With effect from the academic year 2013-2014

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

SEMESTER-I

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<td>Physiological Control Systems</td>
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<td>2. **</td>
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<td>Microprocessors and Microcontrollers in Medical Applications</td>
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<td>4.***</td>
<td>EC 254 UE</td>
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PRACTICALS

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<td>2.</td>
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TOTAL 24 6 550 200 28

*. Syllabus same as MT 251 UE
ELECTIVE-I:
1. BM 304 UE Nanotechnology for medical applications
2. BM 305 UE Biomaterials(revised)
3. BM 306 UE Bio Transport Processes

*Title of the subject is changed from Biological control systems to Physiological control systems, chapter 4 & 5 are modified.
** MPMC has been shifted from IV/IV - 1st semester to III/IV - I semester
*** SATT has been shifted from 2/4 – 2nd semester to III/IV -I semester
****Cardio-pulmonary Equipment title is changed to Biomedical Equipment-I and the syllabus is revised
*****Biomedical Equipment Laboratory syllabus is revised.
PHYSIOLOGICAL CONTROL SYSTEMS

UNIT-I

UNIT-II

UNIT-III

UNIT-IV

UNIT-V
Cardiovascular Control Systems-Regulation of heart rate, blood pressure and cardiac output. Respiratory Control system-Chemical regulation of ventilation, Cheyne Stokes breathing

Suggested Reading:
4. Suresh R. Devasahayam “Signals and Systems in Biomedical Engineering”.

With effect from the academic year 2013-2014

BM 301 UE

Instruction 4 Periods per week
Duration of University Examination 3 Hours
University Examination 75 Marks
Sessionals 25 Marks
Credits 4
BM 404 UE

MICROPROCESSORS AND MICROCONTROLLERS IN MEDICAL APPLICATIONS

Instruction: 4 Periods per week
Duration of University Examination: 3 Hours
University Examination 75 Marks
Sessional: 25 Marks
Credits 4

OBJECTIVES:
a. Distinguish between microprocessors and microcontrollers and their applications.
b. To know the hardware circuitry of each processors and microcontroller.
c. To know the assembly level language programming on microprocessors and Microcontroller in medical applications.

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 Introduction to 32-Bit Microprocessors.

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

UNIT IV

UNIT V
Interfacing of medical sensor circuits: Carbon dioxide and oxygen sensors, respiration, force, flow, differential voltage and current probes and humidity sensors.

Suggested Reading:
With effect from the academic year 2013-2014

BM 303 UE

BIOMEDICAL EQUIPMENT -I

Instruction: 4 Periods per week
Duration of University Examination: 3 Hours
University Examination: 75 Marks
Sessional: 25 Marks
Credits: 4

COURSE OBJECTIVES:
a. State the Physiological reasons for using a particular piece of Biomedical Equipment.
b. Describe the operating principles of a wide range of biomedical equipment.
c. Perform tests to assess the performance and safety of such Equipments.
d. 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: Working principles. Modes of triggering-ventricular triggered (QRS triggered) and atrio-ventricular synchronized pacemaker (P wave triggered), 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

UNIT-IV

UNIT-V

Suggested Reading:
EC 254 UE

SIGNAL ANALYSIS AND TRANSFORM TECHNIQUES
(Common to BME and CSE)

Instruction 4 Periods per week
Duration of University Examination 3 Hours
University Examination 75 Marks
Sessionals 25 Marks
Credits 4

UNIT I
Definitions and classification of Signals and systems:- The environmental signal, analogy between vector and signal, Signal representation by discrete set of orthogonal functions, Orthonormality and completeness, Exponential and trigonometric Fourier series, convergence, Dirichelet’s conditions, the discrete Spectrum, Application of Fourier series to electrical networks.

UNIT II
Signal representation by continuous exponentials:- The direct and inverse Fourier transform, continuous spectrum, Existence and properties of Fourier transform, singularity functions, Parsevals theorem.

UNIT III
Convolution integral:- Convolution integral, convolution as summation, graphical method of convolution, network functions, poles and zeros, time domain behavior from pole zero plot and stability.

UNIT IV
Discret Signals:- Sampling of continuous time sampling, sampling theorem and problems, discrete time signals and systems-Linear shift invariant, linear, stable, causal and memory less. Linear Constant-Coefficient Difference equations, frequency domain representation of systems, Realization of discrete time system-direct, cascade and parallel Forms.

UNIT V
Z Transform and Properties:- Z transform, Properties of the region of convergence for the Z-Transform, Inverse Z Transform, Z transform properties, Inverse Z-Transform using Contour Integration, partial fraction expansion, Long division methods, Parseval’s relation and analysis of discrete time systems using Z-Transform

Suggested Reading:
1. Lathi B.P. Signals, Systems and communication, BSP-2001
With effect from the academic year 2013-2014

BM 251 UE

MATHEMATICS-IV

Instruction: 4 Periods per week
Duration of University Examination: 3 Hours
University Examination: 75 Marks
Sessional: 25 Marks
Credits 4

UNIT I
Functions of Complex Variables: Elementary functions of complex variables, limit and continuity of function, Analytic function, Cauchy-Riemann equations, Complex integration, Cauchy’s theorem, Derivatives of analytic functions, Cauchy’s integral formula and its applications.

UNIT II
Taylor’s and Laurent’s Series Expansions: Zeroes and singularities, Residues, Residue theorem, Evaluation of real integrals using residue theorem, conformal mapping, Bilinear transformation.

UNIT III

UNIT IV
Statistics: Random variable, Distributions, Density functions, Conditional distributions, bay’s theorem, Mathematical expectation, Expected values, moments and Moment generating functions, Distributions: Poisson, Normal, Gamma and Chi-Square distribution, Fitting these curves of the data.

UNIT V
Curve Fitting by Method of Least Squares: Correlation and Regression, Lines of Regression, Tests of Significance, Chi-Square, F and T-Tests

Suggested reading:
NANO TECHNOLOGY FOR MEDICAL APPLICATIONS

Instruction 4Periods per week
Duration of University Examination 3 Hours
University Examination 75 Marks
Sessionals 25 Marks

UNIT-I Introduction to Nano Technology:

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, nanobud, properties of carbon nanotubes, and synthesis by Arc discharge, laser ablation, chemical vapor deposition techniques

UNIT-IV Nanomedicine:

UNIT-V Nano molecular imaging:
Applications of Nanomaterials in Medical imaging. Neuro-electronic interfaces.

Suggested Books:
2. NeelinaMalsch , Biomedical nanotechnology by CRC press release, MalschTechnoValuation, Utrecht, The Netherlands
With effect from the academic year 2013-2014

BM        UE        BIO MATERIALS AND TISSUE REPLACEMENT

Instruction: 4 Periods per week
Duration of University Examination: 3 Hours
University Examination: 75 Marks
Sessionals: 25 Marks
Credits: 4

Course 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.

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
Soft tissue replacements: Sutures, Surgical tapes and Staples, Tissue Adhesives, Percutaneous Devices, Artificial Skin, Maxillofacial implant, Ear and Eye Implants, Fluid Transfer Implants, Vascular Implants, Heart Valve Implants, Heart and Lung Assist Devices, Dialysis Membrane, Drug delivery systems, Burn Dressings, Skin substitutes, Artificial Cartilage.

UNIT – V

Text Books:

References:
3. NPTEL Video lecture: Introduction to Biomaterials.
With effect from the academic year 2013-2014

BM 304 UE

BIOTRANSPORT PROCESSES

Instruction  4 Periods per week
Duration of University Examination  3 Hours
University Examination  75 Marks
Sessionals  25 Marks
Credits  4

Unit I
System concepts for transport processes. Effort variables, flow variables, relationship between flow and effort variables. Chemical balances, force balances, general flow balances, Kirchoff’s laws, system applications.

UNIT II

UNIT III

UNIT IV
Mass transfer principles. Mass balance, molecular diffusion, convection, mass generation and mass storage, mixed mode mass transfer, simultaneous heat and mass transfer. Mass transfer in kidneys, lungs and in artificial organs(dialysers and oxygenators)

UNIT V
Compartmental models. Approaches to pharmacokinetic modeling and drug delivery, one and two compartmental models. Physiological applications-intravenous injection, constant intravenous infusion, determination of renal blood flow volumes and blood flow rates.

Suggested Reading:
With effect from the academic year 2013-2014

BIOMEDICAL EQUIPMENT LAB

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

List of Experiments

1. ECG Recorder Experiment
2. pulse Oximetry Experiment
3. Syringe pump Experiment
4. Audiometry to find the Hearing ability of the subjects
5. Ultrasound Diathermy
6. Shortwave Diathermy
7. Spirometry to test the capacity of Human lungs
8. Multi channel physiological Data acquisition System by using physiopack
9. Nerve conduction Velocity Experiment
10. EEG Recording
11. Recording of Evoked potentials
12. pH-meter
13. Conductivity meter
14. Pacemaker simulator
15. Bedside monitor

Equipment for Demonstration

1. X-Ray machine
2. Portable Ventilator
3. Suction Apparatus
4. Infusion Pump
5. Clinical Instruments (Biochemistry Analyzer, spectrophotometer)
6. Anesthesia Machine

II. Mini Project and Design exercises:

Mini project is to be executed batch-wise. Design exercises are to be carried out individually.
With effect from the academic year 2013-2014

BM 341 UE

DIGITAL ELECTRONICS LAB

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

I. List of Experiments:

Clippers and Clampers-Series and Parallel
Astable, Monostable and Bistable Multivibrators
Logic Gates-AND, OR, NOT, NAND, NOR
Half Adder, Full Adder, Half Subtractor, Full Subtractor
Flip Flops-SR, JK, D, T, JK-Master Slave
A/D and D/A converters
Multiplexers and Demultiplexers
Shift register-Series/Parallel-in to Series/Parallel-out
CMOS-TTL and TTL-CMOS interfacing
BCD-7 segment Display
PLL and Voltage Controlled Oscillator
Counters-Decade, Binary, Divide-by-N

II. Mini Project and Design exercises:

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