be counted towards the degree requirements. ECE 580 (seminar) will not count towards the degree. Students in this track will develop a program of study in consultation with their thesis advisor/committee. For both non-thesis and thesis tracks, with the approval of the School, a maximum of 3 online/distance education credit hours offered by the School, and a maximum of 6 credit hours from academic units outside the school may be applied towards the degree.

A student pursuing the M.S. in Biomedical Engineering degree could switch (non-thesis to thesis or vice versa) upon recommendation of ECBE faculty and with the approval of the School.

Retention

Any student whose cumulative grade point average falls below 3.0 on courses that count towards the degree will be placed on academic probation. Any graduate student on academic probation whose grade point average remains below 3.0 on courses that count towards the degree for two consecutive semesters in which they are enrolled, excluding summer sessions, will be permanently suspended from the program, unless the School grants an exception.

Accelerated Master's Program in Biomedical Engineering

Objectives

The Accelerated Master's Program is designed for high-achieving students who are currently enrolled in an undergraduate program in the School of Electrical, Computer, and Biomedical Engineering at SIUC. The program will allow students to earn both Bachelor's degree and a Master's degree within 5 years by completing 147 credit hours (instead of 156 credit hours if pursuing Bachelor's and Master's studies separately).

Admission

Interested students enrolled in Biomedical Engineering, Computer Engineering, or Electrical Engineering at SIUC will consult their undergraduate Academic Advisor to learn more about the program and how to apply. Students who have earned or are in the process of earning 60 or more credit hours with a minimum GPA of 3.0/4.0 overall could apply. Two recommendation letters from SIU faculty members are needed. The GRE or equivalent test requirement is waived for the accelerated Master's program. However, they are important to qualify for the High Achievers Tuition Rate. See http://tuition.siuc.edu/highachievers2.html.

Apply as early as the beginning of the first semester of junior year for acceptance into the program. Work with the undergraduate Academic Advisor (and a potential graduate faculty advisor, if needed) to develop a program of study identifying 9 credit hours that may be counted towards both the Bachelor's degree and the Master's degree.

Students are considered undergraduates until all requirements for the Bachelor's degree have been fulfilled. For the Master's degree, they can select either the M.S. in Biomedical Engineering (thesis/non-thesis) or the M.E. in Biomedical Engineering degree.

Curriculum

Junior/Senior Year - Complete up to 9 graduate-level ECE credit hours during the junior/senior year taken from the School of Electrical, Computer, and Biomedical Engineering (excluding ECE 492, ECE 592, BME 492, and BME 592). At most 9 graduate-level ECE credit hours will be counted towards both the Bachelor's and the Master's degree requirements. Graduate Year - Complete the remaining Master's coursework within one year of full-time graduate study.

Retention

Any graduate student whose cumulative grade point average falls below 3.0 on courses that count towards the Master's degree in Biomedical Engineering will be placed on program academic probation.

Biomedical Engineering Courses

BME417 - Neuroengineering Applying engineering techniques to study brain function. Topics include: cerebral cortex; sensory, motor, and association areas; neurons and glial cells; pathways and synapses; information processing in visual, auditory, and somatosensory cortices; analyses of brain recordings; brain-computer interfacing, multisensory integration models; context effect models; memory encoding and retrieval models. Restricted to Senior or Graduate Standing. Lab fee: $20 to help defray cost of equipment. Credit Hours: 3

BME418 - Bioelectronics and Biosensors The sources of electrical signals in biological systems. Methods and types of sensors for sensing bioelectrical signals, including amperometric, potentiometric, piezo-electric, impedance, and FET based biosensors. Interface between biosensors and electronics for sensor signal condition and data acquisition. Precision electronics for biosensor signal acquisition, including potentiostat, current, charge, capacitance and impedance sensing circuit, lock-in amplifier. Prerequisite: BME 337 or ECE 345 with a grade of C or better. Credit Hours: 3

BME419 - Biomedical Microelectromechanical Systems The course is designed to introduce students with fundamentals of MEMS and its applications. The emphasis will be on physical principle in sensors and corresponding fabrication techniques, with supplemental discussion of the state-of-art applications in industry and research. Students will learn to analyze and design systems by solving regular homework problems and active participation during lectures and in-class examples. Topics: Introduction of MEMS (Chapter 1), fundamentals of microfabrication and nanofabrication, fundamentals of physics in sensors, a case study of electrostatic sensing, microfluidics and biomedical applications, projects. Prerequisites: MATH 251; PHYS 205A, PHYS 205B; BME 336, each with a grade of C or better. Lab fee: $50 to defray cost of equipment and materials for the project(s). Credit Hours: 3

BME431 - Biomedical Optics Fundamental theories of light, including the wave theory of light and the particle theory of light; Fundamental interactions between light and matter, including reflection, refraction, absorption, scattering, fluorescence, and polarization; Biology of cells and tissues; Tissue optical properties; Tissue-targeted contrast agents; Coherence and interference; Light transport in turbid media; Diagnostic applications of light, including microscopy, spectroscopy, fluorescence imaging, fluorescence-lifetime imaging, optical coherence tomography, diffuse optical tomography, and/or biosensors; Therapeutic applications of light, including photodynamic therapy, photothermal therapy, and/or laser ablation. Prerequisites: ECE 235, MATH 251, and PHYS 205B with a grade of C or better. Credit Hours: 3

BME432 - Introduction to Biomedical Imaging (Same as ECE 467) Principles associated with x-ray imaging, computed tomography, ultrasound, magnetic resonance imaging, and optical imaging. Image quality. Image reconstruction. Prerequisite: MATH 305 and ECE 355 with grade of C- or better, or consent of instructor. Project-based fee: $30 to help defray cost of software licenses and equipment. Credit Hours: 3

BME435 - Computational Methods in Biomedical Engineering Algorithmic, statistical, and data mining concepts in biomedical engineering and bioinformatics. Programming in R: Vectors, Matrices, Lists, Data Frames, Factors, Tables. Classification techniques. ROC curves. Biomarker gene selection. DNA and

protein sequence analysis, sequence alignment. Prerequisite: BME 351 or equivalent with a grade of C or better. Credit Hours: 3

BME438 - Medical Instrumentation: Application and Design (Same as ECE 438) This course introduces the students to the field of medical instrumentation. Medical instrumentation is the application of advanced engineering technology to problems in biology and medicine. The course will focus on fundamentals of instrumentation systems, sensors, amplifiers, and signal precondition. In addition, the course also includes design and applications of medical instrumentation, biopotential measurement, biomedical signal processing, and other related topics. Prerequisite: MATH 305 and ECE 355 with a grade of C or better, or consent of instructor. Restricted to enrollment in BME programs. Project-based fee: $45 to help defray cost of software licenses and equipment. Credit Hours: 3

BME439 - Diagnostic Ultrasound Diagnostic ultrasound is an ultrasound-based medical imaging technique used to visualize muscles, tissue, and many internal organs, to capture their size, structure and any pathological lesions. This course is an introduction to the principles and applications of biomedical ultrasound. This course will focus on fundamentals of acoustic theory, principles of ultrasonic detection and imaging, design and use of currently available tools for performance evaluation of diagnostic devices, and biological effects of ultrasound. Prerequisite: MATH 305 and ECE 355 with a grade of C or consent of instructor. Restricted to enrollment in BME programs. Project-based fee: $30 to help defray cost of software licenses and equipment. Credit Hours: 3

BME453 - Image Sensors Fundamentals of semiconductor physics, including the use of doping and biasing to control electronic potentials in devices; Fundamentals of integrated circuits, including the design and fabrication of diodes, transistors, and interconnects; Fundamental interactions between light and matter, including reflection, refraction, and absorption; Structure and operating modes of photodiodes; Architectures and operating principles for charge coupled device (CCD) image sensors and complementary metal-oxide-semiconductor (CMOS) image sensors; Performance metrics for image sensors, including the noise floor, the full-well capacity, the quantum efficiency, and fixed pattern noise; Construction of color image sensors; Signal processing for image sensors, including color interpolation and color correction. Prerequisite: ECE 235, ECE 235L with a grade of C or better. Credit Hours: 3. Credit Hours: 3

BME470 - Fundamentals of Neural Networks in Data Science Anatomy and physiology of the cerebral cortex, Feed-forward Networks, Multilayer Perceptrons, Recurrent Networks, Hopfield Networks, Self-organizing Networks, Convolutional Neural Network, Applications to pattern recognition, robotics, image processing, and speech processing. Prerequisite: MATH 305 or ECE 315 or BME 351 with a C or better or consent of instructor. Credit Hours: 3

BME481 - Design and Implementation of Vision System (Same as ME 481) This course provides an introduction to a vision system and instrumentation with engineering applications including optical microscopy. A vision system is an essential tool in most of the application, and optical microscopy is a powerful scientific tool to study microscale worlds. Topics covered in basic geometrical optics, Optoelectronic devices, basic electronics for illumination system, optical microscopy, actuators in the microscope, fundamentals of fluorescence microscopy, and advanced imaging techniques. Prerequisites: ENGR 296 or ME 222 or consent of instructor. Credit Hours: 3

BME485 - Cellular and Molecular Biomechanics (Same as ME 485) Mechanics of living cells at the micron/nanoscale level. Molecular forces, bond dynamics, force-induced protein conformational changes. Structural basis of living cells, contractile forces, mechanics of biomembranes, nucleus, cytoskeletal filaments- actin, microtubule, intermediate filaments. Active and passive rheology, microrheological properties of cytoskeleton. Active cellular processes such as cell adhesion, cell spreading, control of cell shape, and cell migration. Discussion on experimental techniques including single-molecule approaches to understanding key cellular processes. Discussion of theoretical models that predict cellular processes and limitations. Introduction to mechanobiology. Restricted to senior or graduate standing. Credit Hours: 3

BME501 - Statistics for Biomedical Engineers Theoretical introduction to the basic principles of statistical modeling and estimation focusing on biomedical engineering applications such as genetics and genetic-related disorders. Prerequisite: PHSL 410A or consent of instructor. Credit Hours: 3

BME505 - Surgical Technologies Overview of the ordinary physiology of cells and tissues and the abnormal physiology associated with cancer and/or other major diseases. Role of surgeries in the

practice of modern medicine with a special focus on cancer treatment and/or other important procedures. Environment of and people inside the operating room. Therapeutic and diagnostic tools and techniques available in the operating room. Open and minimally invasive surgeries. Introduction to image-guided surgeries. Imaging systems and contrast agents for image-guided surgeries. Introduction to robotic surgeries. Preclinical research, clinical research, and FDA-approved process. Prerequisite: ECE 355 (or equivalent). Credit Hours: 3. Credit Hours: 3

BME519 - Microfabrication of Biomedical Devices The course is designed to introduce students to principles of microfabrication techniques and the contributions of microfabrication in medical devices. This course emphasizes the understanding of microfabrication techniques and hands-on experience, where students will observe interesting physical phenomena in devices they fabricate. Moreover, students will use these devices for practical biomedical tests from which they will understand and appreciate the benefits of microfabricated architectures in medical devices. Topics: Introduction of micro/nanofabrication, scaling analysis in physics, Micro-Total-Analysis Systems (?TAS), ?TAS for medical diagnostics & treatment, development of medical devices enabled by microfabrication. Prerequisite: BME 419 or equivalent with a C or better, or consent of instructor. Lab fee: $50 to defray cost of equipment and materials for the project(s). Credit Hours: 3

BME521 - Neuromodulation Principles and practice of neuromodulation. Topics include: introduction to electrophysiology; cellular and neuronal patch-clamp techniques; spinal cord stimulation; deep brain stimulation; neuromodulation for pain. Restricted to Graduate standing. Lab fee: $45 to help defray cost of equipment, supplies, and software licenses. Credit Hours: 3

BME531 - Biophotonics Fundamental principles of optics and photonics, biology, and medicine; imaging, spectroscopy, and optical biosensors. This course is designed for graduate students as well as senior-level undergraduate students in related disciplines who are interested in the interdisciplinary field of biophotonics. This course provides the fundamentals of light and its interaction with matter, optical imaging, lasers, and tissue optical properties. This course also provides the diagnostic applications of biophotonics, which includes biomedical imaging, microscopy techniques, and optical biosensors. Prerequisites: ECE 375, PHYS 320 or 328, with grades of C or better, or consent of instructor. Lab fee: $30 to help defray cost of equipment. Credit Hours: 3

BME533 - Speech Processing (Same as ECE 533) Fundamentals of speech production system, signal analysis of speech, speech coding, linear prediction analysis, speech synthesizing, and speech recognition algorithms. Prerequisite: MATH 250, ECE 355 with grades of C or better, or consent of instructor. Credit Hours: 3

BME534 - Biomedical Sensors & Measurements Design and evaluation of sensors with application in biomedical engineering. Instrumentation and Techniques for measurements related to biomedical applications. Prerequisite: PHSL 410A, CHEM 444, or consent of instructor. Credit Hours: 3

BME535 - Information Processing in Biomedical Engineering Methods for evaluating different approaches in signal processing systems for biomedical applications; provides familiarity with the variety of exciting software and hardware systems. Prerequisite: PHSL 410A, CHEM 444, or consent of instructor. Credit Hours: 3

BME536 - Biomedical Signal Analysis (Same as ECE 534) The nature of biomedical signals. Electricity in living tissue. Biomedical signal processing and modeling. Modeling and simulation of biomedical systems. Prerequisite: MATH 250, ECE 355, with grades of C or better, or consent of instructor. Project-based fee: $20 to help defray cost of software licenses. Credit Hours: 3

BME537 - Embedded Microprocessor System Design Design, analysis, and evaluation of microprocessor-based systems for biomedical implementation. Prerequisite: ECE 424 or consent of instructor. Credit Hours: 3

BME539 - Biomechanics Biomechanics through a rigorous mathematical standpoint while emphasizing the biological aspect. Engineering analysis of the human body. Stress, strain, and deformable body mechanics. Mechanical properties of biological tissues. Students who have completed BME 336 will not receive credit for this course. Prerequisite: PHYS 205A and MATH 251 (or equivalent) with a grade of C or better or consent of instructor. Project fee to defray cost of software license: $45. Credit Hours: 3

BME540 - Tissue Engineering (Same as ME 540) Fundamentals of tissue engineering will be discussed. Developing biomaterials for artificial scaffolds and cell populations within the scaffolds will be discussed. Stem cells for cell-based therapy will be highlighted. Design of various organ-on-chips will be covered. Other topics include recent advances in 3D bioprinting for organ engineering/regenerative medicine. Advances in in-vitro tumor models will be discussed. Ethical considerations will be emphasized. Credit Hours: 3

BME542 - Biomaterials This course addresses the bulk and surface properties of biomaterials used for medical applications. Artificial Organs and Tissues and Tissue Engineering are included. Analytical techniques pertinent to biomaterial evaluation, and testing. Prerequisite: ME 410 or consent of instructor. Credit Hours: 3

BME543 - Kinetics and Kinematics for Engineers An introductory course to the analysis of human movement through the use of mathematical methods from an engineering viewpoint. Human dynamics, linear kinematics and kinetics, angular kinematics and kinetics, and impulse and momentum. Students who have taken BME 341 cannot receive credit for this course. Prerequisite: BME 336 or equivalent with a grade of C or better. Project fee to defray cost of software license: $45. Credit Hours: 3

BME544 - Optical Imaging and Photonics Geometrical optics, including refraction and reflection; Physical optics, including interference, diffraction, and polarization; Optical aberrations, including causes and effects; Fourier optics, with applications to imaging; Light sources, including LEDs and lasers; Photodetectors, including photodiodes and image sensors; Lens systems; Microscopes. Students who are taking or have taken BME 448 are ineligible to enroll. Lab fee: $125 to help defray the cost of equipment, supplies, and software packages. Credit Hours: 3

BME563 - Advanced Image Sensors Pixel- and system-level design of charge coupled device (CCD) and complementary metal-oxide-semiconductor (CMOS) image sensors; Image processing pipelines for CCD and/or CMOS image sensors; Sources of nonlinearity and non-uniformity in image sensors, including photodiodes and amplifiers; Sources of noise in image sensors, including photon shot noise, dark shot noise, reset (kTC) noise, flicker (1/f) noise, and quantization noise; Materials used in image sensors, including silicon and indium gallium arsenide; Sources of resolution loss in image sensors, including crosstalk; Methods for evaluating image sensors; Technologies and techniques for moving beyond intensity-based imaging, including spectral imaging, polarization imaging, volumetric imaging, temporal imaging, and/or light-field imaging. Prerequisite: BME 453 or ECE 453 with a grade of C or better, or consent of instructor. Credit Hours: 3

BME577 - Bioprocess Engineering (Same as ME 577) The course objective is to introduce bioprocessing concepts to ME and BME students. This will introduce the idea of designing a system to achieve a biological reaction objective. It will have content in pharmaceutical production, production of enzymes and other biproducts, research involving cell culture reactors, pharmacokinetics and other bioprocessing. Special approval needed from the instructor. Credit Hours: 3

BME592 - Special Investigations in Biomedical Engineering Individual advanced projects and problems selected by student or instructor. Restricted to graduate standing. Restricted to enrollment in BME program. Special approval needed from the instructor. Credit Hours: 1-3

BME593C - Advanced Topics in Biomedical Engineering - Biotechnology This course covers advanced scientific and engineering topics behind a rapidly evolving, multi-disciplinary biotechnology. Special approval needed from the instructor. Credit Hours: 1-3

BME593H - Advanced Topics in Biomedical Engineering - Bioelectronics Lectures on advanced topics of special interest to students in various areas of bioelectronics. This course is designed to offer and test new experimental courses in biomedical engineering. Special approval needed from the instructor. Credit Hours: 1-3

BME593K - Advanced Topics in Biomedical Engineering - Control Applications Lectures on advanced topics of special interest to students in various areas of control applications in biomedical engineering. This course is designed to offer and test new experimental courses in biomedical engineering. Special approval needed from the instructor. Credit Hours: 1-3

BME596 - Principles of Biomedical Engineering (Same as ECE 596) Principles of biomechanics, biomaterials, electrophysiology, modeling, instrumentation, biosignal processing, medical imaging, and biomedical optics. Professional moral and ethical issues in biomedical research and development. Prerequisite: MATH 250 with a C or better or consent of instructor. Credit Hours: 3

BME599 - Thesis Students are eligible to register for thesis when they have approval of the instructor who will act as thesis advisor. Prerequisite: Consent of thesis advisor. Credit Hours: 1-6

BME601 - Continuing Enrollment For those graduate students who have not finished their degree programs and who are in the process of their thesis or capstone design course. The student must have completed all other course requirements to be eligible to register in this course. Concurrent enrollment in any other course is not permitted. Graded S/U or DEF only. Prerequisites: Completion of course work except BME 592 or 599. Credit Hours: 1

Biomedical Engineering Faculty

Electrical, Computer, and Biomedical Engineering Faculty:

Ahmed, Shaikh S., Professor, Ph.D., Arizona, 2005; 2007. Nanotechnology, semiconductor devices and circuit design, simulation and characterization.

Anagnostopoulos, Iraklis, Associate Professor, Ph.D., National Technical University of Athens, 2014; 2015. Many-core architectures, run-time resource management, embedded systems.

Aruma Baduge, Gayan, Associate Professor, University of Alberta, 2013; 2016. Communications theory, wireless communications, massive MIMO systems, millimeter-wave communications, cooperative relay networks, wireless energy harvesting for IoTs, physical-layer security.

Asrari, Arash, Assistant Professor, Ph.D., University of Central Florida, 2015; 2017. Power systems operation and planning, power systems optimization, smart grid.

Chen, Kang, Associate Professor, Ph.D., Clemson University, 2014; 2015. Software-defined networking (SDN), network function virtualization (NFV), vehicular networks, mobile opportunistic/ad hoc networks.

Chen, Ying (Ada), Associate Professor, Ph.D., Duke, 2007; 2007. Biomedical imaging, image reconstruction, digital tomosynthesis, image quality analysis, signal and image processing, simulation and computing.

Chilman, Bae, Assistant Professor, Ph.D., Pennsylvania State University, 2009; 2019. Bioelectrical engineering, neuroscience, mechanobiology.

Haniotakis, Themistoklis, Associate Professor, Ph.D., University of Athens, 2008; 2013. Digital VLSI design and test, RF IC design and test, low power VLSI design, and fault-tolerant systems.

Harackiewicz, Frances J., Professor, Ph.D., University of Massachusetts-Amherst, 1990; 1989. Electromagnetics, antenna theory and design, microwaves, microstrip phased arrays and anisotropic materials.

Kagaris, Dimitrios, Professor, Ph.D., Dartmouth College, 1994; 1995. VLSI design automation, digital circuit testing, communications networks, biostatistics, bioinformatics.

Komaee, Arash, Associate Professor, Ph.D., University of Maryland, College Park, 2008; 2015. Control systems, microrobotics, signal processing, estimation theory.

Lu, Chao, Associate Professor, Ph.D., Purdue University, 2012; 2015. VLSI system design, device-circuit co-design, 3D IC.

Qin, Jun, Associate Professor, Ph.D., Duke University, 2008; 2012. Sensors and instrumentation, data acquisition, medical devices, therapeutic ultrasound, haptics.

Sayeh, Mohammad R., Professor, Ph.D., Oklahoma State University, 1985; 1986. Neural networks, optical computing, image processing, stochastic modeling, quantum electronics.

Tragoudas, Spyros, Professor and Director, Ph.D., University of Texas at Dallas, 1991; 1999. Design and test automation for VLSI, embedded systems, computer networks.

Wang, Haibo, Professor, Ph.D., University of Arizona, 2002; 2002. Bioelectronics, biosensors.

Weng, Ning, Professor, Ph.D., University of Massachusetts at Amherst, 2005; 2005. High performance routers, network processors, system-on-a-chip, computer architectures.

Mechanical, Aerospace, and Materials Engineering Processes (MAME) Faculty:

Chowdhury, Farhan, Assistant Professor, Ph.D., University of Illinois at Urbana-Champaign, 2011; 2015. Mechanobiology, single-molecule cell mechanics, biomaterials.

Emeriti Faculty

Botros, Nazeih M., Professor, Emeritus, Ph.D., University of Oklahoma, 1985; 1985.

Daneshdoost, Morteza, Professor, Emeritus, Ph.D., Drexel University, 1984; 1984.

Galanos, Glafkos D., Professor, Emeritus, Ph.D., University of Manchester, England, 1970; 1987.

Gupta, Lalit, Professor, Emeritus, Ph.D., Southern Methodist University, 1986; 1986.

Hatziadoniu, Konstantine, Professor, Emeritus, Ph.D., West Virginia University, 1987; 1987.

Osborne, William, Professor, Emeritus, Ph.D., New Mexico State University, 1970; 2005.

Pourboghrat, Farzad, Professor, Emeritus, Ph.D., University of Iowa, 1984; 1984.

Viswanathan, Ramanarayanan, Professor, Emeritus, Ph.D., Southern Methodist University, 1983; 1983.

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