With effect from the academic year 2017-2018

SCHEME OF INSTRUCTION & EXAMINATION
B.E. (BIOMEDICAL ENGINEERING)

BM: SEMESTER - V

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<th>S. No</th>
<th>Course Code</th>
<th>Course Title</th>
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<th>Hrs/Wk</th>
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**Practicals**

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**PE-I* # Professional Elective-I:**

- PE501BM Biological Control Systems
- PE502BM Bioinformatics

**PE-II* # Professional Elective-II:**

- PE503BM Nanotechnology for medical applications
- PE504BM Biomaterials and Applications
With effect from the academic year 2017-2018

PC501BM

MICROPROCESSORS AND MICROCONTROLLERS IN MEDICAL APPLICATIONS

Instruction: 4 Periods per week
Duration of University Examination: 3 Hours
University Examination: 70 Marks
Sessionals: 30 Marks
Credits: 3

OBJECTIVES:
✓ Understand the architecture of 8085 microprocessor and 8051 microcontroller
✓ Program the 8085 microprocessor and 8051 microcontroller using suitable techniques
✓ Interface sensors to 8085 and 8051

OUTCOMES:
✓ Select a microprocessor or microcontroller suitable to the application.
✓ Perform the detailed hardware design of an 8085 microprocessor or an 8051 microcontroller system.
✓ Develop microprocessor and microcontroller based systems for various medical sensors.

UNIT I
8085 Microprocessor: Architecture, Instruction cycle, basic timing diagrams, Addressing Modes, Instruction Set, Memory and I/O interfacing, interrupts, I/O ports and data transfer concepts. Introduction to 8086, Architecture, Memory segmentation.

UNIT II
Peripheral Interfacing: Programmable peripheral interface chip (8255), Programmable communicator chip (8251), Programmable Internal timer chip (8253), Programmable interrupt controller (8259), DMA (8257) controller.

UNIT III
Programming of 8085 Microprocessor: General Programs, debugging of Programs, interfacing with 8085- ADC, DAC, seven Segment display, stepper motor, traffic control, digital multiplexer, digital demultiplexer, square wave generation using microprocessor

UNIT IV

UNIT V

Suggested Reading:
With effect from the academic year 2017-2018

PC502BM

BIOMEDICAL EQUIPMENT -I

Instruction: 3 Periods per week
Duration of University Examination: 3 Hours
University Examination: 70 Marks
Sessional: 30 Marks
Credits: 3

OBJECTIVES:
✓ State the Physiological reasons for using a particular piece of Biomedical Equipment.
✓ Describe the operating principles of a wide range of biomedical equipment.

OUTCOMES:
✓ Perform tests to assess the performance and safety of various Equipments.
✓ Learn the maintenance of biomedical equipment.

UNIT-I
Critical physiological parameters to be monitored. Intensive coronary care unit layout.
Assist devices of the heart: Principles of external counter pulsation techniques. Intra-aortic Balloon pump. Prosthetic heart valves, Mechanical and tissue Valves. Types of mechanical valves: Ball and Cage, tilting disc and Bileaflet valves. Types of tissue valves: Homografts or Allografts (human cadaver) and Heterografts or Xenografts (Porcine or Bovine). Testing of prosthetic heart valves.

UNIT-II
Synchronous / Demand Pacemaker: Modes of triggering-ventricular triggered and atrio-ventricular synchronized pacemaker, Programmable pacemaker. Implantable Pacemaker: Technical and qualitative requirements of power supplies, lead wires and electrodes, packaging. Microprocessor based implantable pacemaker, Rate responsive pacemaker.

UNIT-III
Defibrillators: Need for Defibrillators, D.C. Defibrillator, Need for Synchronous Defibrillators, Types of electrodes and their features, Types of Waveforms, Automatic/Advisory External Defibrillators (AED), Implantable defibrillators.

UNIT-IV

UNIT-V
With effect from the academic year 2017-2018

**Suggested Reading:**

PC503BM

CALIBRATION OF MEDICAL EQUIPMENT

Instruction: 3 Periods per week
Duration of University Examination: 3 Hours
University Examination: 70 Marks
Sessionals: 30 Marks
Credits: 3

COURSE OBJECTIVES:
✓ Perform calibration tests to assess the performance and safety of medical Equipment.
✓ Learn the maintenance of biomedical equipment.
✓ Learn about Quality concepts, Management system and NABL accreditation

OUTCOMES:
✓ Learn the calibration of biomedical equipment.
✓ Learn the standards of NABL and NABH Accreditations

UNIT I

UNIT II

UNIT III

UNIT IV
Technical & Applied mathematics: Scientific and engineering, notation, English/Metric conversions, Ratios. Linear interpolation and extrapolation, Rounding, truncation, and significant figure, Number bases, Volume and area, Angular conversions, Graphs and plots.
QC tools applied statistics: Basic statistical tools, Common distributions, Descriptive statistics Sampling issues.

UNIT V
Uncertainty: Uncertainty management Uncertainty components Estimation of uncertainty Evaluation of uncertainty Reporting uncertainty
Quality Systems & Standards: Quality concepts Management system ISO/IEC 17025 NABL accreditation

Suggested Reading:
BS501MT

STATISTICS AND NUMERICAL METHODS
(B.M.E)

Instruction: 4 Periods per week
Duration of University Examination: 3 Hours
University Examination: 70 Marks
Sessionals: 30 Marks
Credits: 3

OBJECTIVES:
✓ To introduce Laplace Transforms and their applications.
✓ To introduce a few numerical methods to solve certain type of problems.
✓ To introduce basic statistical methods like curve fitting, correlation and regression.
✓ To provide the knowledge of probability distributions like normal, Poisson and tests of significance.

OUTCOMES:
✓ At the end of the course students will be able
✓ To solve differential equations using Laplace transforms
✓ To find numerical solution of algebraic, transcendental equations and ordinary differential equations.
✓ To apply various probability distributions to solve practical problems, to estimate unknown parameters of populations and apply the tests of hypotheses.
✓ To Perform regression analysis and to compute and interpret the coefficient of correlation

UNIT –I
Laplace transforms: Introduction of Laplace transforms, sufficient condition for existence of Laplace transform, Laplace transform of Derivatives, Laplace transform of integrals, Translation theorems (I & II shifting theorems), Differentiation of Laplace transform (Multiplication by t), Integration of Laplace transform (Division by t), convolution theorem, Solving initial value problems using Laplace transform

UNIT-II

UNIT-III
Basic Statistical Measures: Measures of Central Tendency (Mean, Median, Mode), Measures of dispersion, variance, standard deviation, Basics of probability, addition theorem on probability, Bayes theorem and its applications.

UNIT-IV
Random variables and Distributions: Density functions, mathematical expectation, expected values, Normal, Poisson, chi-square distributions .Tests of Significance: Testing of Hypothesis, Type-I, Type-II error, F-Test, t- Test, Chi-Square Test.

UNIT- V
Curve fitting: Curve fitting by method of least squares, correlation and regression, types of correlations, Karl Pearson’s coefficient of correlation, Spearman’s rank correlation coefficient, equal ranks, equations to the lines of regression.
With effect from the academic year 2017-2018

**Suggested Reading:**

With effect from the academic year 2017-2018

PE501BM

BIOLOGICAL CONTROL SYSTEMS

Instruction: 4 Periods per week
Duration of University Examination: 3 Hours
University Examination: 70 Marks
Sessionals: 30 Marks
Credits: 3

OBJECTIVES:
✓ To study system concept and different mathematical techniques applied in analyzing any given system.
✓ To learn to do the analysis of given system in time domain and frequency domain.
✓ To develop an understanding of the fundamental principles behind control of various biological systems.
✓ To apply these analysis to study the biological systems.

STUDENT LEARNING OUTCOMES:
✓ Analyze the concepts that are generally useful in all other engineering disciplines.
✓ Apply quantitative approaches for the analysis of physiological system.
✓ Ability to create simple models of physiological systems.
✓ Ability to understand complex physiological models.

UNIT-I

UNIT-II

UNIT-III

UNIT-IV

UNIT-V
Muscle stretch reflex, skeletal muscle Servo-mechanism. Cardiovascular Control Systems-Regulation of heart rate, blood pressure and cardiac output. Respiratory Control system-Chemical regulation of ventilation, Cheyne Stokes breathing

Suggested Reading:
With effect from the academic year 2017-2018

PE502BM

BIOINFORMATICS

Instruction: 3 Periods per week
Duration of University Examination: 3 Hours
University Examination: 70 Marks
Sessionals: 30 Marks
Credits: 3

OBJECTIVES:
✓ To give students an introduction to the basic techniques of bioinformatics.
✓ Emphasis will be given to the application of bioinformatics and biological databases to problem solving in real research problems.

OUTCOMES:
✓ The students will be able to describe the contents and properties of the most important bioinformatics databases, perform text- and sequence-based searches, and analyze and discuss the results in light of molecular biological knowledge
✓ The students will be able to explain the major steps in pairwise and multiple sequence alignment, explain the principle for, and execute pairwise sequence alignment by dynamic programming.
✓ The students will be able to predict the secondary and tertiary structures of protein sequences.

UNIT I

UNIT II
Algorithms: Algorithms and complexity, Biological algorithms, computer algorithms, The change problem, Correct, incorrect algorithms, Recursive algorithms, Iterative, recursive algorithms, Fast and slow algorithms, Big-O notation, Algorithm designing techniques-Exhaustive search, Branch-and-bound algorithms, Dynamic programming, Divide-and-conquer algorithms, Randomized algorithms, Gibbs sampling.

UNIT III
Computer algorithms for prediction of protein structures. DNA Sequence Comparison, Algorithms for alignment of sequences and structures of proteins and protein families, PAM, BLOSUM, Bayesian modeling and networks, Probabilistic models or Hidden Markov models, Needleman Wunch and Smith Waterman algorithms, Global sequence alignment, Scoring alignments, Local sequence alignment, Alignment with gap penalties. Multiple alignment, Gene prediction-Statistical and Similarity-based approaches. Spliced alignment.

UNIT IV
Genetic algorithms: Genetic algorithms for the prediction of multiple sequence alignment, Gene expression analysis, Hierarchical clustering, K-Means clustering, clustering and corrupted cliques. Evolutionary trees- Distance-based tree reconstruction, Reconstructing trees from additive matrices, Evolutionary trees and hierarchical clustering. Character-based tree reconstruction- Small parsimony problem, large parsimony problem.
UNIT V

Suggested Reading:
PE503BM

NANO TECHNOLOGY FOR MEDICAL APPLICATIONS

Instruction 3 Periods per week
Duration of University Examination 3 Hours
University Examination 70 Marks
Sessionals 30 Marks
Credits 3

OBJECTIVES:
✓ To learn about basis of nanomaterial science, preparation method, types and application.
✓ To know about Drug delivery and tracking systems

OUTCOMES:
✓ Will familiarize about the science of nanomaterials
✓ Will familiarize about the science of nanomedicine
✓ Will develop knowledge in characteristic nanomaterial

UNIT-I Introduction to Nanotechnology

UNIT-II Introduction to Nanotechnology
Nanoparticles and Colloids, structure and bonding in nanoparticles, Nanomaterials fabrication by Bottom-up and Top-down approaches, Classification of nanodevices based on the characteristics, Quantum dots and their properties.

UNIT-III Carbon nanotubes
Carbon nanoparticles, types of carbon nanotubes, single-walled, multi-walled, torus, Nano bud, properties of carbon nanotubes, and synthesis by Arc discharge, laser ablation, chemical vapor deposition techniques

UNIT-IV Nanomedicine
Drug delivery to cells using nanotubes and nanowires, Quantum Dots for drug discovery and imaging, Quantum Dots and gold nanoparticles for cancer treatment, Nanoparticle mediated gene therapy, Growth of neurons on Nanomaterials, Nanomaterials for brain protection and repair, Nanorobotics for surgery

UNIT-V Nano molecular imaging

Suggested Books:
2. NeelinaMalsch, Biomedical nanotechnology by CRC press release, Malsch Techno Valuation, Utrecht, The Netherlands
With effect from the academic year 2017-2018

PE504BM

BIO MATERIALS AND APPLICATIONS

Instruction: 3 Periods per week
Duration of University Examination: 3 Hours
University Examination: 70 Marks
Sessionals: 30 Marks
Credits: 3

OBJECTIVES:
✓ To understand the need and properties of the biomaterials.
✓ To understand the properties, biocompatibility issues and applications of various classes of biomaterials.
✓ To understand the biomaterials-tissue interactions.
✓ To understand the various soft tissue and hard tissue replacements.

OUTCOMES:
✓ Describes the material science and Engineering requirements related to biomaterials.
✓ Describes the application of materials in replacements of soft and hard tissues.
✓ Knowledge to use the techniques, skills for engineering practice.
✓ Knowledge of contemporary issues and testing of biomaterials.

UNIT – I
Properties of Biomaterials: Biomaterial–definition and need, Types of Biomaterial, Requirements of an ideal biomaterial, Biocompatibility.
Characterization of materials – Mechanical, chemical, thermal, electrical, optical and other properties.

UNIT – II
Properties of Ceramic biomaterials - Aluminum Oxides, Calcium Phosphate, Glass ceramics and carbons.
Properties of Polymeric biomaterials – Polyamides, Polyethylene, Polypropylene, Polyacrylates, Poly Vinyl Chloride.
Properties of composite biomaterials and biological/natural materials.

UNIT – III
Tissue response to biomaterials and testing of biomaterials: Inflammation, wound–healing and foreign body response, systemic toxicity and hypersensitivity, Blood compatibility, Carcinogenicity, implant–associated infection. In-Vitro and In-Vivo assessment of tissue compatibility and testing of blood–materials interaction.
Degradation of metals, polymers and ceramics in general and in the biological environment.

UNIT – IV

UNIT – V
Interface of orthopedic implants. Bone-cement fixation, Porous in growth (Biological) fixation, Direct bonding between bone and implant, Interference and passive fixation.

**Suggested Reading:**
5. NPTEL Video lecture: *Introduction to Biomaterials.*
PC551BM

MICROPROCESSORS AND MICROCONTROLLERS IN MEDICAL APPLICATIONS
LAB

Instruction: 3 Periods per week
Duration of University Examination: 3 Hours
University Examination: 50 Marks
Sessionals: 25 Marks
Credits: 1

1. Basic Assembly Programs in 8085 microprocessor and 8051 microcontroller.
   a) 8-bit Arithmetic operations (Addition, Subtraction, Multiplication, Division)
   b) 16-bit Arithmetic operations (Addition, Subtraction, Multiplication, Division)
   c) Moving an array from one memory location to another.
   d) Arranging an array in ascending and descending order.
   e) Maximum and Minimum values pickup from an array.
   f) Program to generate delays.

2. Interfacing with 8085 microprocessor and 8051 microcontroller
   a) Serial Communication with PC interface.
   b) 7-segment display.
   c) Analog to Digital Converter.
   d) Matrix keyboard.
   e) LCD display.
   f) Digital to Analog Converter.
   g) Stepper motor.
   h) DC- motor.
   i) Interrupt based application.

Note: Minimum of 10 experiments to be performed.
PC552BM

MEDICAL INSTRUMENT DESIGN AND CALIBRATION LAB

Instruction: 3 Periods per week
Duration of University Examination: 3 Hours
University Examination: 50 Marks
Sessionals: 25 Marks
Credits: 1

List of Experiments

1. ECG Recorder.
2. EEG monitoring system.
3. Pulse Oximeter.
5. Syringe pump Experiment.
6. Audiometry to find the Hearing ability of the subjects.
7. Ultrasound Diathermy.
8. Shortwave Diathermy.
9. Spirometry to test the capacity of Human lungs.
11. Recording of Evoked potentials.

Calibration of Medical equipment using following Analyzers

1. Infusion Pump Analyzer.
3. Electrical Safety Analyzer.

Note: Minimum of 10 experiments to be performed.
PW561BM

MINI PROJECT

Instruction: 3 Periods per week
Duration of University Examination: 3 Hours
University Examination: 50 Marks
Sessionals: 25 Marks
Credits: 2

Mini Project and Design exercises:

1. Mini project is to be executed batch-wise.
2. Design exercises are to be carried out individually.