**MAT BME 201 ENGINEERING MATHEMATICS III [4-0-0-4]**

**Complex variables:** Functions of a Complex Variable, Limits, Continuity, Analytic functions, C-R equations, Conformal mapping, Bilinear transformations, Complex integration: Cauchy's integral theorem, Cauchy's integral formula, Taylor's and Laurent's series, Cauchy's residue theorem. Evaluation of standard real integrals.

**Fourier Series:** Periodic Functions, Euler's formula, Fourier Series of even and odd functions, Fourier series of functions of arbitrary period, Half-range expansions, Fourier sine and cosine series, Exponential Fourier Series, Fourier Transforms: Definition, Convolution and Applications.

**Partial differential equations:** Basic concepts formulation of PDE, solution of PDE using indicated transformations. Solution by the method of separation of variables, Fourier series solution of one dimensional wave and heat equations by the method of separation of variables, D’Alembert’s solution of wave equation.

**Numerical Analysis:** Finite Differences: Forward differences, Backward differences, Newton's forward interpolation formula, Newton's backward interpolation formula, Newton's general interpolation formula, Numerical Differentiation, Numerical integration, The general quadrature formula: Trapezoidal and Simpson’s 1/3 rule

**References:**
2. S G Stanton, “*Numerical Analysis For Science And Engineering*”.
BME 201 ELECTRONIC DEVICES & CIRCUITS [3-1-0-4]

Working principle and characteristics of PN diode, Zener diode, Photo diode, tunnel diode, Varactor diode, Light emitting diode, BJT, Photo transistor, JFET, MOSFET, UJT, SCR, DIAC and TRIAC. Biasing and stabilization of Q-point of BJT, Biasing circuits, and stability factors. Low frequency analysis of BJT, Composite transistors circuits. Biasing and stabilization of Q-point of FET, FET Small signal analysis. Hybrid-π Model of transistor and analysis. Integrated circuits principles and fabrication methods.

References:

Network topology, principles of duality & network transformation, KVL and KCL equations for DC and AC networks, network reduction using Y-Δ transformations, coupled circuits, network theorems, series and parallel resonant circuits, transient behavior and Initial conditions in networks, switching condition and their representation, evaluation of initial and final conditions, Laplace transforms, Inverse Laplace transform and applications, one and two port networks, driving point admittance and transfer function, Open circuit impedance parameters, Short circuit admittance parameters, transmission parameters, h-parameters.

References:

References:
PART-A ANATOMY


PART-B PHYSIOLOGY

Introductory lecture pertaining basic functional concept of the human body as a whole and contribution of individual system for achieving the goal. Leverage system i.e. bone and muscle physiology in general. Nerve action potential and its ionic basis. Body temperature regulation based on thermostats - principle and its operation in different environmental temperature and its abnormalities. Biophysical aspects of blood pressure (Bop) and its recording technique. Electrocardiograph and its gross normal features and alterations, Optics of the eye. Fundamental tonal analysis, determination of pitch, loudness and quality of sound. Sensorium - general role of receptor as transducers, generator potential. Motor control of skilled voluntary movements: Mechanism of abnormal oscillatory movements Electroencephalogram and electrocortcogram.
References:
3. Best Charles Herbert, Taylor, Norman Burke, “The living body”.

References:
BME 211 PHYSIOLOGY LAB [0-0-3-1]


BME213 ELECTRONIC DEVICES AND CIRCUITS LAB [0-0-3-1]

To conduct the following experiments to find the characteristics and waveforms: Diode Characteristics, Transistor Characteristics, FET Characteristics, UJT Characteristics, SCR Characteristics, Full-wave Bridge rectifier circuit, Zener regulator, Voltage multiplier circuits, Photo diode characteristics, Photo transistor characteristics, Resonance circuits
Special functions: Solution by infinite series-Legendre's and Bessel's equations. Orthogonal properties.


References:
Power supplies: Rectifiers, unregulated power supply, Zener regulator, linear voltage regulator, Switched mode power supply, voltage doublers, and quadruplers, Feedback amplifier: classification (voltage series, voltage shunt, current series, current shunt), effect of feedback on Ri, Ro and Bandwidth of amplifier, Oscillators: Barkhausen criterion, R-C phase shift oscillator, Weinbridge oscillators, RF oscillators (Colpitt's oscillator, tuned drain oscillators), and Crystal oscillator, Multistage amplifiers: Frequency response characteristic (Log-magnitude and Polar plots), Gain bandwidth product, and Distortion in amplifiers, Large Signal Amplifiers: Classification(Class A, B, AB, & C), Transformer coupled Amplifiers, Push-pull arrangements, Theoretical efficiency, Distortion analysis, Complementary and Quasi-complementary push-pull amplifiers, Tuned amplifiers: Parallel resonant circuit, Quality factor and Bandwidth, Single tuned capacitor coupled amplifier, Single tuned transformer coupled amplifier, Double tuned amplified.

References:
BME 204 DIGITAL ELECTRONICS [3-1-0-4]

Linear wave shaping, analysis of RC high pass and low pass circuits with different input waveforms, clipping circuits using diodes, clamping circuits, bistable, monostable and astable multivibrators using discrete components, logic gates, basic and universal logic gates with discrete and IC version, logic families and their characteristics, number systems and codes, Boolean algebra, canonical and standard forms, K-map and MEV techniques, combinational logic circuits, sequential logic circuits such as flip-flops, asynchronous and synchronous counters, shift registers, ring counters.

References:
PART-A CARDIOLOGY

Heart structure and function - overview, Detail cardiovascular physiology - blood flow (circulation), Detail anatomy of human heart, principles of cardiovascular measurements - blood pressure, cardiac output, etc. Heart valves, Prosthetic heart valves – evolution, detail structure, functions and applications, Open heart surgery and Heart lung machines, Basics of 12-lead Electrocardiography – Einthoven’s triangle, ECG potentials – generation and conduction, conduction system, Applications of ECG in cardiac clinics, Normal and abnormal ECGs, Diagnostic applications, Interpretation of ECG, Cardiac pacing. Assisted cardiac devices-concepts and applications from biomedical engineering perspective, Holter monitor.

PART-B ANAESTHESIOLOGY

This course will provide an overview of basic physical principles and their applications in anaesthesia and intensive care. It will begin with the description of general and regional anaesthetic techniques fundamental to the practice of anaesthesia before going on to describe the anaesthesia machine, medical gas supply systems and intravenous drug delivery systems. The principles of equipment used in pain therapy will be discussed. Finally, students will learn about mechanical ventilation with special emphasis on mechanical ventilators and nebulisers. Humidifiers, Baby Incubators, Central oxygen supply. Principles of operation theatre tables and lights, phototherapy, surgical diathermy.

PART-C ENT

References:
1. Ganong, “Review of Medical Physiology” [available at MIT and KMC libraries]
2. Cyril and Neil, “Samson Wright’s applied physiology” [available at MIT and KMC libraries]
3. C.C. Chatterjee, “Human Physiology” [available at MIT and KMC libraries]
BME 208 BIOMEDICAL EQUIPMENTS [4-0-0-4]


References:
BME 210 ANALOG ELECTRONIC CIRCUITS LAB[0-0-3-1]


BME 212 DIGITAL ELECTRONICS LAB[0-0-3-1]

PART-A  OPHTALMOLOGY

Physiology of Eye: Structure of eye, function, Generation of signals and transmission to brain Electrophysiology, Aqueous humor production: Intraocular pressure fluctuations.


References:

PART-B ORTHOPAEDICS

the functions of articular cartilage, Degeneration of cartilage, Degenerative arthritis and Rheumatoid arthritis, Joint replacement, hip, knee, shoulder, small joints.

**Biomaterials:** Requirements of implant materials and biocompatibility, Material implants: Metals, Ceramics, Plastics (UHMWPE), Neoligaments, Materials in external appliances, Materials in prosthetics, Materials in Orthotics, Bioengineering principles of management of paralytic problems, Gait analysis, Orthotics, Principles of tendon transports, Bioengineering principles of amputation and prosthetics, Upper limb prosthesis, Lower limb prosthesis.

**References:**
3. Frankel, Lea, Febiger , Nordin, “Basic Biomechanics of the skeletal system”.

**PART – C SPEECH & HEARING**

Audiometers, Middle ear analyzer, Evoked potentials, OAE, Hearing aids, Cochlear implants, ALD, Hearing aid analyzer, Electro Glottography, AAC, Introduction to speech assessment, DSP, Assessment of voice and fluency, Voice and fluency therapy assessment, Artificial larynx, Spirometry, Speech synthesis, Practical demonstration.

**References:**

References:

BME 305 INTEGRATED CIRCUIT SYSTEMS [3-1-0-4]

Operational amplifiers, characteristics, frequency response, differential amplifiers, offset voltages and currents, linear applications of OP-AMP, instrumentation amplifier, active filters, integrators and differentiators, non-linear applications of OP-AMPS, switched Capacitor filter, 555 Timer IC and its applications, phase locked loops, and applications, voltage to frequency converters, voltage regulators, fixed and adjustable voltage regulator, switching regulators, different type of ADC and DAC, introduction to VLSI, MOS shift registers and charge coupled devices.

References:

References:

References:
Fundamental concepts of programming language, Object Oriented Programming paradigm, Characteristics of OOPs, C++ Programming basics: Constants, Variables, Data-types, Expressions & Operators, Control flow: Decision making and looping and functions, Classes and Objects: Class specification, Accessing Class Members, Constructors and Destructors, Overloaded Constructors, Operator Overloading and type conversion, Inheritance: Derived class and base class, class hierarchies, Levels of Inheritance, and Multiple Inheritance, Polymorphism, and Virtual Functions, Pure function, Friend function, Friend classes, Files and streams, Exception Handling, Text mode graphic functions, Graphics mode Graphics functions, Object oriented system development.

**Reference Books:**
BME 313 INTEGRATED CIRCUIT SYSTEMS LAB [0-0-3-1]


BME 315 MICROPROCESSOR LAB [0-0-3-1]

Familiarization with IBM PC and Assembler, execution and debugging the programs. Arithmetic and logical operations. Display programs. Memory array and String handling. Applications of Assembler Directives. Writing MACROS using 8086 assembly language instructions. DOS and BIOS Function Calls and waveform generation.
PART - ANEUROLOGY


Reference:
PART-B -RADIOLOGY


PART-C RADIOTHERAPEUTICS

Principles of radiation oncology and cancer radio therapy, LET and RBE, Radio sensitivity and Radio resistance tumors and tissues, Clinical definition of tumor radiosensitivity, Classification of tumors according to cell Radiosensitivity, Cell survival theory, Cell cycle kinetics and age response function, Cell survival curves, Oxygen effect, OER, Cell repair- sublethal and potentially damage repair. Radio curability of tumors, Therapeutic ratio, Normal tissue tolerance dose, Modification of radiation response, Physical, Chemical and Biomedical modifiers, Radiation biology stages of radiation actions, Physical stage LEI-RBE, Physiochemical reactions, Chemical stage. Radioactive effect of important Biological macromolecules, Radiation on cell site in cells, DNA repair process, Effects of radiation on cell cycle process, Cell death survival curves, Oxygen effect, Fractionation, Biological effects of Radiation, Radioactive protection, Acute Radiation syndromes, Somatic effects LD-50, Cause of radiation death - skin - blood and blood forming organs, Reproductive organs, Embryo-Late effects of Radiation, Radiation carcinogenesis, Leukemogenesis, Cataract, Genetic effects, Hazards and permissible exposures, maximum permissible occupational doses, Hazards in various branches of radiation, Protective lines of defense, Protective measures, Physical measurements and medical investigations.
References:
3. Romesh Chandra, “Introduction to Nuclear Medicine”.

References:
BME 306 Medical Image Processing [4-0-0-4]

Review of signals, systems & transforms; 2D signals & systems, 2D DFT and its computation. Image perception – the human vision system, psycho-visual experiments, monochrome vision model, temporal properties. Image compression – the discrete cosine transform (DCT), properties, computation, practical compression algorithm. Image Enhancement: Point operations, Spatial filtering: linear filters & the median filter; Connected-component labeling. Medical Imaging: Imaging modalities; Computed tomography (CT): mathematical basis, the Radon transform & the central slice theorem; Image reconstruction from projections: the Direct Fourier Method, convolution backprojection (CBP) algorithm, reconstruction from fan-beam projections; X-rays: utility, generation and detection; X-ray CT systems. Emission CT: principles, Positron emission tomography (PET); Magnetic resonance imaging: Principles of data-generation, resolving the tissues, resolving the spatial locations.

References:

BME 308 TELEMETRY SYSTEMS [4-0-0-4]


References:

BME 310 INSTRUMENTATION & EQUIPMENT LAB [0-0-3-1]


BME 312 MICROCONTROLLER LAB [0-0-3-1]

Familiarization of 8051 simulation software and 8051 instruction set, Arithmetic and logic related programs, Array handling and code conversion programs, Bit manipulation and programming using I/O ports, Timer/Counter programming, Programming using 8051 trainer kit in keyboard mode, Programming 8051 using trainer kit in serial mode and interrupt programs, Interfacing DAC ,ADC ,Seven segment display, keyboard, LCD and Stepper motor.
ESSENTIALS OF MANAGEMENT AND ENGINEERING ECONOMICS [4 0 0 4]

HUM-302/401


References:

BME 401 ADVANCED BIOMEDICAL SIGNAL PROCESSING [4-0-0-4]


Reference:
BME 403  Advanced Medical Image Processing [4-0-0-4]


References:

5. Papers / Hand-outs / Notes given in the class.
BME 405 SIGNAL AND IMAGE PROCESSING LAB[0-0-6-2]


BME 407 SEMINAR[0-0-3-1]

Students will have to present a topic related to advanced biomedical field. The duration of the presentation is limited to one hour, with the report of the topic to be submitted in advance. Presentation should be done using OHP/LCD projector.

References:
BME 322 PHYSIOLOGICAL CONTROL SYSTEMS[4-0-0-4]

Introduction to feedback control systems, transfer functions, Block diagrams and simplification, Signal flow graphs, mechanical modeling, time domain analysis, Routh-Hurwitz criteria, Root Locus Techniques, Bode plots, Introduction to physiological control system, different regulations in the body, physiological system differential equations, modeling the body as compartments, Urea distribution model, the human thermal systems, heat production and heat loss, Human eye tracking, pupil control system, Respiratory system, Cardiovascular system.

References:

References:

Pattern recognition system, Applications, Feature, Feature space, Class, Feature vector, Classifier, Classification and approaches, and Design cycle, Probability theory basics, Statistical decision making: Bayes theorem, Multiple features, conditionally independent features, Decision boundaries, unequal costs of error, Estimation of error rates, the leaving one-out technique, characteristic curves, and Estimating the composition of populations, Clustering: Hierarchical clustering, Agglomerative clustering algorithm, Single, Average and Complete linkage algorithms, Partitional clustering, K means, and Ward’s algorithm, Artificial Neural Networks: Introduction, nets without hidden layers, Nets with hidden layers, the back propagation algorithm, Hopfield nets, Special networks, Applications: PR approach for biological signals (eg: ECG, EEG, etc), Blood sample image analysis, biometric systems, DNA analysis and other case studies.

References:

BME 423  HEALTH CARE MANAGEMENT [4-0-0-4]

Introduction: ABC of Hospital Administration, Principles of Management
Human Resources: Motivation, Time Management, Leadership and Supervision, Nursing Services, Effective Communication, Conflicts, Monitoring and Control, Public Relations, Medical Social Service department, Professional Hazards, Clinical Services: Indoor Services, Outpatient Department, Casualty and Emergency Wing, Intensive Care areas, Operating room and post-operative units, Support Services: Laboratories, Blood Bank, Radiology Services, Pharmacy, Central sterile supply department, Medical Record department, Materials Management, House keeping and maintenance, Linen and laundry, Dietary Services, Hospital Information system and computerization, Security and safety, Finance and Budget, Costing, Medical Ethics, Law and medical profession, Hospital acquired infections, Waste disposal, Quality assurance and medical audit, Disaster Management.

References:

1) PragnaPai, ‘Effective Hospital Management’ – National Series(Text Book)
2) Colonel (Retd) B.M.Sakharkar, ‘Principles of Hospital Administration and Planning’ (Jaypee Brothers)
4) S L Goel, R Kumar, “Hospital Administration and Management, Vol 1,2,3”, Deep & Deep.
Introduction to Artificial Intelligence - Architecture of Artificial Intelligence System-The AI Problems-AI Technique.

Problems & problem spaces: State space search, Production systems, Control strategies, Searching the problem space, Problem characteristics, Production system characteristics.

Problem solving methods: Forward and Backward reasoning, Problem graph Matching, Weak methods, Search techniques using heuristic functions.


Game playing: An Overview, Minimax search procedure- Alpha –Beta cutoffs-Additional refinements-Limitations.

Reference:

Data mining: basics and concepts. Data preprocessing – motivation, dirty data, importance of preprocessing, measure of data quality, Mining data descriptive features, measuring data central tendencies, measuring dispersions, normal distributions, box plot analysis, histogram analysis, quartile plots (Q-plots). Data warehousing and OLAP technology - basics, DW vs. Heterogeneous DBMS, DW vs. Operational DBMS, OLTP vs. OLAP, why separate DW, Tables, spreadsheets, data cubes, conceptual modelling of DW, Measuring data cubes.Classifications & predictions-concepts and necessities, classification vs. prediction, steps of classification, What is a cluster analysis? Clustering-an amalgamation of rich applications and multidisciplinary efforts, examples of clustering applications, Mining time-series data: concepts, principles and applications, categories of time-series movements, trend curve estimations, moving average, estimation of seasonal variations, similarity search in time-series analysis, data transformation – discrete fourier transform, Hidden Markov model: concept, Hidden Markov chain model, working principle and applications in biological data, Graph mining: introduction and concepts, importance of graph mining, graph pattern mining, graph mining algorithms, SUBDUE, WARMR, frequent subgraph mining approaches, properties of graph mining algorithms.

REFERENCES:
2. J. Han & Others. Data Mining. Elsevier. New Delhi India [available at MIT library].
**BME 429 EMBEDDED SYSTEMS [4-0-0-4]**

Introduction to Embedded systems, processor and memory organization, Devices and buses for device networks, Device drivers and interrupts servicing mechanisms. Programming concepts, and embedded programming in C. Real Time Operating systems, and Serial and Parallel Buses. PIC Architecture and Instruction set, MPASM assembler and its usage, Analog-to-Digital Conversion, UART.

**References:**

2. Frank Vahid and Tony Givargis, “Embedded system Design – a Unified Hardware/Software Introduction” Wiley India Pvt. Ltd.
BME 330 BIOMEDICAL INSTRUMENTATION [3-0-0-3]

Study of Bio-electric signals & Electrodes, Transducers, Blood pressure & Blood flow measurements; Study of therapeutic equipments: Pacemakers, Haemodialyser, Lithotriptor, Anesthesia machine, Ventilator, Infusion pump, Infant Incubator; Study of Surgical devices: ESU, LASER & Endoscope; Cardiac-assist devices: Heart lung machine & Defibrillator; Study of Audiometer & Hearing-aids; Medical Imaging Systems: CT, MRI, Ultrasonography, Thermography & PET.

Reference Books:
BME 332 BIO-MECHANICS [3-0-0-3]


Reference books:

References:
Review of digital signals, systems, and transforms; linear filtering; elements of probability, random variables and random processes; correlation and power spectrum density (PSD); PSD estimation. The action potential, ENG, EMG, ECG, EEG, PCG, EGG, Speech signal, VMG, VAG, cardio-respiratory interaction, the knee-joint and muscle vibration signals, segmentation of the PCG into systolic and diastolic parts, random noise, structural noise and physiological interferences. ECG signal averaging, Data reduction techniques: Turning point algorithm, Huffman coding, ECG QRS detection, ECG interpretation.

References:

1. AV Oppenheim, Willskey and Young, Signal Analysis,


**BME 402 INDUSTRIAL TRAINING /TOUR [0-0-3-1]**

Students will undergo training/tour for a period of at least three weeks at reputed hospitals/concerns pertaining to the biomedical field. A report then has to be submitted, once the training is completed.

**BME 499 PROJECT WORK / PRACTICE SCHOOL [0-0-0-20]**

The project work is carried out in the institution/ hospital/ industry/ research laboratory or any other competent institutions.

The duration of project work should be a minimum of four months.

There will be a mid-semester evaluation of the project work done after about 2 months. An interim project work is to be submitted to the department during the mid-semester evaluation. The mid-semester evaluation will be done by the department /project guides and will be out of 100 marks.

Each student has to submit to the department a project report in proper format after completing the work. The final evaluation and viva-voce will be after submission of the report.

Each student has to make a presentation on the work carried out, before the departmental committee for project evaluation, using OHP/ multimedia projects. The end semester evaluation will be done by the departmental committee including the guides. The final evaluation will be out of 300 marks, the break-up, which is as follows:

- Project work evaluation (end semester evaluation): 200 marks.
- Project work evaluation (mid semester evaluation): 100 marks.
- Viva-Voce: 100 marks.
- Total marks for the project work: 400 marks.