

B.S. Biomedical Engineering

Academic Program

2023-2022

First Year

First Year										
First Semester					Second Semester					
Course Title	T	A	P	U	Course Title	T	A	P	U	
BME111	Statics					BME121	Dynamics			
BME112	Biology 1					BME122	Biology 2			
BME113	Calculus I 1					BME123	Calculus I 2			
BME114	Anatomy I 1					BME124	Anatomy I 2			
BME115	English Language 1					BME125	Physics			
BME116	Freedom and Democracy					BME126	Engineering Drawing			
BME117	Computer Skills & programming 1					BME127	Computer Skills & programming			
BME118	Intro to Biomedical Engineering 1					BME128	Intro to Biomedical Engineering 2			

Second Year

Second Year										
First Semester					Second Semester					
Course Title	T	A	P	U	Course Title	T	A	P	U	
BME211	Math. II 1					BME221	Math. II 2			
BME212	Anatomy II 1					BME222	Anatomy II 2			
BME213	Chemistry 1					BME223	Biochemistry			
BME214	Electric Circuits 1					BME224	Electric Circuits 2			
BME215	Circuits Laboratory 1					BME225	Circuits Laboratory 2			
BME216	Biomaterials Science 1					BME226	Biomaterials Science 2			
BME217	Mechanics of Materials					BME227	Mechanics of the Musculoskeletal System			
BME218	** Computer Skills and Computing for BME 1					BME228	** Computer Skills and Computing for BME 2			
BME219	English Language 2					BME229	Arabic language			

Third Year

Third Year										
First Semester					Second Semester					
Course Title	T	A	P	U	Course Title	T	A	P	U	
BME311	Analog Electronics					BME321	Digital Electronics			
BME312	Signal Processing					BME322	Signals and Systems for BME			
BME313	Systems Physiology 1					BME323	Systems Physiology 2			
BME314	Engineering Analysis					BME324	Numerical Methods			
BME315	Rehabilitation Science and Eng.					BME325	Electromagnetic Fields			
BME316	Electronics Laboratory1					BME326	Electronics Laboratory2			
BME317	Transport Phenomena for BME					BME327	Thermodynamics			
BME318	Medical Lasers in Engineering					BME328	Medical Optics in Engineering			
BME319	English Language 3					BME329				

Forth Year

Forth Year										
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Program syllabus

Program Syllabus for the First Year

First Semester

Anatomy II. 3 cr. hrs.التشريح

Introduction to Anatomy, Bones of Upper limbs shoulder, Bones of upper limbs arm and forearm, Bones of hands and joints, pectoral muscles region, muscles of the scapular region, Brachial plexus, vascular system of upper limbs, Facial compartment of the upper arm, forearms part 1, forearms part 2, muscle of the hands, Relationship to other regions.

Biology 1. 4 cr. Hrs علم الحياة

Introduction to Biology, sub-disciplines of biology, Life process, Hierarchical structure of life, Evolution, Evolution theories, Ecology, Ecosystem, Bio diversity, Cell, Cell membrane structure, functions, Endoplasmic Reticulum, types, functions, Lysosomes, types, functions, Golgi apparatus, Mitochondria, Organelles without limiting membrane, Nucleus, chromatin, chromosome, DNA, RNA, Gene Expression, Regulation of gene Expression, Growth factor, Extracellular component, Cell junction, Desmosome, Introduction to the Energy of life, Forms of Energy, Free energy, Stability and Equilibriums.

English Language. 2 cr. hrs الانكليزي

Sentences & Phrases, Simple present and present progressive, Nouns & Pronouns, Articles and Uncountable nouns, Prepositions, Simple past and irregular verbs, Building Vocabulary & Spelling, Future Tense, The Conjunction Words, Introduction to academic writing, Writing Long sentences, Building Bigger Sentences with Subordinating Conjunctions, Useful transitions words and phrases, Presentation projects.

Calculus II. 4 cr. hrs. الرياضيات

Inequalities: (absolute value, greater integer and signum function), Line, circle and parabola Functions: domain and range and their graphs, Operation on algebraic function, Trigonometric functions, Limit: definition and calculating it by using it's laws, One-sided limits, Infinite limits and Calculating all types of Asymptotes, Continuity, Tangents, Differentiation and it's rules, Derivative by using Chain rule, Derivatives of Trigonometric functions, The derivative as a rate of change, The Implicit differentiation, Matrices and determinations: theorems, Inverse matrix, Solution by using Cramer rule.

Statics. 5 cr. hrs. علم السكون

fundamental concepts, Kinds of force systems + scalars and vectors, Vector addition of forces + addition of a system of coplanar forces, Addition and subtraction of Cartesian vectors, Equilibrium of a particle: The free-body diagram, Force system resultants, Moment of a couple + equivalent system, Resultants of a force and couple system, Equilibrium of a rigid body, Trusses: joint method and section method, friction, Frictional forces on screws, Moment of inertia.

Introduction of computer programming 1. 3 cr. hrs. برمجة

Introduction of computer C++ programming Arithmetic operation, Algorithms, If, if...else statement, loop statement, s for statement examples, do... while statement, Switch statement, Break and continue statement, One dimensional array, Application for array.

Introduction to biomedical engineering1 3 cr.hrs مقدمة بالطب الحياتي

Introduction to BME, field of research in BME, Branches of BME, Selected subject from anatomy and physiology, physiology and branches of the CNS, brain region and its function, Introduction to bio- sensors and transduction, Displacement measurements sensors, optical measurements, development in medical sensors and transduction
introduction to bio-signals, measuring the heart activity using ECG signals, measuring the muscles activity using EMG signals, Measurement the brain activity using EEG signals

Second Semester

Anatomy II. 3 cr. hrs.

Thoracic wall, thoracic cavities, Anatomy of the heart, Gluteal region, Bones of lower limbs, pelvises, anterior compartment of the thigh, post compartment of the thigh, Muscles of feet and joints, blood supply of lower limbs

Biology 2. 4 cr. hrs.

Transportation across cell membranes, Passive transport, simple diffusion, Facilitated diffusion, Active transport, primary & secondary transport, Cell division, Cell cycle phases, Regulation of cell cycle, Introduction of nervous system, Function and division of the nervous system, Neuron cell, Classification of neuron, Functionally and important zones of neuron, Excitation & conduction, Action potential, refractory period, Types of impulse, types of nerve fibers, Synaptic transmission, types of synapse, Neuroglia cells, types of glial cells.

Dynamics. 5 cr. hrs.

Introduction, Rectilinear Kinematics: Continuous Motion, Rectilinear Kinematics: Erratic Motion, General Curvilinear Motion, Curvilinear Motion: Rectangular Components, Motion of a Projectile, Curvilinear Motion: Normal and Tangential Components, Absolute Dependent Motion Analysis of Two Particles, Relative-Motion of Two Particles Using Translating Axes, Kinetics: Newton's Second Law of Motion, The Equation of Motion, Equation of Motion for a System of Particles, Equations of Motion: Rectangular Coordinates, Equations of Motion: Normal and Tangential Coordinates, Work and Energy: The Work of a Force, Principle of Work and Energy, Principle of Work and Energy for a System of Particles, Power and Efficiency, Conservative Forces and Potential Energy, Conservation of Energy, Kinetics of a Particle: Impulse and Momentum, Principle of Linear Impulse and Momentum, Principle of Linear Impulse and Momentum for a System of Particles, Conservation of Linear Momentum for a System of Particles.

Physics: 3 cr. Hrs

THE INTERNATIONAL SYSTEM OF UNITS AND, CHANGING UNITS AND LENGT, SIGNIFICANT FIGURES AND DECIMAL PLACES, VECTORS AND THEIR COMPONENTS, UNIT VECTORS, ADDING VECTORS BY COMPONENTS, MULTIPLYING VECTORS, POSITION, DISPLACEMENT, AND AVERAGE VELOCITY, INSTANTANEOUS VELOCITY AND SPEED, ACCELERATION, CONSTANT ACCELERATION, FREE-FALL ACCELERATION, NEWTON'S FIRST AND SECOND LAWS, SOME PARTICULAR FORCES, APPLYING NEWTON'S LAWS, FRICTION, THE DRAG FORCE AND TERMINAL SPEED, WORK AND KINETIC ENERGY, WORK DONE BY THE GRAVITATIONAL, FORCE, WORK DONE BY A SPRING FORCE, WORK DONE BY A GENERAL VARIABLE FORCE

Calculus I2. 4 cr. hrs.

Definite integral, Area under the curve, The Fundamental theorem of Calculus, Indefinite Integrals and the substitution rule, Find area between curves by integral, Transcendental functions: Inverse functions and their derivatives, Natural Logarithms and the Exponential function, a^x and $\log_a x$ function, Inverse Trigonometric function, Hyperbolic functions, Integration by: Making a simplifying substitution, completing the square, Integration by using Trigonometric Identity, Integration by Eliminating a square root, multiplying by a form of 1, Integration by reducing an improper fraction.

Introduction of computer programming 2. 3 cr. hrs.

Array, String, Read and write 2D array, String with 2D array, function, Examples for functions type, Recursion function, Application for function, Read and write files.

Introduction to BME 2. 3 cr. hrs.

Introduction to Electromagnetic waves, Applications of Electromagnetic waves in medicine, Fundamentals of Laser, Laser interactions with human body, Medical Applications of Laser, PC applications in medicine, Anatomy and Physiology of human brain, Introduction to Brain Computer Interface, Components of a BCI, Signal Acquisition, Feature Extraction, Feature Translation Algorithm, Introduction to Telemedicine, Usages and applications of telemedicine, Introduction to DICOM system, Introduction to the x-ray system, Introduction to the dialyzer machine.

Engineering Drawing. 3 cr. hrs.

Introduction to engineering drawing + Using engineering drawing tools, Kind of lines, arcs, Arabic and English engineering letters, Engineering drawing operations, Projectile theory, Drawing the three projects, Dimensions, Find the missing project, Isometric, Sections

Program Syllabus for the Second Year

First Semester

Anatomy III. 3 cr. hrs.

Head & Neck Landmarks, Blood Supply of head & neck, Pharynx, Thyroid gland, Trachea, Esophagus, Cranial Cavity, The Scalp, The Brain, Brain Stem and Cerebellum, Cranial Nerves, Spinal Cord Anatomy.

Chemistry. 4 cr. hrs.

Introduction to general chemistry, Methods and measurements, Structure of atom and atomic number and mass no, the periodic table of elements, Application of analytical chemistry, Acids and alkaline solutions and buffers, Volumetric analysis, Calculation of molarity and titration, Hydrolysis and calculate the pH, Acid – base indicators, Precipitation titration, electrochemistry, thermochemistry.

Biomaterials Science 1. 3 cr. hrs.

Introduction to biomaterial, Structure of solid, Theoretical Density Metals & Imperfections in crystalline structures, Types of materials Metals, Metallic Implant Materials, Corrosion, Phase diagram (Building), Polymer (Types), Polymer (determine Molecular weight), Polymerization, Physical states of polymers, Polymeric Implant Materials, Ceramics material.

English Language. 2 cr. hrs.

Overview of verb tenses, Prepositions for place and time, Introduction to long paragraph: Brainstorming/ Articles and countable uncountable nouns, Pronouns, Introduction to long paragraph: headlines and first draft, Building vocabulary: phrasal verbs, transition words in writing, Building vocabulary: types of adjectives, Writing Long sentences: Compound sentence, Building Bigger Sentences with Subordinating Conjunctions, descriptive paragraph, Writing Informative paragraph, an overview of useful techniques and tips of academic writing, Presentation projects.

Calculus III. 4 cr. hrs.

Polar coordinates: equivalent points and equivalent equation, Plotting curves, certain standard curve, the angle between tangent to curve and the radius vector, Arc length, area of a plane region, Asymptotes, conic section, Hyperbolic functions: the functions and their inverse, Relation to the logarithmic function, derivative and integration, the catenaries, Vectors: operations on vector in space, linear dependence, The scalar and vector product, the triple product, lines and planes in space, vector – valued functions of single variable, Limit and continuity, derivative, The unit vector U_r and U_θ velocity and acceleration, The unit vector T , N , B in coordinates, and integration of a vector valued function, Partial derivative: (functions of two or more independent variables, limit and continuity, Partial derivatives, differentiable functions, total differentia, chain rule, Jacobian, normal lines and tangent planes to surfaces, the gradient of a function.

Computing for BME 1. 3 cr. hrs.

MATLAB Environment and help, Data Type -Variable and array Simple Operations, Matrices operation Curve Fitting, BASIC 2D and 3 D plotting functions, -Script File and comments- if Statements nested if- Comparison - Logical Operators-break-continue, User

define function ,recursion, The error and warning Functions,The try and catch Method, Data Precision and data Conversion (Number ,Character and Logical Type),Structure Data Type, Input and Output File (Basic Input/ Output Functions),Functions for Dealing with Text Files,Reading from Files, Writing to files

Mechanics of Materials. 3 cr. hrs.

Introduction to Mechanics of Materials, Mechanical Properties of Materials, Shear Stress and Strain, Axially Loaded Members, Statically Indeterminate Structures, Thermal Effects, Strain Energy, Torsion, Stresses and Strains in Pure Shear, Shear Forces and Bending Moments, Shear-Force and Bending-Moment Diagrams, Stresses in Beams (Basic Topics), Normal Stresses in Beams, Shear Stresses in Beams.

Electrical Circuits 1. 3 cr. hrs.

Introduction and basic elements connections, Equivalent resistance and delta-star transformation, Kirchoff's voltage laws, Branch current analysis, Mesh loop analysis, Nodal analysis, Format approach of mesh and nodal analysis, Thevenin and Norton Theorems, Maximum power transfer theorem, Capacitance and equivalent capacitor, Capacitor transients in DC circuits, Inductor and equivalent inductance, Inductor transients in DC circuits, Review and general discussion.

Circuits Laboratory 1. 3 cr. hrs.

Define Devices & Components, Resistance Connection series and parallel circuits, Ohm's Law, Circuit configuration (Series and Parallel), Kirchoff's Laws (KV&KCL), Power Measurements, Nodel Analysis, Mesh Analysis, Super Position Theorem, Thevenen's Theorem, Norten Theorem, Max. Power Transfer Theorem, Transients circuits RL & RC, Transients circuits RLC.

Second Semester

Anatomy II2. 3 cr. hrs.

Anterior Abdominal wall, Peritoneum, Gastrointestinal tract (GIT), Accessory Organs of the Gastrointestinal Tract (G.I.T), The Pelvis, Nerves, Arteries, Joints of the Pelvis, Contents of the Pelvic Cavity.

Biochemistry. 4 cr. hrs.

Introduction to biochemistry, Carbohydrate, mono and disaccharides, Protein structure and function, Primary, secondary, tertiary structure of protein, Proteins denaturation's and digestion, Enzymes, Effects on energy of reaction, Cofactor and coenzymes, Lipids and their function and fatty acids, Structure of biological membrane, Carbohydrate metabolism, Aerobic respiration, Degradation of amino acids, Introduction of molecular genetics, Structure of DNA, RNA and genetic code.

Calculus II2. 4 cr. hrs.

Hyperbolic functions: the functions and their inverse, Relation to the logarithmic function, derivative and integration, the catenaries, Partial derivative: (functions of two or more independent variables, limit and continuity, Partial derivatives, differentiable functions, total differentia, chain rule, Jacobian, normal lines and tangent planes to surfaces, the gradient of a function, Sequences and infinite series: convergence of a sequence, Bounded and monotomic sequence, subsequences, Power series, Tylor's theorem, Differential equation: the order, degree, Special and general solution, Divergence and curl of a vector valued, exact differential, max and min with constrains, Multiple integrals: the double

integral as a limit of sum.

Biomaterials Science 2. 3 cr. hrs.

Mechanical properties (Stress Strain & Tensile Properties), Mechanical properties (Fracture, True stress & strain, Failure), Design Using Fracture Mechanics, Failure (Fatigue), Calculating damage with Miner's Rule, Failure (Stress cycle parameters & Performance of Biomaterials), Electrical properties & Thermal Properties, Optical properties, Viscoelasticity.

Computing for BME 1. 3 cr. hrs.

Top-Down Design 1, Top-Down Design 2, Bottom-Up Design 1, Bottom-Up Design 2, Combined Design, Time and Memory Efficiency, Improving Time Efficiency, Improving Memory Efficiency, Storing and Reading 1-D Signals, Processing 1-D Signals, Building a GUI with the Guide Tool 1, Controlling a GUI Components: Events and Callback 1, Controlling a GUI Components: Events and Callback 2, MATLAB Simulink -model file- Simulink library, Dealing with Simulink data (from and to) file and workspace

Mechanic of Musculoskeletal System. 3 cr. hrs.

Introduction to Mechanics of Musculoskeletal system, Mechanical Properties of hard tissue (bone), Plane Stress, Plane Strain, Plane Stress and Strain relation, Tri-axial stress, Tri-axial strain, Failure Theories, Strength of Bone, Combined Load, Viscoelasticity, Model of Viscoelasticity, Fatigue of Musculoskeletal, Fracture of bone.

Electrical Circuits 2. 3 cr. hrs.

AC circuits fundamentals, Sinusoidal voltage, current, phase shift, average and RMS values, impedance, Complex numbers and mathematical operations, R, L and C elements in AC circuit, Ohm's law in AC circuits; phasor diagram, Kirchhoff's laws in AC circuit and admittance concept, Power in AC circuits and power factor, Resonance, series resonance, frequency response and Q factor, Selectivity, BW and half power frequencies in series circuits, Parallel resonance, frequency response and Q factor, Selectivity, BW and half power frequencies in parallel circuits.

Circuits Laboratory 2. 3 cr. hrs.

Series RL Circuit, Parallel RL Circuit, Series RC Circuit, Parallel RC Circuit, Series RLC Circuit, Parallel RLC Circuit, Kirchhoff's laws, KVL & KCL, Nodal Analysis, Power Measurements, Nodal Analysis, Mesh Analysis, Super Position Theorem, Thevenin's Theorem, Norton Theorem, Max. Power Transfer Theorem, Transients circuits RL & RC, Transients circuits RLC.

اللغة العربية 2 ساعتان

تعريف الطالب بمصطلحات اللغة العربية من نحو وصرف وادب وشعر ونثر واملاء, بيان انواع الخطأ التي يقع فيها الطالب وهي على ثلاثة انواع خطأ لغوي وخطأ نحوي وخطأ املائي والخطأ في كتابة الظاء والضاد, بيان انواع الجمل في اللغة العربية وتحديد عناصر كل نوع منها, بيان علامات الاعراب الاصلية والفرعية, بيان انواع الفعل من ناحية التعدي واللزوم ومن ناحية الزمن, شرح الفاعل وبيان علامات اعرابه وانواعه, شرح المفعول به وبيان علامات نصبه وتقديمه على الفاعل مرة وعلى الفعل مرة ثانية, شرح الجملة الاسمية وبيان علامات رفع المبتدأ والخبر وحالات تقديم الخبر على المبتدأ وجوبا وجوازا, اعطاء الطلاب مجموعة من الاخطاء الشائعة في لغة البحث الاكاديمي, شرح كيفية كتابة الهمزة الاولية والوسطية والاخيرة, بيان علامات التنقيط واهميتها في بيان المعنى, اعطاء الطالب مجموعة من حكم الامام علي عليه السلام, شرح قصيدة اليا ابو ماضي فلسفة الحياة وبيان معانيها مع حفظها من قبل الطلاب, شرح قصيدة الجواهري يادجلة الخير وبيان معانيها وحفظها من قبل الطالب

Program Syllabus for the Third Year

First Semester

Engineering Analysis. 4 cr. hrs.

Fourier series: Series expansion & Euler coefficients; even & odd functions; half range expansion; Complex exponential form of Fourier series, Applications, Special functions : The Gamma; Impulse & the unit step function, Fourier transform : periodic & aperiodic signals, Fourier transform of periodic signals, Laplace transform : existence, definition of piecewise regular functions & functions of exponential order, Properties of Laplace transform, Inverse Laplace transform, The z-transform: Sampling theory & discrete functions; Residual formula, Properties of z-transform, Inverse z-transform, Matrices : Definitions & theorems Rank, System of linear equations, Eigen values & Eigen vectors, Analytic functions of a complex variable : Algebraic preliminaries & geometric representation of complex numbers, Functions of a complex variable; Properties of analytic functions; The logarithmic function.

Systems Physiology 1. 4 cr. hrs.

Introduction to human physiology, Levels of Structural Organization, interrelationships among body organ systems, Homeostasis, Feedback Mechanisms, Regulation of body system, Blood physiology, Blood Composition and Functions, Formed Elements, Bone marrow, Red blood cells, Erythropoietin, Production of Erythrocytes, formation of hemoglobin, anemia, polycythemia. Regulation and Requirements for Erythropoiesis, Blood types, transfusion reactions resulting from mismatching, transplantation of tissue and organs, Muscle physiology, skeletal muscle, sarco-tubular system, Excitation-contraction coupling, muscle twitch, muscle types, Oxygen debt mechanism, Physiology of digestive system, digestion, saliva, gastric juice, Bile juice, pancreatic juice, intestinal juice, Absorption, Regulation of digestion, Introduction to Immunity, types of immunity, Immunization, Vaccine, Resistance of body to infection, Humoral immunity, classes of Antibodies. Complement system, Cell-mediated immunity, and types of t-cells.

Signal Processing. 3 cr. hrs.

Introduction to DSP / Type of signals, Representation of discrete time signal / Definition of discrete System, Discrete convolution / Graphical method, Analytical method, linear constant coefficient difference equation, The frequency response of linear shift invariant system, Property of frequency response / Definition of Z- transform, Definition of fourier transform and its properties, The discrete fourier transform, DITFFT / DIFFFT, Digital filter and spectral analysis, Design of non-recursive digital filter (FIR), Design of recursive digital filter (IIR).

Transport Phenomena. 3 cr. hrs.

Introduction to physiological fluid mechanics, Basic concepts in fluid mechanics, Viscosity, Hematology and blood rheology, Fluid flow, Shear stress in fluids, Poiseuille's law, Mass, Bernoulli and Energy Equations, Friction coefficients of pipe flow, Head loss, Fluid statics and measurement of pressure.

Analog Electronics. 3 cr. hrs.

Electrical circuit analysis, Semiconductors, diode theory, diode types, Diodes applications circuit1, circuit2, circuit3, BJT transistor types, BJT transistor D.C analysis, FET transistor D.C biasing, BJT transistor A.C analysis, BJT transistor application circuits, FET transistor types.

Electronics Laboratory 1. 3 cr. hrs.

Diode Characteristics, half wave rectifier, Full wave rectifier, Clipping Circuits, Clamping Circuits, AND Gats using Diodes, OR Gats using Diodes, Zener Diodes, Transistor BJT

Characteristics, Fixed Bias Transistor, Transistor as a switch, Single stage amplifier, Emitter Follower C.C BJT, Transistor Signal stage.

Electromagnetic fields. 4 cr. hrs.

Introduction, X, Y, Z coordinates, Cylindrical coordinates, Spherical coordinates, Vectors analysis, Coulomb's law, Electrical Forces, Electrical Field Intensity, Point, Line, surface charge, Electrical field density, Flux, Flux intensity, Gauss's law, Energy and potential, Potential field of a point, line and sheet charges.

Rehabilitation Science & Eng. 4 cr. hrs.

Introduction to rehabilitation engineering, Rehabilitation engineering design, Wheelchair safety, standards and testing, Manual wheelchair design, Power wheelchairs, Orthopedic Rehabilitation, Lower extremity orthoses, Upper Extremity Orthoses, Joint Replacement.

Medical Lasers in Engineering. 4 cr. hrs.

Introduction, A brief history of the laser, Basic theory, Laser beam characteristics, Types of lasers, Laser interaction with biological tissue, Techniques for control of laser output, Applications of lasers, Applications of lasers in medicine, Laser safety.

Second Semester

Signal & System for BME. 3 cr. hrs.

Introduction to BMSF, Examples of Biomedical signals, temperature and blood pressure, Introduction to Mat-lab, Biological systems, Introduction to basic signal processing techniques, The Electromyography and The Electrocardiography, The phonocardiography and Carotid pulse, Other signals (VAG, VMG, speech), objectives and difficulties with biomedical signals, Computer-aided diagnosis: CAD.

Systems Physiology 2. 4 cr. hrs.

Physiology of urinary system, Urine formation, GFR, Micturition, RAA System. Dialysis, Physiology of Endocrine system, Cell signaling, Hormonal System, Transmissions, Chemical structure of Hormones, Mechanisms of hormonal action, Physiology of Central nervous system, Neurotransmitters, classification of neuro transmitters, neuro modulators, action of neuromodulators, Receptors, classification, mechanism and development of receptors, Reflexes, classification, reflex Arc, Knee-Jerk reflex, withdrawal reflex, Sensations, somatosensory system, Pain, referred pain, analgesia system, gait control theory, Memory, types of memory.

Numerical Analysis. 4 cr. hrs.

Least square fitting; straight line and polynomial, exponential & logarithmic least square fitting, Interpolation: equal intervals finite differences; forward & backward Newton's formulas, Central interpolation, forward & backward formula, Interpolation for unequal intervals; divided differences, Numerical differentiation, General formula, Numerical integration; general method; trapezoidal rule, One third & three eight Simpson's rule, Numerical Analysis: Solution of nonlinear equations, fixed point iteration method, Bisection method, Secant method, Newton-Raphson method, Solution of ordinary differential equations; power series method, Euler & modified Euler methods; 2nd order & 4th order Runge-Kutta methods, Jacobi method for finding Eigen values, Numerical methods for double integrals; trapezoidal rule and Simpson's rule.

Thermodynamics. 3 cr. hrs.

A Review of Thermodynamic Concepts, Introductory Concepts & Definitions in

Thermodynamics, Energy Transfer by Heat & Work, Equation of State, Heat and Other Forms of Energy, The First Law of Thermodynamics, Energy Balance for Steady-Flow Processes, Mass and Energy Analysis of Control Volumes, Heat Transfer Mechanisms, Phase-Change Processes of Pure Substances.

Electromagnetic fields. 4 cr. hrs.

Introduction, X, Y, Z coordinates, Cylindrical coordinates, Spherical coordinates, Vectors analysis, Coulomb's law, Electrical Forces, Electrical Field Intensity, Point, Line, surface charge, Electrical field density, Flux, Flux intensity, Gauss's law, Energy and potential, Potential field of a point, line and sheet charges.

Medical Optics in Engineering. 4 cr. hrs.

Introduction, Properties of light, Lenses and prisms, Eye and vision, Refractive errors, Optical instruments, Applications of light in medicine, Fiber optics / Introduction, Types of optical fibers, Fundamental parameters of an optical fibers, Transmission characteristics of an optical fibers, Applications of optical fibers in medicine.

Digital Electronics. 4 cr. hrs.

Introduction of digital system, logic operations, Number System, operations and codes, Logic gates, Boolean Algebra, Logic Simplification, Combinational logic Analysis, Functions of combinational logic (Adder, Comparator), Decoders, encoders, multiplexer and demultiplexer, Latches, Flip-Flops, Asynchronous Counter, Synchronous counter, Shift registers, Memory and storage

SCR type characteristic, SCR trigger circuit, SCR application, multistage systems, multistage systems & special amplifiers, Large signal amplifiers (power transistors), power transistors, class A, power transistors, class A transformer coupled, power transistors, class B (push-pull), BJT & FET frequency response, The operational amplifier as an electrical circuit, Operational applications, Frequency Response of BJT Transistor, Frequency Response of FET Transistor.

Electronics Laboratory 2. 3 cr. hrs.

Two Stage Amplifier, Frequency Response BJT Transistor, AND gate, OR & NOT gates, EX-OR & EX-NOR Gates, Combinational Logic Circuits, Karnaugh Map, ADC, DAC, 555 Timer, Mixer, OP-AMP Inverting & Non-Inverting, OP-AMP Summing & Subtracting, SCR Characteristics.

Program Syllabus for the Fourth Year

Artificial Limbs & Artificial organs. 3 cr. hrs.

Friction, types of friction, law of static and dynamic friction, friction in general bearing, friction measurements. Hydrodynamic lubrication, squeeze film, boundary lubrication, Elasto hydrodynamic lubrication, Theory and type of wear. Wear measurements Tribology in human body, lubrication of human joints, wear in human joints.

Design of machine Elements. 3 cr. hrs.

Mechanism: - Introduction to the study of mechanism constrained motion, Velocity and acceleration diagram, forces acting in mechanism. Hooke's Joints (Universal Joints) Gyroscopic couple, Governors, balancing of rotating masses Fatigue, creep, Ductile material, brittle material, Detachable fastenings, (screws, keys, knuckle joints, cotter joints, pins, snap), Power screw, belt and chain clutches and brakes, gears and bearings.

Microwave and X-ray. 2 cr. hrs.

Properties of light. Lenses & prisms. Medical applications of light. Electronic Image. Eye

&Vision. Visual acuity. Defective vision. Physiology of the eye. Optical Instruments.
Laser: - a physics of laser. Characteristic of laser. Device & Types of laser in Medicine.
Laser interaction with Biological Tissue. Laser safety.

Medical Instrumentation and System I. 4 cr. hrs.

Cardiovascular measurements. Blood flow measurements, Plethysmography, Catheterization laboratories. Cardiac stimulation and life support equipment. Defibrillators Pacemakers, Heart-lung machines. Respiratory instrumentation. Spirometers, Pulmonary measurement systems and instruments, artificial mechanical ventilation.
Electroencephalography (EEG). EEG-electrodes, EEG-amplitude and frequency bands, Multi-channel EEG recording systems and typical external controls, Pre-amplifiers and EEG-system, EEG-artifacts. Intensive care unit. ICU- equipment, Cardio tachometers, Alarms Lead fault indicator, Remote oscilloscopes, Memory system. Electro surgery generators. Electro surgery machines, Electro-surgery circuits, Electro surgery safety.

Control System Design. 6 cr. hrs.

Linear control system. Introduction: Open-loop system. Closed-loop system
.Mathematical Background: - Laplace transform. Matrices. Transfer Function of system-
Electrical system. Mechanical system. Electro-Mechanical System. Chemical Process modeling. Bio-Medical Examples. Block diagram Reduction Rules. Signal flow graph and Mason's rule. Time responses analysis of control system. Routh stability criterion. Root locus Techniques. Frequency response analysis of control system, Bode plot techniques. Nyquist stability criterion. Non-Linear control system (describing function Approach).

Medical Measurements. 2 cr. hrs.

Introductions to measurements. Resistive, capacitive, inductive, LVDT, piezoelectric transducers. Forward and inverse problem. ENG, EMG, ECG. Chest leads. Evoked potential. Biopotential electrodes, Cardiac pacemaker. Cardiac defibrillator. Other Medical Measurement system.

Micromicrocontroller. 4 cr. hrs.

Microcomputer system microprocessor- Microprocessor registers, arithmetic logic unit, control unit, address, data, control buses, memory, input/output devices and interfaces, the microprocessor internal organization (programming models), segmented memory, machine language, and Instruction set. Data transfer instructions, Arithmetic instructions. Logic instructions, String manipulation instructions. Control transfer instructions. Interrupt instructions. Miscellaneous instructions. Memory. Memory fundamentals, Basic element of the memory. Reading from/Writing into memory, RAM, ROM. Internal architecture of memory. The microprocessor operations and system organization: 8088 microprocessor minimum mode, External signals: address\data bus, memory, I/O control signals, interrupt interface signals, DMA interface signals, system timing. Main memory system design: Microprocessor read/write timing). Memory interfacing to the microprocessor. Address decoding and the memory map. Basic input/output. Input/output instructions, Basic port design. Input/output timing diagrams, Operation. Peripheral-mapped I/O). Memory -mapped I/O. Input/output Techniques: - Programmed I/O (interfacing keyboard). Interrupt-Driven I/O:- (Maskable interrupts, Non-maskable interrupts, multiple interrupts and priorities, interfacing keyboard). DMA (Direct Memory Access)

Laboratory instrumentation. 2c4 hrs.

Clinical Laboratory Instruments(MEDICAL DIAGNOSIS WITH CHEMICAL TESTS , SPECTROPHOTOMETRY, SPECTROPHOTOMETER TYPE INSTRUMENTS,COLORIMETERS,SPECTROPHOTOMETERS ,CLINICAL FLAME PHOTOMETERS ,SELECTIVE-ION ELECTRODES BASED ELECTROLYTES ANALYSER ,AUTOMATED BIOCHEMICAL ANALYSIS SYSTEMS ,Blood Gas Analysers ,ACID-BASE BALANCE ,BLOOD PH MEASUREMENT ,MEASUREMENT OF BLOOD PCO₂ ,BLOOD PO₂ MEASUREMENT ,INTRA-ARTERIAL BLOOD GAS MONITORING, A COMPLETE BLOOD GAS ANALYSER ,Blood Cell Counters,TYPES OF BLOOD CELLS,METHODS OF CELL COUNTING ,COULTER COUNTERS ,PORTABLE COULTER COUNTERS ,AUTOMATIC RECOGNITION AND DIFFERENTIAL COUNTING OF CELLS ,FLOW CYTOMETRY
 Optional, .Oximeters ,OXIMETERS ,EAR OXIMETER,PULSE OXIMETER ,SKIN REFLECTANCE OXIMETERS,INTRAVASCULAR OXIMETER ,MODEL QUESTIONS<, Automated Drug Delivery Systems,INFUSION PUMPS ,COMPONENTS OF DRUG INFUSION SYSTEMS,IMPLANTABLE INFUSION SYSTEM,CLOSED-LOOP CONTROL IN INFUSION SYSTEMS,EXAMPLES OF TYPICAL INFUSION PUMPS,INSULIN PUMPS,MODEL QUESTIONS

Computer aided design: 3 cr. hre

Introduction, including mean , standard deviation, histogram,Statistics and probability / accuracy and precision, Hardware and software effects on execution speed of a written program , ANSI IEEE754 single and double precision system For representing floating numbers, also unsigned integer,sign and magnitude , binary offset , 2's complement for representing fixed integers Signals and systems general intro , linearity (additivity + homogeneity(, Engineering point of view (sinusoidal fidelity + static linearity(, synthesis and decomposition of signals , convolution , Analog , digital and hybrid systems , Mathematical modeling of sampling + A/D conversion, Z- transform & Inverse Z transform

Program Syllabus for the Fifth Year

Biomechanic lab 3 cr.hrs

Introduction to equipment's, Relation between EMG and Force of Contraction under Different Conditions (%MVC, Visual and Sensory Feedback) with the use of Hand Dynamometer, Investigation of different pinch forces with sEMG and han Dynamometer, Study of Postural Balance using Force Plate and Accelerometer, Study of Ground Reaction Force Profile during Walking with Different Worn Shoes, Study of the Gait Kinematics, How to work on logger lite.

Biomechanic Cours 2

- Tensile testing
- Compression testin
- Bending testing
- Fatigue testing

Bioelectronics lab : 5 cr. hrs

Introduction to bioelectronics, usage of cautery, ESU, autoclave, patient monitorsm infusion pump, EEG, EMG, bio- sensors and transduction, Displacement measurements sensors, optical measurements, Computed tomography (CT-scanners). CT-technology, ECG, X- rays

Clinical issues in BME 4 cr. hrs.

ENG (Electro-Neurograph), EMG (Electro-Myography). EEG (Electroencephalograph), Vitalograph. Spirometer, Peak Flowmetry, ECG (Electrocardiograph) Gram poly graph, Exercise Physiology

Medical Imaging. 6 cr. hrs.

Radiographic film, Film construction, Latent image, Types of film processing, processing chemistry, Automatic processing methods, Alternative processing methods. Intensifying screens, Screen construction, and Screen characteristics Screen-film combination. The Grid Characteristics of grid construction, Measuring grid performance, Types of grids, Grid selection. Radiographic quality. Film factors, Geometric factors, Subject factors improved radiographic quality, Radiographic exposure, KVP, MAS, Exposure time, Distance. Radiographic technique. Patient factors, Image quality factors, Automatic exposure techniques, Special X-ray imaging, Select plane-film procedure, Tomography, Magnification radiography, Mammography, Introduction, X-ray apparatus, Image receptors. Fluoroscopy. Image intensifying tube, Block diagram and operation of a fluoroscopic machine.

Medical Instrumentation II. 6 cr. hrs.

Ultrasound, scanners, Introduction, A-scan, B-scan, M-scan, Real-time scanners, Doppler methods for flow measurements, US contrast media and harmonic imaging. Magnetic resonance imaging. Introduction, T1-recovery and T2-decay, Contrast of MRI, Magnetic field gradients, Slice selection Frequency encoding, MRI-pulse sequences, Resolution and field of view, Instrumentation for MRI (MR-spectrometer, radiofrequency coils, magnets, shims coils and gradient coils). Computed tomography (CT-scanners). CT-technology, Scanning gantry tubes and detectors. Data handling systems. Hemodialysis machines. Electrical safety precautions, typical faults, troubleshooting and maintenance.

Signals Processing. 6 cr. hrs.

Types of signals according to mathematical view point according to signal continuity, according to Signal certainty, according to signal values and according to signal periodicity. Important continuous / discrete signals (examples). Examples of typical biomedical signals. Representation of continuous / discrete time signals. Continuous / discrete time systems. Signal processing from implementation view point. Basic operations applied to continuous / discrete time signals. Processing types of continuous / discrete time signals block diagrams. Continuous / discrete time system. Linearity and time invariance. Response of LTI systems. Bibo stability and causality. Active, passive and lossless systems. Structures for realizing LII systems. Signals / systems time domain analysis. Convolution techniques. Correlation techniques auto – correlation and cross – correlation. Sampling and sampling theorem. Practical aspects of sampling and reconstruction. Furrier analysis. The z – transform and its application to discrete time system analysis. Discrete time Fourier transform (DFT) Calculation of spectra using the DFT.

Engineering Project. 4 cr. hrs.

An application represent the student knowledge of engineering sciences field in their specialties where this project are one of the graduated requirements.

Biomedical Sensor. 6 cr. hrs.

Fourier component of periodic waveforms, Effect of system response on periodic

signal, Thermal characteristics of metals, thermistors, and thermocouples, Properties of strain gage materials. Example of strain gages. Example of force transducer. Strain gage manual, project lab handout, Strain-duration curves for ultra-sonic power, Capacitive and inductive displacement sensors, Hall effect sensors, Electromagnetic flowmeter, Absorbance spectrum of hemoglobin and basic design of optical oximeters, Phenol red and pH measurements, Some optical components and their spectral characteristics, Fluorescent O₂ and pH indicators, Optical system design, Fiber optic O₂ and pH sensors, Ray diagrams of optical fibers, Important blood gases and other analyses, Electrochemical sensors, pH, PCO₂ and PO₂ electrodes, Oxyhemoglobin dissociation curve, Electrode handout-electrical characteristics of metal/electrode interface, Polarizable and non-polarizable electrodes, Glass microelectrodes.

Statistic for Biomedical engineering : 3cr hrs:

Introduction , Design a biomedical ,test 2 4,Sample selection and population , Average, mean and standard deviation ,distribution table, Draw and representing statistical data, Confidence interval , Exam , P-value , F- test, T-test ANOVA , Exam

المرحلة	الفصل الاول	الفصل الثاني
المرحلة الاولى	Statics	Dynamics
	Biology 1	Biology 2
	Calculus I 1	Calculus I 2
	Anatomy I 1	Anatomy I 2
	English Language 1	Physics
	Freedom and Democracy	Engineering Drawing
	Computer Skills & programing 1	Computer Skills & programming
	Intro to Biomedical Engineering 1	Intro to Biomedical Engineering 2
المرحلة الثانية	Math. II 1	Math. II 2
	Anatomy II 1	Anatomy II 2
	Chemistry 1	Biochemistry
	Electric Circuits 1	Electric Circuits 2
	Circuits Laboratory 1	Circuits Laboratory 2
	Biomaterials Science 1	Biomaterials Science 2
	Mechanics of Materials	Mechanics of the Musculoskeletal System
	Computer Skills and Computing for BME 1	Computer Skills and Computing for BME 2
المرحلة الثالثة	English Language 2	Arabic language
	Analog Electronics	Digital Electronics
	Signal Processing	Signals and Systems for BME
	Systems Physiology 1	Systems Physiology 2
	Engineering Analysis	Numerical Methods
	Rehabilitation Science and Eng.	Electromagnetic Fields
	Electronics Laboratory1	Electronics Laboratory2
	Transport Phenomena for BME	Thermodynamics
المرحلة الرابعة	Medical Lasers in Engineering	Medical Optics in Engineering
	English Language 3	
	Control Systems 1	Control Systems 2
	Design of Machine Elements	Laboratory Instrumentation
	Clinical Issues in BME Design	Microcontroller
	Computer Aided Design 1	Computer Aided Design 2
	Medical Measurements Lab1	Medical Measurements Lab2
	Biom. Instrumentation Design I 1	Biom. Instrumentation Design I 2
المرحلة الخامسة ك1 وك2 (7)	Artificial Limbs	Artificial Organs
	Microwave, X-ray & Gamma ray 1	Microwave, X-ray & Gamma ray 2
	English Language 4	
	Biomedical Sensors 1	Biomedical sensors 2
	Senior Design Project 1	Senior Design Project 2
	Neural Engineering	Biomedical Signal Analysis
	Biomedical Instrumentation Lab	Biomechanics Design Lab
	Biom. Instrumentation Design II 1	Biom. Instrumentation Design II 2
Image Processing for the BME 1	Image Processing for the BME 2	
Statistics for Biomedical Engineer	Selected Topics in Biom. Eng.	