School	
Major	Masters of Science in Electronic Engineering-Biomedical Engineering

Core Requirements			
Code	**Title**	**Credits**	**Description**
EENG554	Biomaterials and Artificial Organs	3	The course is focused on biomaterials and artificial organs. Indeed, the replacement__augmentation of failing human organs with artificial devices and systems has been an important element in health care for several decades. Significant advances in the biomedical technologies have continuously occurred during the previous 50 years, saving numerous lives with cutting edge technologies. The basic physiology of each system is reviewed with emphasis on identifying the bioengineering design requirements for appropriate biomaterials and organ replacement systems. This course brings together fundamental engineering and life science principles to provide a focused coverage of various classes of biomaterials, prostheses and artificial organs. It emphasizes on the properties original organ to be substituted as well as on the evaluation of the substitute. Commercially available systems are analyzed from the point of view similarity to the host, biomechanics, and size and efficiency of the device. Student will be required to design an artificial organ consistent with the above mentioned considerations.
EENG504	Biomechanics	3	This course provides first an introduction of a constitutive equation, stress-strain relationships, shear rate, viscous and nonviscous fluids, elasticity, linear and nonlinear viscoelasticity, etc. Certain rheological models are derived. The rheometers used to determine the rheological properties of blood are described. The biofluid mechanics in the cardiovascular system are also treated, including the biomechanics of vessels and heart. Finally, the mechanical properties of muscles, ligaments, tendons and bones are studied.
EENG564	Robotics and Telemedicine	3	This course introduces telemedicine technology, a very broad scope defined as the use of telecommunications to allow caregivers to interact with patients and/or other caregivers operating at remote locations. We first define and then discuss emerging efforts at utilizing telemedicine in ways that may be pertinent to medical and surgical practices. Economics of telemedicine practice are examined, followed by some futuristic thoughts about telemedicine in different medicine fields (Radiology, Emergency, Surgery.). The course emphasizes on current uses and application of telecommunications approaches for medical diagnosis and patient care. Thus it focuses on the status of the technology, where information and telecommunication technology has developed effective and efficient tools for delivering health services to widely dispersed populations, and has allowed for the provision of medical services to sites that are physically separated from the provider. The course examines the capabilities of this technology extension to the reach of medical facilities and resources, promoting efficiency, productivity, improved quality of care, better communication between providers, increased beneficiary access to specialists, reduced transportation expenses, and increased cost efficiency. The course deals with Telemedicines three areas: decision-making aids, remote sensing, and collaborative arrangements for real-time management of patients at a distance using a wireless mobile robotic technology.

Major Requirements			
Code	**Title**	**Credits**	**Description**
EENG694A	Master Thesis Project(Part I)	3	Students must selec_t a project in one of these two areas: 1. Application of instrumentation and measurement techniques to biomedical engineering projects involving measurement, replacement__augmentation of biomedical systems. 2. Software projects employing engineering, mathematical, and computational principles; applications include sensory and motor processing. Thesis Work related to current trends and developments in the field of biomedical engineering.

EENG664	Clinical Engineering	3	Clinical engineering emerged as a discipline in the latter half of the twentieth century as increasing numbers of complex electronic and mechanical medical devices entered the healthcare environment for preventive, therapeutic, diagnostic and restorative applications. The purpose of this course is therefore to provide a central core of knowledge and essential information to biomedical engineer needs to practice the profession. The goals are to help the engineer to work within the complex environment of the modern hospital. The course emphasizes on the role of the engineers who are active in the healthcare sector that have great opportunities to contribute to long-term quality enhancement by developing new techniques__improving existing ones to ensure safe and effective patient care. The disciplines of clinical engineering include safety and efficacy of medical devices, healthcare technology management, quality management, professionalism and ethics, information systems, facilities, education and practice. Student will be required to develop projects consistent with the above mentioned considerations.
EENG634	Image Processing for Medicine	3	This course aims to enable the students to develop their own imaging solutions using Matlab and Mathematica and the Biomedical Digital Image Processing application package and to give the attendees a detailed comprehensive demonstration of Matlab and Mathematica□s relevant features and capabilities.
EENG674L	Medical Laboratory Instrumentation Lab	1	This laboratory course offers practical applications to medical laboratory instrumentation equipment. Laboratory sessions include description of the equipment and their principle of operation. Regular maintenance and quality control principles are introduced. Tests are performed on controlled samples and results are interpreted accordingly. Topics discussed include: Blood Collection and Centrifuge, Electrocardiography, Hematology, Microscopy, Spectrophotometry, Spirometry, Stethoscopes, and heart sounds.
EENG674	Medical Laboratory Instrumentation	3	This course is designed to fill the gap in the scientific communication between biomedical engineers and physicians, to give students an understanding of how scientists with medical__scientific degrees treat tests and clinical cases in both hospital and academic settings. There will be interactive discussions with research clinicians and scientists about the challenges in the medical and biomedical field, and how a biomedical engineer can interact with the doctor to deliver the best solutions for the patient.
EENG634L	Image Processing for Medicine Lab	1	This laboratory provides students with practical knowledge of image formation, and image processing techniques like spatial-domain filters, Fourier-domain filters, image enhancement, registration and segmentation. In this laboratory, students are expected to gain experience in these image processing techniques by practicing image processing exercises using Matlab software Image Processing Toolbox, and ImageJ software developed by the US National Institute of Health. At the end of the semester, students are expected to apply their acquired knowledge on the processing of real imaging datasets, for example, filtering out breathing noise from an MRI dataset
EENG624	Biomedical Optics	3	The first part includes tissue optics (propagation of optical radiation in tissues, skin optics, blood optics, eye optics and optics of the hard tissues), optical sensing for diagnostics, monitoring and Raman-Spectroscopy. The second part covers laser-tissue interactions and laser treatment (laser safety, laser bio-stimulation, laser photodynamic therapy - PDT, laser applications in cosmetology, surgery, dentistry and other medical specialties).
EENG534L	Signal Processing for Medicine I Lab	1	This laboratory course introduces the basic signal processing techniques, including an introduction to MATLAB, creation of function, digital signal processing techniques, and digital filters.

EENG574L	Medical Instrumentation II Lab	1	This lab course builds on the topics covered in the EENG574 course where students are introduced to the theory, design, and main components of a variety of medical equipment (blood counters, electrosurgical units, pacemaker, defibrillators, oximeters, anesthesia machines, lithotripters, ventilators, and Hemodialysis delivery systems). This laboratory provides thorough understanding of the operation of these equipment and instructions on their calibration, and testing of their performance. In addition, students are expected to complete two term projects that provide them with hands-on experience in designing and building medical devices prototypes, and allow them to apply their knowledge of sensors, electric circuits, electric safety, and data display in a new context. Term projects ideas are to be suggested but not forced by the lab instructor. Examples of suggested term projects are: designing and implementing a photoplethysmogram, heart beat monitor, etc.
EENG574	Medical Instrumentation II	3	This course is a natural extension of the Medical Instrumentation I course offered in the third year of the BS program. It describes the physiological basis and engineering principles of various medical equipments. It also introduces the principles of operation and the performance parameters of a wide range of instruments including recording and monitoring instruments, measurement and analysis techniques, and therapeutic equipment.
EENG524	Medical Imaging II	3	This course covers image reconstruction for both X-ray computed tomography and for nuclear medicine applications. Magnetic resonance imaging and reconstruction and imaging techniques are presented in details. Introduction to infrared medical imaging techniques. Research topics in the medical imaging domain are treated and discussed in this course.
EENG514	Computer Simulations and Modeling for Medicine	3	This course will present a comprehensive account of the application of modeling methodology to the investigation of biological systems. The emphasis will be on an organized overview of the tools and techniques rather than the detailed mathematical structures upon which they may rely. Neural networks and Fuzzy logic operations in modeling are also treated. The course will draw examples widely from the current literature in an attempt to not only show the topical relevance of the subject matter but also to equip participants with an understanding of the diversity of domains to which the techniques and methodologies apply.
EENG534	Signal Processing for Medicine I	3	This course covers the basic concepts such as noise, ensemble averaging, spectral analysis: classical methods, digital filters, spectral analysis: modern techniques, time frequency methods, the wavelet transform, advanced signal processing techniques.
EENG694B	Master Thesis Project(Part II)	3	Students must selec_t a project in one of these two areas: 1. Application of instrumentation and measurement techniques to biomedical engineering projects involving measurement, replacement__augmentation of biomedical systems. 2. Software projects employing engineering, mathematical, and computational principles; applications include sensory and motor processing. Thesis Work related to current trends and developments in the field of biomedical engineering.