Course Description

110406210 Biomechanics I: (3, 0, 3) Prereq. (110102101):

Introduction to the analysis of the musculoskeletal systems using principles of engineering mechanics. Basic principles of mechanics, stress, strain and deformation in beams are presented and used to characterize the material properties of tissues such as skin, tendon, ligament, bone and cartilage. Principles of biomechanics are applied to the design of medical devices and bioengineered tissues. forces, moments of forces, free body diagrams, principal stresses, transverse shear stresses and beam loading.

110406229 Fundamentals of electrical circuits: (3, 0, 3) Prereq. (110101102 & 110102102):

Units, definitions, independent/dependent source, ohm's law, kirchoffe's current/voltage laws, division rule. Nodal and Mesh Analysis. Thevenin's and Norton's theorems. Operational amplifiers. Inductance and capacitance. Source free RL, RC, and RLC circuits. Sinusoidal steady state analysis. The phasor concept, phasor representations for R, L, and C circuits, problem solving using PSPICE.

110406260 Applied Mathematics: (3, 0, and 3) Prerequisite (110101203):

Coordinate systems and linear algebra, vectors, matrices, Cramer's rule, gauss elimination, Eigen values, Eigen vectors, and matrix manipulation. Laplace transform, Fourier analysis, and complex numbers. Partial differential equations (PDE's) and numerical iteration (PDE's).

110406310 Biomaterials: (3, 0, 3) Prerequisites (110103107):

Introduction to biomaterials selection and the limitations imposed by the technology and the host environment. Overview of materials formation, thermodynamic potentials, and material structure, physical and mechanical properties of materials. Bio-molecules structure, synthesis, and function. Concept of biocompatibility and the role of the immune response. Subsequently, the structure and properties of metals, ceramics, and polymers will be discussed and evaluated.

110406311 Bio-fluids: (3, 0, 3) Prereq. (110406210 & 110406260):

This course consists two parts: in the first part students will learn the fundamental laws of statics, kinematics and dynamics applied to fluid. The course will include fluid properties, conservation of mass, momentum and energy as applied to real and ideal fluids. Laminar and turbulent flows, fluid resistance and basic boundary layer theory will also be considered. The second part emphasizes the applications of fluid mechanics to biological systems. It concentrates primarily on the human circulatory and respiratory systems. Topics covered include: blood flow in the heart, arteries, veins and microcirculation and air flow in the lungs and airways.

110406320 Biomedical Electronics: (3,0,3) Prereq. (110409240)

Rectifiers, diodes and zener diodes. Power amps., thyristors, triac, diac, MOSFET controlled switch, invertors and schmit triggers. Opamps, inverting, no-inverting, differentiators, adders comparators and instrumentational amplifieries. Active filters.

110406321 Biomedical Instrumentation (1) (3, 0, 3) Prereq. (110501222 & 110406320):

Introduction and basic concepts of biomedical instrumentation. Introduction to measurement systems. Basic sensors and principles, amplifiers and filters, Origin of bio-potentials. Biopotential electrodes and biopotential amplifiers. Blood pressure, heart sounds, blood flow, and blood volume measurements and chemical biosensors. Safety requirements.

110406329 Electronics: (3, 0, 3) Prerequisites (110409203):

DC and AC analysis of electronic circuits; theory, circuits, and applications of diodes, bipolar junction transistors (BJT), field effect transistors (FET), operational amplifiers, power amplifiers and regulators; introduction to power electronics.

110406370 Signal and System Analysis for biomedical engineering: (3, 0, 3) Prereq. (110406260):

This course inculdes definitions and general introduction of signals and system, time domain signal analysis: impulse response and convolution for continuous linear time invariant systems. Frequency domin signal Analysis: Fourier Series and Fourier transform, sampling theory. Introduction to Laplace transform and Z transform, time-frequency signal analysis: introduction to wavelet transform.

110406410 Biomechanics II: (3,0,3) Prereq. (110406210)

applications of mechanics to describe the material properties of living tissues. description and measurements of these properties as related to their physiological functions. interrelationship between biomechanics and physiology in medicine, surgery, body injury and prostheses. Review of basic mechanics, stress, strain, constitutive equations and the field equations, viscoelastic behavior, and models of material behavior. The measurement and characterization of properties of tendons, skin, muscles and bone. Biomechanics as related to body injury and the design of prosthetic devices. Advanced topics in soft tissue and cellular biomechanics.

110406411 Cardiovascular mechanics: (3, 0, 3) Prereq. (110406210 &110501222):

This course concerned with the description of the mechanics of the cardiovascular system. Topics covered include: anatomy and physiology of the cardiovascular system, blood theology, elastic. Description properties of the arterial wall, pulsatile flow dynamics, flow dynamics past valve prostheses, flow through capillaries, force-velocity studies of the heart muscle, force-deformation analysis of left ventricle, atherosclerosis and hemodynamic theories.

110406420 Biomedical Instrumentation (2) (3, 0, 3) Prereq. (110406321):

Concepts and design strategies for Therapeutic, laboratory and diagnostic medical systems. Respiratory system measurements. Clinical laboratory equipment: spectrophotometer, hematology and electrophoresis. Intensive care unit (ICU) and

coronary care unit (CCU) equipment. Operating rooms (OR). Therapeutic and prosthetic devices: dialysis machine, electric stimulators, defibrillators, ventilators, and infant incubators. Electro surgery instruments and lithotripsy. Therapeutic applications of the laser.

110406421 Biomedical Instrumentation Lab (1): (1, 3, 0) Prereq. (110409342 & 110406321):

Experiments of electronics that interacts with biomedical applications and signals, safety requirements, amplifiers, opto-electronic components, types of filters, analogue to pulse shaping and visual and sound indicators.

110406422 Biomedical Instrumentation Lab (2): (1, 3, 0) Prereq. (110406421 & 110406420-Co-requisite):

Experiments that interact with biopotential signals such as ECG, EEG, EOG and EMG. Also pulse experiments and Temperature sensors (diode and thermocouple) and their usage in biomedical measurements. Medical devices such as Blood pressure monitors, Audiometer, and Spirometer.

110406423 Biomedical transducers and telemetry: (3, 0, 3) Prereq. (110406370 & 110406321):

Revision to various principles of transducers, classification of biomedical telemetry systems. Types of modulation techniques, amplitude, frequency, and pulse code. Analogue and digital transmission in single and multichannel telemetry systems, using different types of bio-transducers and modulation techniques. Principle of antenna. Receivers and demodulators. Passive telemetry. Applications of the previous concepts in Biomedical Engineering.

110406424 Biomedical transducers and telemetry lab: (1, 3, 0) Prereq. (110406423):

Experiments on different transducers principles, construction and applications. Deflection bridges, analog to digital conversion. Detection, conversion and .transmission of various physiological parameters using different types of modulation techniques such as amplitude modulation and frequency modulation.

110406425 Bio-Electromagnetism: (3,0,3) Prereq. (110406260 & 110409203):

Review of vector analysis, Divergence and Stokes's theorem, electrostatic fields, Coulomb's law, unbound electric fields, electrostatic boundary-value problems, Magnetostatic fields, Maxwell's equations for static EM fields. Magnetic force, Torque, and Moment. Magnetic materials, magnetic devices. Faraday's law, Displacement current, Time varying potentials, and Maxwell's equations for time varying fields. Transmission Lines. Examples of cell response to electric and magnetic fields, electromagnetic fields within body tissues such as bone, skin, nervous system.

110406430 Artifitial Organs , and Prosthetics: (3,0,3) Prereq. (110406310 & 110406321):

Exploration of the biological, mechanical, electrical, and magnetic principles utilized in substitutive medicine. Artificial heart, artificial lung, artificial kidney, and other artificial organs and prosthetic systems will be discussed and analyzed. Engineering replacement for living organs will be addressed as well as the factors involved in these replacements such as the geometry, material, and functionality, electrical, magnetic, and mechanical aspects. Hybrid artificial organs and the integration of cell based therapy in artificial

organ design. Direct integration of prosthetic systems into bone. As well as virtual reality applications in prosthetic systems design and applications.

110406440 Modeling and Simulation of Biomedical systems: (3, 0, 3), Prereq. (110406260 & 110108112):

Mathematical modeling of organs and organ sub-systems will be described and analyzed. Biological and physiological processes of selected organs will be quantified. Heart and circulation, gas exchange in the lungs, electrical properties of excitable membranes, renal countercurrent mechanism and muscle mechanics are among the topics covered. Emphasis will be placed on control systems in the human body, as well as on numerical simulation of the models described. Using MATLAB environment.

110406450 Practical training: (0, 0, 0), Prereq. (Successfully completion of 112 credit hours):

8 uninterrupted weeks of engineering training in Jordan or abroad.

110406470 Medical Imaging: (3, 0, 3) prereq. (110406321):

Physics and instrumentations of x-ray radiography, CT, Nuclear Medicine including SPECT and PET, MRI and ultrasound medical imaging modalities, biological hazards and safety requirements.This course includes term project.

110406510 Biomaterials design and Characterization: (3, 0, 3) Prerequisites (110406310):

Quantum mechanical origins of spectroscopy, the relationship of spectroscopic behavior to thermal characteristics of a material, and the differences in approach to the chemical and physical characterization of synthetic and biological polymers. The course includes term projects involving the application of design principles to standard problems in biomaterial design.

110406511 Fundamentals of Micro/Nanotechnologies in Biomedical Engineering: (3, 0, 3) prereq. (110406310 and 110104101):

Technologies and tools available for interfacing living cells from a sub-cellular, single-cell, and multi-cellular (tissue models) approach. Key concepts of the biology of cells and tissues and will explore the technologies (micro-/nanotechnologies) and tools (sensors and actuators) available for the investigation of cell and tissue biology. Includes a term project involving the application of design principles to standard problems in biomedical design**.**

110406520 Robotic Surgery: (3, 0, 3) Prereq. (110406420 & 110406423):

Introduction to the new applications of robotics, to achieve the benefits of traditional surgery with the least disruption to the normal functions of the human body.
Fundamental principles of robotic surgery and their clinical application. The technology of robotic surgery, operating room Setup and robot preparation, anesthesia for robotic surgery. Robotics in cardiac surgery and robotics in general surgery.

110406521 Therapeutic ultrasound: (3, 0, 3) Prereq. (110406470):
Fundamentals of ultrasound waves, PZT material, single element transducer, linear arrays and phased arrays with pressure wave field simulation.Different therapeutic ultrasound applications include cancer treatment using hyperthermia and high intensity focus ultrasound, bone fracture healing, wound healing, drug delivery and extracorporeal lithotripsy. Term paper will be submitted from each student.

110406530 Rehabilitation Engineering: (3, 0, and 3) Prerequisites: (110406210 & 110406423):
This course will discuss the Principles of engineering mechanics and science applied to human structural and kinematic systems. Topics include anatomy; gait analysis, human force systems; human motion in 3 D; forward dynamics, inverse dynamics, the boundary method in 3-D Simulation of human motion; orthopedic implants design and manufacturing, supports, ballistic motion, and replacements limbs. Furthermore this course will discuses intelligent mobility aids and robotic manipulation aids design and technology.

110406531 Biomechanics and Rehabilitation Engineering Laboratory: (1, 3, 0) prereq. (110406310 & 110406530):
The lab consists of two parts, the first part focuses on the mechanical characterization of soft and hard tissues (i.e. stress-strain curve, fatigue, etc …) as well as the application of principles of engineering mechanics on different biomaterials. The second part focuses on Human Performance Analysis via the study and analysis of human motion, in this part, new motor tasks will be investigated and analyzed via an optical motion capture and tracking system to improve the quality of life of persons with disabilities and improve performance for athletes.

110406532 Fundamentals of Tissue Engineering: (3, 0, 3) prereq. (110406310 & 110104101):
Introduction to the field of tissue engineering as a therapeutic approach to treat damaged or diseased tissues in the biotechnology industry. In essence, new and functional living tissue can be fabricated by delivering cells, scaffolds, DNA, proteins, and/or protein fragments at surgery. This course will cover the advances in the fields of cell biology, molecular biology, material science and their relationship towards developing novel "tissue engineered" therapies. The course will also include a project involving the application of various principles to standard problems in tissue regeneration.

110406570 Medical Digital image processing: (3, 0, 3) prereq. (110409422):
Introduction to medical digital image, physiological vision properties, image sampling and transforms, image enhancement, edge detection, morphological analysis, geometrical modification, Texture Analysis using Wavelet Transform, Digital Halftoning and Inverse Halftoning.
As course assignments, different experiments on medical digital image processing using MATLAB will be performed. Experiments will include 2D FFT, Image filtration, enhancement, restoration, edge detection, segmentation, and wavelet transform applications.

110406591 Graduation Project (1): (1,3,0) Prereq. (successfully completion of 120 credit hours and department approval):

In this course selected projects in biomedical engineering will be provided to students. Each project will be supervised by faculty member, The students start up their graduation project with the needed lituretur review . the students in this course will submite a report that contains their hypothesis and detailed experiment design.

110406592 Graduation Project: (2) (2,6,0) Prereq. (110406591):

The students employ their theoretical and practical experience that they gained through the period of their project 1 to create new applications that strengthen their knowledge in this specialty. This course includes testing the hypothesis and implementing the experiments design in project one. This course will give the students the ability to learn, implement, and conducting scientific research.

110406593 Fundamentals of Medical Devices Design and Development: (3, 0, 3) Prereq. (110406420):

Introduction to design, development, and evaluation of medical devices. The course describes project definition, technology transfer of potential biomedical products, the fundamental systems used in design, development, material selection, design strategies, manufacturing of medical devices; these should be related to user needs and industry regulations. Emphasis is placed on the process of matching technological opportunities to medical needs. Case studies and term project will be assigned.

110406594 Special Topics in Biomedical Engineering: (3,0,3) Prereq. (Department's Agreement);

Current trends and developments in the field of biomedical engineering. Contemporary Issue in biomedical engineering.

110406595 Clinical Engineering: 3 C.H (3, 0, 3) Prereq. (110406310):

A foundation course in medical and clinical terminology. Food and drug administration regulations and classifications. This course deals with clinical and animal trials regulations:
Blinded and double blinded clinical trials;
Good Laboratory Practice (GLP) rules and regulations;
Institutional Review Board (IRB) rules and regulations;
Safety considerations in the clinical environment;
Clinical engineering management and data processing tools;
Hospital planning and management;
National codes for Hospital planning and medical waste management.