### SEMESTER – I

<table>
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<tr>
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<th>Sessionals</th>
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<td>Anatomy &amp; Physiology</td>
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<td>MTBM – 6</td>
<td>Bio-Medical Instrumentation – I</td>
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**Elective - I**

- a) Orthopedics & Rehabilitation
- b) Bio-Medical Signal Processing
### SEMESTER – II

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<td>MTBM –9</td>
<td>Bio – Medical Instrumentation – II</td>
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<td>MTBM –10</td>
<td>Principles of Radiology</td>
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<td>MTBM –11</td>
<td>Hospital Management &amp; Support Services</td>
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#### Elective – II

- a) Nano-Technology and Applications
- b) Robotics and Artificial Intelligence
- c) Bio – Materials and artificial organs

### SEMESTER – III

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Project work to be submitted before the end of 3rd Semester and it will be evaluated by a committee consisting of Chairman, Board of Studies, Head of the Department and Thesis Guide.

### SEMESTER – IV

<table>
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<tr>
<th>Subject Code</th>
<th>Subject Title</th>
<th>Credits</th>
<th>Sessionals</th>
<th>Univ. Exam (Viva – Voce)Marks</th>
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<td>Thesis (Part – II)</td>
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</table>
Thesis work is for a period of SIX months in Industry/Department. The students are required to submit their thesis two/three phases. Thesis is evaluated by a committee consisting of an external member from reputed institution, HOD, Chairman BOS and Thesis Guide.
M.Tech (Bio-Medical Engineering)  
I-Semester  
Syllabus for  
ANATOMY AND PHYSIOLOGY  

Credits : 4 
Max. Marks : 70  
Sessionals : 30  

Subject Code : MTBM – 1  

1. Introduction  
   • Cell and its constituents,  
   • Functional characteristics of cell organelles,  
   • Cell division : Mitosis and Meiosis,  
   • Tissue structure and overview of organ systems  

2. Nervous System  
   • Structure of brain, spinal cord  
   • Neuromuscular junction  
   • Motor pathways : Pyramidal and extra pyramidal  
   • Sensory pathway  
   • Sensory end organs  
   • Special sensors  
     o Auditory pathway  
     o Visual pathway  
     o Olfactory pathway  
     o Gustatory pathway  

3. Energy balance, metabolism and nutrition  
   • Energy metabolism  
   • Intermediary metabolism  
   • Nutrition  

4. Respiratory System  
   • Anatomy of lungs  
   • Properties of gases  
   • Gas exchange in the lungs  
   • Mechanics of respiration  
   • Hypoxia, effect of exercise  

5. Kidney  
   • Functional anatomy  
   • Glomerular filtration  
   • Tubular function  
   • Effects of disordered renal function  

6. Muscular System  
   • Anatomy and structure of skeletal and smooth muscle  
   • Process of contraction of skeletal and smooth muscle  
   • Exercise physiology  

Reference Books :  
2. Ross & Wilson : Anatomy and Physiology  
3. Ganeny Phidyogy
M.Tech (Bio-Medical Engineering)  
I-Semester  
Syllabus for  
ELECTRONICS DEVICES AND CIRCUITS  

Credits : 4  
Subject Code : MTBM – 2  
Max. Marks : 70  
Sessionals : 30

1. Diode Characteristics and Applications

Diode working, Basic applications of PN diode, Diode specifications, Diode equivalent circuits, Characteristics of a PN diode, Volt-ampere characteristics of PN diode, Diode resistances, Diode testing, Varactor diode, Zener diode, Tunnel diode, Light Emitting Diode, Photo diode, Solar cells,

2. Rectifier Circuits

Half-wave rectifier, Full-wave rectifier, Bridge rectifier, Comparative characteristics of rectifier circuits, Filter circuits

3. Transistor Characteristics and Applications

Operation of the transistor, Transistor configurations, Current amplification factor, $\beta$, Differences among the parameters of CE, CB and CC transistor configurations, The transistor equivalent circuits, The specification parameters correspondent to maximum ratings of BJT, Applications of transistors, Testing of transistors,

4. Biasing and Stability of Transistors

Biasing of amplifiers, Definition of operating point, Stability factors, Self-bias or emitter bias, Diode compensation, Thermister compensation, Sensistor compensation, Thermal runway, Thermal resistance, $T_R$, Thermal stability

5. Field Effect Transistors

Classification of field effect transistors, Junction field effect transistors (JFET), The salient features of JFET, Comparative characteristics of JFET and BJT, Merits of JFET

Demerits of JFET, Construction of JFET, JFET characteristics, JFET parameters, Transfer characteristics, Drain characteristics, Applications of JFETs, Metal oxide semiconductor field effect transistor (MOSFET), Enhancement type MOSFET, Depletion type MOSFET, Salient features of enhancement and depletion type of MOSFET
6. Feedback Amplifiers


7. Oscillators

Definition of oscillator, Definition of generator, Conditions for oscillators, Bharkhausen criteria, The characteristics of oscillators, Classification of oscillators, Sinusoidal oscillators, Relaxation oscillators, RC phase shift oscillator, Salient features of RC phase oscillator, Wein bridge oscillator, Colpitts oscillator, Hartley oscillator, The crystal oscillator

8. Operational Amplifiers and Applications

Introduction to integrated circuits, Salient features of op-amps, Symbol of op-amp, Classification of integrated circuits, Differences between linear and digital ICs, Characteristics of an ideal op-amp, Applications of operational amplifiers, The equivalent circuit of op-amp, The circuits inside an op-amp, Definitions of op-amp parameters, Frequency sensitive parameters of op-amp, Temperature sensitive parameters, Applications of linear ICs, Typical op-amps, Salient features of op-amp 741 series, Specifications of µA 741, Virtual ground concept, Applications of op-amp, Typical pin designations of op-amp

Textbook


Common with M.Tech (Radar and Microwave Engineering), EMI/EMC (MTRM-5),
M.Tech (Communication Systems) EMI / EMC (MTCS-6a) and M.E. (Electronic
Instrumentation) EMI/EMC (MEI-6a)

1. Introduction, Natural and Nuclear sources of EMI / EMC :
   Electromagnetic environment, History, Concepts, Practical experiences and concerns, frequency spectrum conservations. An overview of EMI / EMC, Natural and Nuclear sources of EMI.

2. EMI from apparatus, circuits and open area test sites :
   Electromagnetic emissions, noise from relays and switches, non-linearities in circuits, passive intermodulation, cross talk in transmission lines, transients in power supply lines, electromagnetic interference (EMI). Open area test sites and measurements.

3. Radiated and conducted interference measurements and ESD :
   Anechoic chamber, TEM cell, GH TEM Cell, characterization of conduction currents / voltages, conducted EM noise on power lines, conducted EMI from equipment, Immunity to conducted EMI detectors and measurements. ESD, Electrical fast transients / bursts, electrical surges.

4. Grounding, shielding, bonding and EMI filters :
   Principles and types of grounding, shielding and bonding, characterization of filters, power lines filter design.

5. Cables, connectors, components and EMC standards :
   EMI suppression cables, EMC connectors, EMC gaskets, Isolation transformers, optoisolators, National / International EMC standards.

Text Books :

References :
M.Tech (Bio-Medical Engineering)

I-Semester

Syllabus for

MEDICAL IMAGE PROCESSING

Credits : 4

Subject Code : MTBM – 4

Max. Marks : 70

Sessionals : 30

1. Imaging In medicine – CT scan principle – reconstruction from projection – Fourier slice theorem -

2. Parallel and fan beam projection algorithm –

3. Uniqueness and resolution – X – ray - ultrasound – microwave tomography-

4. Positron Emission Tomography

5. MRI systems – T1 and T2 based imaging

6. Image processing in medicine – digital image processing –

7. Contrast enhancement – edge shaping –


Reference Books :

1. Albert Kacovasaki : Medical imaging systems

2. Gonzalves : Digital Image processing

3. Rosenfield & A.C. Kak : Image processing Vol. 1,2
M.Tech (Bio-Medical Engineering)

I-Semester

Syllabus for

Elective I(a) : ORTHOPAEDICS AND REHABILITATION

Credits : 4

Subject Code : MTBM – 5
Max. Marks : 70
Sessionals : 30

1. Basics of orthopedics
2. Physiology of bones
   a) Calcium and phosphorous metabolism
   b) Bone physiology
   c) Vitamin ‘D’ metabolism
   d) Effects of hormones and humoral agents on calcium metabolism
3. Skeletal System
   Organization
   Bone formation and growth
   Fracture healing
   Bio-mechanism of joints
4. General Orthopedics
   a) Gait
   b) amputations
   c) Prosthesis and Research work
5. Rehabilitation
Diagnostic aids in orthopedics
   a) Radiological
   b) Electrophysiological
   c) Bone densitometry
   d) Arthroscopy

Reference Books :

M.Tech (Bio-Medical Engineering)

I-Semester

Syllabus for

Elective I(b) : BIO-MEDICAL SIGNAL PROCESSING

Credits : 4

Subject Code : MTBM – 5

Max. Marks : 70

1. Discrete-time Signals and Systems
Characterization, classification and time-domain representation of discrete-time signals, Typical sequences and their representation, Classification of sequences, Basic operations on sequences, Discrete-time systems.

2. The Discrete Fourier Transform
The discrete-time Fourier transform (DTFT), The discrete Fourier Transform (DFT), Computation of the DFT

3. Theory of Z-Transform
Mathematical derivation of the unilateral z-transform, Properties of the z-transform, the inverse-z-transform, The bilateral z-transform, Power series, Region of convergence (RoC) and its impedance

4. Neurological Signal Processing
The brain and its potentials, The electrophysiological origin of brain waves, The EEG signal and its characteristics, EEG analysis, Linear prediction theory,

5. Neurological Signal Processing
The autoregressive (AR) method, Recursive estimation of AR parameters, Spectral error measure, Adaptive segmentation, Transient detection and elimination – the case of epileptic patients, Overall performance.

6. Cardiological Signal Processing
Basic electrocardiography, ECG data acquisition, ECG lead system, ECG parameters and their estimation,

7. Cardiological Signal Processing
The use of multi-scale analysis for parameters estimation of ECG waveforms, Arrhythmia analysis monitoring, Long-term continuous ECG recording.

8. ECG Data Reduction Techniques
Direct data compression techniques, Direct ECG data compression techniques, Transformation compression technique, Other data compression techniques, The PRD index

Textbook
M.Tech (Bio-Medical Engineering)  
I-Semester  
Syllabus for  
BIO-MEDICAL INSTRUMENTATION – I

Subject Code : MTBM – 6  
Max. Marks : 70  
Sessionals : 30

1. **Introduction to Biomedical Instrumentation**  
The age of biomedical engineering, Development of biomedical instrumentation, Biometrics, Introduction to the man-instrument system, Components of the man-instrument system, Physiological Systems of the body, Problems encountered in measuring a living system

2. **Basic Transducer Principles**  
The transducer and transduction principles, Active transducers, Passive transducers, Transducers for biomedical applications

3. **Sources of Bioelectric Potentials**  
Resting and action potentials, Propagation of action potentials, The bioelectric potentials.

4. **Electrodes**  
Electrode theory, Biopotential electrodes, Biochemical transducers

5. **The Cardiovascular System**  
The heart and cardiovascular system, The heart, Blood pressure, Characteristics of blood flow, Heart sounds.

6. **Cardiovascular Measurements**  
Electrocardiography, Measurement of blood pressure, Measurement of blood flow and cardiac output, Plethysmography, Measurement of heart sounds.

7. **Patient Care and Monitoring**  
The elements of intensive-care monitoring, Diagnosis, Calibration and repairability of patient-monitoring equipment, Other instrumentation for monitoring patients, The organization of the hospital for patient-care monitoring, Pacemakers, Defibrillators.

8. **Measurements in the Respiratory System**  
The physiology of the respiratory system, Tests and instrumentation for the mechanics of breathing, Gas exchange and distribution, Respiratory therapy equipment.

**TEXT BOOK :**  

**Reference Book**  
M.Tech (Bio-Medical Engineering)

I-Semester

Syllabus for

DIGITAL SIGNAL AND IMAGE PROCESSING LAB

Credits : 4

Subject Code : MTBM – 7  
Max. Marks : 70  
Sessionals : 30

1. Digitization of ECG using IBM PC and A/D connector cords

2. Digitization of EEG and EMG signals using IBM PC and A/D connector cords.

3. Digital smoothing using averaging filter

4. Digital filtering to eliminate 50Hz pick up and limiting bandwidth (notch filters and low pass filters)

5. Digital signal compression for biotelemetry applications

6. Image processing for contract enhancement and sharpening the edges

7. MR image processing

8. Digital image compression
M.Tech (Bio-Medical Engineering)

Syllabus for

BIO-MEDICAL INSTRUMENTATION – II

Credits : 4

Subject Code : BME – 9
II – Semester
Max. Marks : 70
Sessionals : 30

Chapter – I : Sources of Bioelectric potentials and Electrodes
Electrode theory, Bio Potential Electrodes, Biochemical Transducers

Chapter – II : The Cardiovascular System and Cardiovascular Measurements,
The Heart and Cardiovascular System, The Heart, Blood Pressure, Characteristics of Blood Flow, Heart Sounds
Electrocardiography, Measurement of Blood Pressure, Measurement of Blood Flow and Cardiac output, Plethysmography, Measurement of Heart Sounds,

Chapter – III : Patient Care & Monitory and Measurements in Respiratory System
The elements of Intensive Care Monitory, Diagnosis, Calibration and repairability of Patient Monitoring equipment, other instrumentation for monitoring patients, pace makers, defibrillators
The Physiology of respiratory system, tests and instrumentation for mechanics of breathing, respiratory theory equipment

Chapter – IV : Bio telemetry and Instrumentation for the clinical laboratory
Introduction to biotelemetry, physiological parameters adaptable to biotelemetry, the components of biotelemetry system, implantable units, applications of telemetry in patient care
The blood, tests on blood cells, chemical test, automation of chemical tests

Chapter – V : X – ray and radioisotope instrumentation and electrical safety of medical equipment.
Generation of Ionizing radiation, instrumentation for diagnostic X – rays, special techniques, instrumentation for the medical use of radioisotopes, radiation therapy.
Physiological effects of electrical current, shock Hazards from electrical equipment, Methods of accident prevention

TEXT BOOK :
M.Tech (Bio-Medical Engineering)

Syllabus for

PRINCIPLES OF RADIOLOGY

Credits : 4

Subject Code : BME – 10

Max. Marks : 70

II – Semester

Sessionals : 30

1. GI Tract
   Liver
   Gallbladder
   Pancreas
   Kidney
   Urinary Bladder
2. Female Genital Tract
   Chest
   Orthopaedics
   Nervous System
   Breast
   Thyroid
3. Helical CT Technique and Protocols
   Common Acute Abdominal Pathologies
   CT in Bowel Obstruction
   CT in the Evaluation of Intestinal Volvulus
   Abdominal Wall Hernias and Role of CT
4. CT in Inflammatory Bowel Diseases and Infectious Colitis
   Ischemic Bowel Disease
   Acute Intra-abdominal Vascular Emergencies and Hemorrhage
   Miscellaneous
5. Basic Principles
   Instrumentation
   MR Safety
   MR Contrast Media
   Principles of Interpretation : Neuroimaging
   Principles of Interpretation : Body Imaging
   MR Angiography
   Cardiac MRI

Textbooks

M.Tech (Bio-Medical Engineering)

II-Semester

Syllabus for

HOSPITAL MANAGEMENT AND SUPPORT SERVICES

Credits : 4

Subject Code : BME – 11

Max. Marks : 70
Sessionals : 30

1. Evolution of hospitals
   Hospital Administration
   Outpatient Department (OPD)
   Inpatient (IP) Services

2. Operation Theatre Complex (OT Complex)
   Delivery Suite
   Pharmacy
   Laboratory Services (LAB)

3. Radiology Department (X-ray Department)
   Central Sterile Supply Department (CSSD)
   Medical Records Department (MRD)

4. Medico-legal Sciences
   Professional Ethics
   Labor Laws

5. Building Requirements
   Laboratory Services
   Blood Bank, Drug and Cosmetic Rules for regulation of blood banks, Drug and Cosmetic Rules
   Radiological and Imaging Services

6. Material Management
   Hospital Dietary Services
   Ambulance Services

7. Hospital Environmental Control
   Hospital Waste Management, Bio-Medical Waste (Management & Handling), Rules

8. Autopsy and Mortuary Management
   Fire Prevention, Communication and Workshop
   Transplantation of Human Organs Act

Textbooks

1. The Hospital Administrator by M.A. George, Jaypee Publications, 2005.

2. Essentials for Hospital Support Services and Physical Infrastructure by Madhuri Sharma, Jaypee Publications,
M.Tech (Bio-Medical Engineering)

Syllabus for

CLINICAL MEDICINE

Credits : 4
Max. Marks : 70

Subject Code : BME – 12
Max. Marks : 70
II – Semester
Sessionals : 30

1. Evaluation of Headache
   Evaluating Chronic Cough
   An Approach to Interpret Arterial Blood Gases
   Pre-operative Medical Evaluation

2. Adult Immunisation
   Newer Developments in Management of Hypertension
   Exercise Testing in Diagnosis and Prognosis of Heart Disease : An Overview
   Cardiovascular Risk Assessment
   Management of Valvular Heart Disease

3. Update on Management of Type 2 Diabetes Mellitus
   Postprandial Hyperglycaemia : A Real Challenge in Diabetes Mellitus
   Vascular Complications in diabetes – Clinical Evaluation and Screening
   Antithyroid Drugs
   Viral Hepatitis

4. Iron Deficiency Anaemia
   Typhoid Fever
   Millary Tuberculosis
   Multidrug-resistant Tuberculosis (MDR-TB)
   Diagnostic Approach to Malaria

5. Preventive Strategies in Acute Renal Failure
   Management of Anaemia of Chronic Renal Disease
   Urinary Tract Infection
   Parkinson’s Disease
   Management of Difficult Asthma
   Advances in the Treatment of Rheumatoid Arthritis and
   Spondyloarthropathes

Textbook

1. Clinical Medicine by AK Agarwal and DG Jain
M.Tech (Bio-Medical Engineering)

Syllabus for

PRINCIPLES OF ELECTROTHERAPY

Credits : 4

Subject Code : BME – 13
Max. Marks : 70
II – Semester
Sessionals : 30

1. Introduction
   Low Frequency Currents

2. Medium Frequency Currents
   High Frequency Currents

3. Radiation Therapy
   Laser Therapy

4. Superficial Heating Modalities
   Ultrasonic Therapy

5. Cryotherapy

Textbook

M.Tech (Bio-Medical Engineering)

Syllabus for

Elective II (a) : BIO-MATERIALS AND ARTIFICIAL ORGANS

Credits : 4

Subject Code : BME – 14

Max. Marks : 70

II – Semester

Sessionals : 30

1. Structure of biomaterials :
   Definition and classification of biomaterial – mechanical properties – visco – elasticity, elasticity of Non – Hoopkean material

2. Biocompatibility :
   Wound healing process – body response to implants – blood compatibility

3. Metallic implants :
   Stainless steel – cobalt based alloys – titanium based alloys – applications – deterioration of metallic implants

4. Ceramic and polymeric implants :
   Aluminum oxides, Hydroxyapatite, Glass ceramics, carbons, polymerization, acrylic polymers, rubbers, high strength thermoplastics, medical applications, deterioration of polymers.

5. Soft – tissue replacement implants :
   Sutures, Surgical tapes, adhesives, percutaneous and skin implants

6. Hard – tissue replacement implants :
   Internal fracture fixation devices, joint replacements dental implants

7. Artificial kidney devices :
   Methods of artificial waste removal – hemodialysis, artificial kidney system.

8. Artificial heart – lung devise :
   Use of patients Lungs for gas exchange – the ideal heart – lung devices – comparison of natural and artificial lungs.

Reference Books :

M.Tech (Bio-Medical Engineering)

Syllabus for

Elective II(b) : ROBOTICS AND ARTIFICIAL INTELLIGENCE

Credits : 4

Subject Code : BME – 14

II – Semester

Max. Marks : 70

Sessionals : 30

Robots : Basic components – Classification – performance characteristics.


Definition and scope of Artificial Intelligence (AI) – Fundamentals of expert systems – date base programs versus expert systems – components, features and categories of expert systems.


M.Tech (Bio-Medical Engineering)

Syllabus for

Elective II(c) : NANOTECHNOLOGY AND APPLICATIONS

Credits : 4

Subject Code : BME – 14
II – Semester

Max. Marks : 70
Sessionals : 30

Unit 1 : Introduction to Nanotechnology

Essence of Nanotechnology, Nano in daily life, Brief account of nano applications, Properties of nano materials, Metal nano clusters, Semiconductor nano particles.

Unit 2 : Nano Materials

Nano composites, Nanofying electronics, Sensing the environment, Mechanising the micro world, Energy and cleaner environment with nano technology.

Unit 3 : Carbon Nano Structures

Introduction, Carbon molecules, Carbon clusters, Carbon nanotubes, Applications of carbon nanotubes.

Unit 4 : Diagnosing Personal Health and Medical Applications

Lab on a chip, Super X-ray vision, Mapping the genes, Understanding how pharmaceutical company develops drugs, Delivering a new drug the Nanotech way, Cooking cancer with nano cells, Biomimetics.

Unit 5 : Biological Materials

Introduction, Biological building blocks, Nucleic acids, Biological nanostructures.

Textbooks

M.Tech (Bio-Medical Engineering)

Syllabus for

BIO-INSTRUMENTATION LAB

Credits : 4

Subject Code : BME – 15

Max. Marks : 70

II – Semester

Sessionals : 30

1. Transducers for physiological parameters.

2. Polygraph studies – ECG, EMG, EEG, EPG, EOG experiments.

3. Bio – Medical instrumentation amplifiers


6. Spirometer and respiratory measurements

7. Photometric and optical instrumentation, photoplethysmography.

Reference Books :

1. R.S. Khandpur : Biomedical instrumentation.

2. L.Cromwell : Principles of biomedical instrumentation.