Course Code: BMEG2000
Course Title: Introduction to Biomedical Engineering
Units: 3
Definition, scope, basic principles and problems in biomedical engineering. Introduction to the enabling technologies for biomedical engineering. Overview of various topics in biomedical engineering, e.g., biomedical sensors, bioinstrumentation, bio-signal processing, biomechanics, biomaterials, molecular engineering, tissue engineering, bio-nanotechnology, medical imaging, rehabilitation engineering, etc. Applications of engineering principles to selected medical and biological problems. Contemporary issues and roles of biomedical engineering.

Course Code: BMEG2010
Course Title: Biomedical Engineering Laboratory
Units: 3
Hands-on experience in various aspects of biomedical engineering. Introduction to basic electronics, chemistry, molecular biology, microbiology, and electrophysiology laboratory techniques. Laboratory skills, experimental design, interpretation of data, technical writing and ethical issues relevant to laboratory work. Concludes with a student-driven design project.

Course Code: BMEG2210
Course Title: Orthopaedic Biomechanics and Musculoskeletal Injury
Units: 3
This course covers biostatics, biodynamics, and biosolid mechanics and their applications to the human musculoskeletal systems and the clinical practice of orthopaedics. Topics include: force and moment vectors, equations of equilibrium, moments of inertia, kinematics of particles, Newton’s second law, kinematics of rigid bodies, dynamics of rigid bodies, stress-strain relations, linear elasticity, loading and deformation, shear forces and bending moments, multi-body kinematics and application to skeletal system, musculoskeletal injury mechanisms associated with musculoskeletal biology (aging, gender, diseases, adverse effects of treatments) and external forces (sports and traffic accidents), basic principles for designing medical devices and implants for prevention and treatment of musculoskeletal injuries. Clinical scenarios will be presented with open-ended questions. Relevant laboratory sessions on musculoskeletal force analysis, human movement studies, animal tissue testing will be synergized with the corresponding lectures to enhance learning. Students are expected to have prior knowledge on the basic principles of Newtonian mechanics at secondary school level.
**Course Code:** BMEG3102  
**Course Title:** Bioinformatics  
**Units:** 3

This course introduces the basic concepts in bioinformatics. On the theoretical side, students are expected to learn the relevant knowledge in computer science, biology and mathematics from lectures and tutorials. On the practical side, they are given assignments and tutorials to get hands-on experience in locating, studying and using developed tools to apply the learned concepts in performing standard analytical tasks on biomedical data. Topics to be covered include: introduction to bioinformatics, reviews of molecular biology and genetics, biomedical data types and databases, sequence alignment and searching methods, mutation models and molecular phylogenetics, molecular structures, basics of human genetics and genetic diseases, clinical bioinformatics for genetic diseases diagnosis.

**Course Code:** BMEG3110  
**Course Title:** Biomedical Ethics, Safety and Practice  
**Units:** 2

This interdisciplinary course prepares students to address the multi-dimensional issues of biomedical engineering practice in research and development, design and manufacturing, and in clinical applications. Topics covered include development of the biomedical engineering discipline, professional organization, global market of healthcare technology, R&D involving experimentation on humans and animals, intellectual property and technology transfer, standards and regulations of medical devices, cost-benefit and cost-effectiveness analysis, technology distribution and access, and the future of being human in view of the advancing biomedical technology. Relevant definitions, concepts and principles will be introduced as the course unfolds, followed by case-based discussions. The course will have guest sharing by practicing biomedical engineers, industrialists, healthcare administrators, policy makers, clinicians and end-users. Students are expected to have taken at least one introductory subject in biomedical engineering.

**Course Code:** BMEG3120  
**Course Title:** Database and Security for Biomedical Engineering  
**Units:** 3

Introduction of fundamental applications of information technology for healthcare, with focus on medical informatics, basic concepts of database management systems, security protocol, firewalls and computer viruses, system security threats, etc.
Course Code: BMEG3130  
Course Title: Tele-medicine and Mobile healthcare  
Units: 3  

Concepts of P-healthcare (personalized healthcare), E-medicine, and M-healthcare (mobile healthcare). Basic techniques in tele-medicine and M-healthcare: communication systems and networks, medical devices, E-healthcare records, wireless communications in medicine, information security and confidentiality, medical data coding and compression, functions of PACS and HIS. Applications include: tele-consultation, tele-geriatrics, tele-monitoring, M-healthcare, smart wards, etc.

Course Code: BMEG3210  
Course Title: Biofluids  
Units: 3  


Course Code: BMEG3320  
Course Title: Biomedical Imaging  
Units: 3  

This course covers the fundamentals of biomedical imaging: the physiology and physics that are involved in the imaging process (waves, spins, resonance, radioactive decay), the mathematics that are needed to modelize the image formation (linear algebra, multidimensional calculus, 2D Fourier transform, Radon transform, probabilities), the signal and image processing techniques that help analyse digital images (2D filtering, discrete 2D Fourier transform, interpolation, contrast, quality), and the hardware used for acquiring these images (X-ray tubes, detectors, magnets, coils, gamma cameras, transductors). A particular emphasis will be laid on four imaging modalities: X-ray radiography, Computed Tomography (CT), Emission Computed Tomography (scintigraphy, SPECT and PET), Magnetic Resonance Imaging (MRI) and Ultrasound Imaging.

Course Code: BMEG3330  
Course Title: Neuroengineering Fundamentals  
Units: 3  

Introduction to neuroengineering: the past, the current status and the future; Neural system and neuron activity; Neural modeling and computation; Neural information processing; Neuromuscular systems and Electromyography (EMG); Neural-
machine interface and neuroprosthesis: pacemaker, EOG and cochlea. Electric and magnetic field of human brain (EEG and MEG). Mechanisms underlying neurological disorders (stroke, Parkinson's disease, Alzheimer's disease or epilepsy); Neural opto-electronic technologies, Principles and applications of neuroimaging such as functional magnetic resonance imaging (fMRI), and positron emission tomography (PET).

Selected state-of-the-art topics in a highly interdisciplinary field that combines neurobiology, electrophysiology, neural activity imaging, optics and engineering technologies. Other selected topics of recent research interests.

**Course Code:** BMEG3420  
**Course Title:** Medical Robotics  
**Units:** 3  
Introduction to medical robotics, mechanical structures and dynamics, robotic sensing and control, human-robot interface, surgical robotic systems, rehabilitation robotic systems, micro-scale robotic medical devices, state-of-the-art in medical robotics.

**Course Code:** BMEG3430  
**Course Title:** Biomaterials and Tissue Engineering  
**Units:** 3  
Fundamentals in design, fabrication and selection of biomaterials for medical applications. Physical, chemical and mechanical properties and bio-compatibility of different types of biomaterials, e.g. natural, synthetic, inorganic and composite, etc. Introduction to tissue engineering. Principles of tissue engineering for medical application. Physical and biological considerations of biomaterials applications in clinical indications.

**Course Code:** BMEG3910  
**Course Title:** Undergraduate Research in Biomedical Engineering  
**Units:** 3  
Students will conduct research study of a topic in Biomedical Engineering under the supervision of a teaching staff.

**Course Code:** BMEG4103/ELEG4190  
**Course Title:** Biomedical Modelling  
**Units:** 3  
Basic physiologic systems: neuromuscular system, auditory system, pulmonary-cardiovascular system, etc. Bioelectric phenomena: action potentials, cellular
membrane models, volume conductor models, ECG, EMG, EEG, etc. Biomedical modelling: lumped element model, bio-impedance and otoacoustic emissions. Topics in bio-modelling of recent interest.

**Course Code:** BMEG4220  
**Course Title:** Body Sensor Networks  
**Units:** 3

Introduction to wearable medical devices and bio-sensing technologies. Design of on-body and in-body biosensors. Communication topologies, protocols, standards and media of body sensor networks (BSN). Usages and roles of BSN in real-life applications. Selected issues in state-of-the-art development of BSN, e.g. information security, signal interference, energy scavenging, multi-sensor fusion and context-aware sensing.

**Course Code:** BMEG4320  
**Course Title:** Biomedical Imaging Applications  
**Units:** 3

Knowledge and technical background on the current available bio-imaging technologies developed for assessment of quality of musculoskeletal tissues with emphasis on their application for bone and cartilage, such as QCT, pQCT, microCT for animals and human, nano-CT, MRI, ultrasound, and other advanced imaging modalities; Contrast-enhancement media for musculoskeletal and vascular applications; Use of above bioimaging modalities for evaluation of scaffold biomaterials developed for enhancement of repair of musculoskeletal tissues; Applications of biomedical imaging in diagnosis, prevention and treatment of aging related disorders of musculoskeletal, cardiovascular and other relevant living systems.

**Course Code:** BMEG4330  
**Course Title:** Sound and Light Waves in Medicine  
**Units:** 3

This course introduces and discusses medical imaging and treatment techniques which make use of sound and light waves including ultrasound, terahertz and laser techniques. Ultrasound imaging techniques and applications: wave propagation theory (wave equation, transmission and reflection coefficients, attenuation),
medically relevant examples. Terahertz imaging techniques and applications: generation and detection methods, principles of data analysis, molecular spectroscopy and potential medical applications. Laser techniques for medical treatments: photodynamic therapy, laser surgery.

Course Code: BMEG4410
Course Title: BioMEMS
Units: 3


Course Code: BMEG4450
Course Title: Bionanotechnology
Units: 3

This course consists of two parts. The first half covers basic concepts in nanotechnology (e.g., length scales (<100 nm) effect on properties of materials and devices), and introduces techniques and tools for fabricating nanostructured and bioengineered materials: quantum dots, DNA, self-assembly and templating, surface patterning, and functionalization. The second half introduces three key applications of nanotechnology in biomedical research (i.e., diagnostics, in vivo imaging, and targeted drug delivery), and briefly discusses the process of translating laboratory discoveries to therapies applicable in clinical trials.

Course Code: BMEG4510
Course Title: Biomolecular Engineering
Units: 3

This course consists of two parts. The first half covers basic concepts in biomolecular engineering, including structure and properties of biomolecules (e.g., nucleic acid, protein, lipid, and sugar), the central dogma of molecular biology, and regulation of gene expression. Building on the theoretical framework from the first half, the second half introduces experimental tools involved in biomolecular engineering research, including synthesis and characterization of DNA and protein, gene recombination, and basic genomics. Set at the advanced undergraduate level, the course focuses on developing students’ ability to analyze research data and
critique the scientific literature.

Course Code: BMEG4520  
Course Title: Cardiovascular Engineering  
Units: 3  
Microcirculation as a dynamic entity; Concentration and velocity profiles of blood cells in microcirculation; Intercellular collisions and their effect on microcirculatory transport; Model studies of the rheology of blood in microvessels; Fluid dynamics and thrombosis; Rheological factors and disease; Flow and vascular geometry; Ex-vivo models for studying thrombosis; Cardiac valve replacement with mechanical prostheses; Flow through mechanical heart valves and thrombosis.

Course Code: BMEG4530  
Course Title: Musculoskeletal Tissue Engineering  
Units: 3  
Application of the principles of biology and engineering to the development of viable substitutes which restore, maintain, or improve the function of musculoskeletal tissues. Musculoskeletal tissues: tissue engineering of tendon/ligament, cartilage and bone; understanding the interactions between extracellular matrices and cells, mechanobiological responses of cells/tissues. Musculoskeletal biomaterials: The development of bioactive, biomimetic advanced biological materials for replacement of aged and diseased musculoskeletal tissues.

Course Code: BMEG4540  
Course Title: Electrophysiology  
Units: 3  
Introduction to the nervous system: Neuroanatomy, Resting cell potential (structure, protein, gradient, potential), Action potential (myelination, propagation), Synapses and neurotransmitters (receptors, packaging, recycling), Ion basis for conduction; Analog to electrical system: Circuit theory, Electrical properties of neurons, Cable equation, Hodgkin-Huxley Model, Core-conductor theory, local circuit theory; Electrophysiological methods: Ionic basis for conduction, Basic instrumentation (recording electrode, oscilloscope), Voltage- and current clamp in vitro, Single channel patch clamp, Stimuli and recording, Electroencephalography and cortical potential, Local synaptic decoupling and modeling.
Course Code: BMEG5140  
Course Title: Rehabilitation Engineering  
Units: 3  

Course Code: BMEG5530  
Course Title: Tissue Engineering  
Units: 3  
This course provides an overview on the fundamental elements of tissue engineering including stem cell, extracellular matrix, biomaterials, soluble factor, drug delivery, mechanotransduction and bioreactor and recent advances in these fields. This course helps the students to understand how knowledge and techniques from biochemistry, biology, material science and various engineering disciplines can be applied to promote the advancement in tissue engineering of various physiological systems. Basic level of knowledge in biomaterials, biology and biochemistry is recommended.

Course Code: BMEG5610  
Course Title: Research Methods in Biomedical Engineering  
Units: 3  
This course presents research methods in biomedical engineering, and primarily aims at preparing postgraduate students for basic research or employment in the clinic and biomedical industries. Students will learn relevant concepts and tools for analyzing data arising from quantitative and qualitative research in molecular, physiological, and clinical systems. This course focuses on developing students’ ability to analyze research data and critique the scientific literature.

Course Code: ELEG2202  
Course Title: Circuits and Devices I  
Units: 3  
Basic circuit laws and theorems; mesh and nodal analysis, superposition and source transformation. Phasor, impedance and AC analysis. Introduction to three-
phase circuits. P-N junction diode, bipolar transistor and MOS transistor: terminal I-V characteristics and circuit models; diode rectifiers; single-stage transistor amplifiers: biasing and small signal analysis. Operational amplifier and its applications.

Course Code: ELEG3101/3240
Course Title: Medical Instrumentation and Sensors
Units: 3


Course Code: ELEG5101/5110
Course Title: Advanced Medical Instrumentation and Sensors
Units: 3

Review on physiological measurements and medical devices; electrodes and transducers for biomedical measurements; physiological monitoring and therapeutic devices; drug delivery systems; body sensor networks (BSN) and body area networks (BAN); wearable sensors and systems; e-textile devices. Medical imaging modalities: MRI, CT, PET, SPECT, ultrasound, etc.; bio-imaging: molecular imaging, cell imaging, etc. Selected topics of current interests in biomedical sensors.

Course Code: ELEG5102
Course Title: Biomedical and Health Informatics
Units: 3

Neuro-informatics: neural communication, neuro-myoelectrical channel, random point process, cable analogy. Medical information technologies: HIS, virtual hospital, PACS, etc. Health informatics: wireless physiologic sensing, medical data compression and telemedicine techniques, etc. Selected topics of recent interest.

Course Code: ELEG5103/5130
Course Title: Prosthetics & Artificial Organs
Units:  3
Basic concepts of biological prosthetic systems and artificial organs; Functional electrical stimulation; Restoration of movement of paralyzed arms and legs; Design of implantable devices and systems; Engineering replacements of kidney, lung, heart, and other organ functions and their electrical, mechanical, materials, chemical, pathological and surgical aspects.

Course Code:  ELEG5104
Course Title:  Introduction to Biomimetic Engineering
Units:  3
Definition, scope and approach of biomimetics; engineering designs, concepts and models inspired by nature. Principle of information transduction from the biological realm to optical, electronic and mechanical domains in which modern sensors operate as governed by underlying biological structure and processes. Frontiers in biomimetic engineering, technology and applications, such as molecular based sensing, electronic nose, electronic tongue, CMOS/molecular memory, artificial green leaf energy, microfluidics, self assembly of biological sensors, and hybrid systems at the interface of biotic and abiotic materials. Application of quantitative techniques in understanding and analyzing different biological processes. Students will work on projects where they will take examples of designs, concepts, and models from nature and explore their potential in engineering applications.

Course Code:  ELEG5302/5521
Course Title:  Biophotonics
Units:  3

Course Code:  ENGG1100
Course Title:  Introduction to Engineering Design I
Units:  3
This is a hands-on project-based course which introduces the basic engineering
concepts, experimental skills and design methodology needed for the design and construction of a hardware based system. Students will work in small groups on a practical project in which they will apply the design methodology introduced to them in lectures in a design project. The project work will involve defining milestones, identifying the constraints and requirements, defining the requirement specifications of the design, making and evaluating different possible designs by carrying out experiments to obtain data for refining the design, prototyping of the final design and testing of the system built in the project.

Course Code: ENGG1110
Course Title: Problem Solving By Programming
Units: 3

This is a software project course. Students will learn fundamental programming concepts. They will choose project(s) from the engineering disciplines. Through the project(s), students will acquire the skills to define problems and specifications, to perform modelling and simulation, to develop system prototypes, to carry out verification, validation, and performance analysis.

Course Code: ENGG1410
Course Title: Engineering Mathematics I
Units: 3

Linear algebra: matrices, matrix addition, matrix multiplication, inverses, special matrices; vector spaces, basis and dimension, linear independence, rank, determinants; linear transformations, projection, orthogonality, systems of linear equations, Gaussian elimination, LU decomposition; eigenvalues and eigenvectors. Vector calculus: 3-D vector space and algebra; vector differential calculus, gradient, divergence, curl; vector integral calculus, Green's theorem, Gauss's theorem, Stokes' theorem.

Course Code: ENGG2030
Course Title: Signals and Systems
Units: 3

Basics of signals and systems; continuous-time and discrete-time signals and systems; Fourier series and Fourier transform for analysis of signals and systems; characterization of systems; linear time-invariant systems and their characteristics; sampling; Laplace transform; z transform.
Course Code: ENGG2120  
Course Title: Introduction to Digital and Microprocessor Systems  
Units: 3  
Digital system concepts, numbering systems and codes. Boolean algebra, logic gates and logic circuit elements. Combinational and sequential logic circuit concepts and examples. Introduction to microprocessor systems, assembly language programming, input and output interfacing, analogue-digital conversion, application examples. LabVIEW programming, programming and application of microcontrollers. Laboratory work and project for gaining hands-on experience on microprocessor programming and application.

Course Code: ENGG2420  
Course Title: Engineering Mathematics II  
Units: 3  

Course Code: ENGG2430  
Course Title: Engineering Mathematics III  
Units: 3  
Fundamental probability concepts: probability and events; expectation, variance, moments, characteristic functions, moment generating functions; single variate distributions. Multivariate probability: conditional probability, joint probability; Bayes’ Theorem; conditional expectation, covariance; multivariate distributions, functions of random variables. Central limit theorems, law of large number. Random process: definition, stationary and ergodic random processes, Gaussian random processes, white noise. Statistics: estimation, sample size and applications.

Course Code: ENGG2520
Course Title: Engineering Physics II
Units: 3

This is an introductory calculus-based engineering physics course covering topics in modern physics and electromagnetism. Topics in modern physics include: Wave-particle duality, momentum and energy of photons and electrons, electronic states and energy bands, electrical conduction in metals and semiconductors. Topics in electricity and magnetism include: Coulomb’s law, electric field, electric flux, Gauss’ law, electric potential, capacitance, electrostatic energy and forces, Biot-Savart Law, magnetic dipole, magnetic field, inductance, magnetic energy and forces, electromagnetic fields and Maxwell’s equations, propagation of plane electromagnetic waves. Contents will be supplemented by discussions on applications relevant to engineering. Students usually take this course after Engineering Physics I, or with permission of instructor.

Course Code: ENGG2600
Course Title: Technology, Society & Engineering Practice
Units: 3

Impact of technology on society; introduction to engineering as a profession (different engineering fields, professional societies and registration, soft skills for working in a team); engineering design and innovation; introduction to intellectual property (copyright, trademarks, registered design and patents); engineering project management; product safety; professional ethics; liability and responsibility; workplace safety; environmental impact and market requirements; case studies and experience sharing from industry; global energy policies and standards; industrial and professional workshops or seminars as required by the Major programme.

Course Code: ENGG4010
Course Title: Final Year Project I
Units: 3

The course is designed to provide students with an opportunity to carry out, under the supervision of an academic staff, an independent project with research elements in engineering.

Course Code: ENGG4020
Course Title: Final Year Project II
Units: 3

The course is designed to provide students with an opportunity to carry out,
under the supervision of an academic staff, an independent project with research elements in engineering.

Course Code: SBMS1431  
Course Title: Human Anatomy and Physiology I  
Units: 2

This course adopts a combined structural (anatomical) and functional (physiological) approach of introducing the organization of the human body and various organ systems which are relevant to students of biomedical engineering. Students will be introduced to the general plan of the human body (i.e. anatomical directions and positions), and the structural and functional organization of the body parts starting from cells and tissues, and then to the different organ systems. More emphases are put on the basic principles and quantitative concepts based upon which the practice of biomedical engineering can be applied.

Course Code: SBMS1432  
Course Title: Human Anatomy and Physiology II  
Units: 2

This course adopts a combined structural (anatomical) and functional (physiological) approach of introducing the organization of the human body and various organ systems which are relevant to students of biomedical engineering. Students will be introduced to the other organ systems not covered in part 1 of this course. More emphases are put on the basic principles and quantitative concepts based upon which the practice of biomedical engineering can be applied.

Course Code: SBMS1440  
Course Title: Cell and Molecular Biology in Biomedical Engineering  
Units: 2

The course aims at introducing students the basic cell and molecular biology concepts as well as selected applications of biotechnology in biomedical sciences. Students will first have a glance on cell biology including cell structure and functions of the compartmentalized organelles, membrane and cellular transport, cell communications and motility. This will be followed by the functions of biomolecules, properties of biocatalyst, and an overview of metabolism. Topics on transmission of genetic information, regulation of gene expression, and a brief introduction on bioinformatics in the format of hands-on workshop will also be covered. In the later part of this course, lectures covering the applications of biotechnology in biomedical sciences will be accompanied by laboratory and site visits to allow students’ exposure on the sophisticated research equipment and
facilities in biomedical research laboratories.

**Course Code:** MAEG5080  
**Course Title:** Smart Materials and Structures  
**Units:** 3  
Overview of smart materials technology. Characteristics of smart materials such as piezoelectric materials, magnetorheological fluids, and shape memory alloys. Smart actuators and sensors. Structural modelling and design. Dynamics and control for smart structures. Integrated system analysis. Applications in biomedical devices, precision machinery, transportation, and buildings. (Equivalent to ACE5120)

**Course Code:** MBTE2000  
**Course Title:** Introduction to Molecular Biotechnology  
**Units:** 2  
The aim of this course is to introduce the basic principles and current topics in molecular biotechnology. The course will first cover major discoveries for the advancement of molecular biotechnology, basic principles of gene expression and recombinant DNA technology. Then, selected topics in molecular biotechnology such as human genome project, microbial, plant, animal and medical biotechnology will be introduced.

**Course Code:** MBTE4320  
**Course Title:** Genetic Engineering  
**Units:** 3  
The course will provide an extended understanding on the basic concepts, applications, and strategies of genetic engineering. Contents include a comprehensive introduction of recombinant DNA technology, selected techniques for genomic and functional genomic studies, and an overview on organism cloning and transgenic organisms.