EVALUATION SCHEME & SYLLABUS

FOR

B. TECH. FOURTH YEAR

(BIOMEDICAL ENGINEERING)

On

Choice Based Credit System
(Effective from session 2019-20)
<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Sub Code</th>
<th>Subject Name</th>
<th>Dept.</th>
<th>L-T-P</th>
<th>Th/Lab Marks</th>
<th>Sessional</th>
<th>Subject Total</th>
<th>Credit</th>
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<td>1</td>
<td></td>
<td>Open Elective-I**</td>
<td>Other Dept.</td>
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<td>70</td>
<td>20</td>
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**Departmental Elective – III**
1. RBM071  Bioinformatics
2. RBM072  Artificial Organs & Rehabilitation Engineering
3. RBM073  Therapeutic Equipments

**Departmental Elective – IV**
4. RBM074  Telemedicine
5. RBM075  Biotransport Phenomenon
6. RBM076  Data Communication Networks
## Evaluation Scheme

### B.Tech. Biomedical Engineering

#### Year 4th / Semester VIII

Effective from the Session 2019-20

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**Departmental Elective – V**

1. RBM081 Advanced Biomedical Instrumentation  
2. RBM082 Tissue Engineering  
3. RBM083 Principles of Radio Diagnosis and Radio Therapy  

**Departmental Elective- VI**

4. RBM084 Design and Modelling of Biomedical Systems  
5. RBM085 Communication Engineering  
6. RBM086 Artificial Intelligence & its Applications in Biomedical Engineering
RBM701  BIOMEDICAL IMAGE PROCESSING

UNIT-I  IMAGE PERCEPTION

Introduction, light, luminance, brightness and contrast, MTF of the visual system - visibility, function, monochrome vision models, color representation, color matching and reproduction, color vision model Image sampling and quantization, Image quantization, visual quantization.

UNIT-II IMAGE ENHANCEMENT & IMAGE RESTORATION

Point operations; contrast stretching, clipping and threshold, digital negative intensity level slicing, bit extraction, Histogram modeling, histogram equalization, modification, Convolution theorem and correlation, spatial operations, smoothing techniques.

UNIT-III IMAGE TRANSFORMS

Two dimensional orthogonal and unitary transforms, properties of unitary transforms — one dimensional DFT, cosine, sine Harmrd and Haar transforms.

UNIT-IV IMAGE SEGMENTATION ANALYSIS AND COMPUTER VISION

Spatial feature extraction, transforms features, Segmentation techniques, Analysis techniques.

UNIT-V
Application of MATLAB for Digital image processing.

BOOKS:


UNIT I
Classification of hospital & architecture: General hospital, specialized hospital, primary health care – their role and functions. Aspects of hospital services – inpatient, outpatient and emergency. Location and environment of hospital, Hierarchy of medical and paramedical staff & their functions and responsibilities. Modern Hospital Architecture- space in a hospital building, design of ward, intensive care units, air conditioning, plumbing & sanitation, gas supply, waste disposal, cleaning, dietary, sterilizing, laundry, storage and operation theatre systems, Radiology, Central labs, Blood banks, OPD, Casualty, etc.

UNIT II

UNIT III

UNIT IV

UNIT V
Hospital Information system: Role of database in HIS. Need of Networking in HIS. Overview of Networking, topologies and its configuration. Structuring medical records to carry out functions like admissions, discharges, treatment history etc. Computerization in pharmacy & billing. Automated clinical laboratory systems & radiology information system. Need for evolving health policy, health organization in state, health financing system, health education, health insurance, health legislation.

TEXT BOOKS
1. P.E.Stanley, Handbook of hospital safety, CRC Press (UNIT II)
2. Arun Kumar, Hospital Management, Anmol Publications Pvt. Ltd., Jan 2000 , 1st.ed (UNITS IV & V)
3.Harold E. Smalley, “Hospital Management Engineering – A guide to the improvement of hospital management system”, PHI.

REFERENCES:
1. Sharma, Essentials for Hospital Support Services and Physical Infrastructure, 1/e, Jaypee Medical Publishers 2003
3. Gupta, Kant, Chandrashekar, Satpathy, Modern Trends in Planning and Designing of Hospitals Principles and Practice with CD-ROM, Jaypee Medical publishers, 1/e, 2007
4. Sakharkar, Principles of Hospital Administration and Planning, Jaypee Medical publishers 1/e, Reprint 2004
RBM751  BIOMEDICAL IMAGE PROCESSING LAB

1. Study of MRI Images.
2. Study of CT Scan.
3. Study of Mammograms.
4. Reconstruction of Images.
5. Image analysis.
6. MATLAB implementation.

REFERENCE BOOKS:

1. Pathology & Micro Biology Laboratory Manual
1. pH meter: Study, standardisation & calibration.

2. Calorimeter

3. Spectro Photometer

4. Flame photometer

5. Hb meter

6. Conductivity meter

7. Study & familiarization of Laser Equipments

8. Study of physiological pre-amplifiers.


10. Servicing of ECG equipments.

11. Study of multi channel physiological recorders.

12. Study of vacuum tube and solid state cautery.

13. Study of ventilator.


15. Study of X-ray radiography system.
UNIT-I INTRODUCTION TO BIOINFORMATICS
Objectives of Bioinformatics, Data integration, Data Analysis, Bioinformatics databases and tools, Molecular approach versus Bioinformatics approach, Overview of Bioinformatics application.

UNIT-II MOLECULAR BIOLOGY AND INFORMATION
Basic chemistry of nucleic acids, Structure of DNA, Genes, The functional elements in DNA, DNA sequencing and Polymeric chain reaction, Cloning methodology, Amino acids, Protein structure Protein folding, Protein function.

UNIT-III SEQUENCE ALIGNMENT
Introduction to Sequence Analysis, Models for sequence analysis and their Biological motivation, Methods of alignment, Usage of gap penalties and Scoring matrices, Tools for sequence alignment, Tools for multiple sequence alignment, Applications of Multiple alignment.

UNIT-IV GENE MAPPING AND GENE EXPRESSION
Applications of Gene mapping, DNA sequencing, DNA micro arrays, Algorithms for gene alignment, Gene prediction tools, Tools for DNA/RNA structure and function analysis.

UNIT-V PROTEOMICS
Protein structure visualization, Protein structure prediction, Methods of protein structure for known folds, Methods of protein structure for unknown folds, Methods for structure prediction, Protein analysis, Tools for protein analysis.

BOOKS
- Tisdall James, “Beginning Perl for Bioinformatics”, O’Reilly publications.
UNIT I
Introduction to artificial organs: Biomaterials used in artificial organs and prostheses, inflammation, rejection, correction. Rheological properties of blood, blood viscosity variation: effect of shear rate, hematocrit, temperature and protein contents. Casson equation, flow properties of blood through the blood vessels, problems associated with extracorporeal blood flow.

UNIT II
Artificial kidney: Brief of kidney filtration, basic methods of artificial waste removal, hemodialysis, equation for artificial kidney and middle molecule hypothesis. Hemodialysers: flat plate type, coil type and hollow fiber. Analysis of mass transfer in dialyzer (cross current & cocurrent flow), regeneration of dialysate, membrane configuration, wearable artificial kidney machine, separation of antigens from blood in ESRD patients.

UNIT III

UNIT IV

UNIT V

TEXT BOOKS:

REFERENCE BOOKS:
RBM073 THERAPEUTIC EQUIPMENTS

UNIT I
Cardiac Pacemakers & Defibrillators: Effects of electric field on cardiac muscles and laws of stimulation. External, internal, and Programmable pacemakers. Pulse generator: sensing, output and timing circuits. Power sources, electrodes and leads system, pacing system analyzers. Defibrillators - basic principle and comparison of output wave forms of different DC defibrillator, energy requirements, synchronous operation, implantable defibrillators, defibrillator safety and analyzers, RF ablation treatment for arrhythmia.

UNIT II
Ventilators & Anaesthetic system: Basic principles of ventilators, different generators, inspiratory phase and expiratory phase, different ventilatory adjuncts, neonatal ventilators, p based ventilator, ventilator testing. Anaesthesia: Need of anaesthesia, gas used and their sources, gas blending and vaporizers, anaesthesia delivery system, breathing circuits.

UNIT III
Physical therapy: Physical therapy principles
Electrical stimulators: Strength-duration curve, types of stimulators, an electrodiagnostic / therapeutic stimulator. Nerve-muscle stimulator: peripheral nerve stimulator, Ultrasound stimulators, stimulators for pain and relief.
Diathermy: IR diathermy, UV diathermy, short wave diathermy, microwave diathermy, ultrasonic diathermy.

UNIT IV

UNIT V

TEXT BOOKS:
   J. Webster, “Bioinstrumentation”, Wiley & Sons

REFERENCES:
   Jacobson & Websler, “Medicine & Clinical Engg”
DEPARTMENTAL ELECTIVE IV

RB074       TELEMEDICINE

UNIT I


UNIT II

Clinical network, Clinical parameters, Cardiology, Dermatology, Tele-radiology, EMI emergency medicine, Gastroenterology, Homecare, Neurology, Oncology, Ophthalmology, Mental health, Tele-rehabilitation, Tele-pathology & Tele-surgery.

UNIT III

Use of computers in distance mode of healthcare delivery, Web technology, Satellite communication systems; Hypertext, voice & image transfer protocols, Medical image scanning, Data compression and Transfer, Capturing of medical signals, Analog to digital conversion, Video conferencing, Remote sensing, Rural primary setups, Referral and Super speciality centers, Societal medico legal aspects, Networking (local, national & global).

UNIT IV

Video conferencing hardware/software, Video production, Editing and Broadcasting, Tele-medical workstations, DSL equipments, Cable modem, POTS line, Fast switches ethernet, Fiber optic equipment, Router, Hubs, Monitoring devices, Vital sign monitoring devices, Respiratory monitoring devices, Neurological monitoring devices, Video scopes, Robotics and virtual reality devices

UNIT V

Legal and ethical issues, Duty of care, Malpractice and liability, Licensure and accreditation, Security and confidentiality, Ethical standards, Intellectual property rights

TEXT BOOKS:

2. A.C. Norris, “Essentials of Telemedicine and Telecare”

REFERENCE BOOKS

UNIT 1
Introduction to fluid mechanics, heat and mass transfer. Physical, chemical and rheological properties of blood.

UNIT II
Unified approach of momentum, heat and mass transfer. Heat Transport: Heat production in humans, Loss of heat to the environment, Heat transfer within the body

UNIT III
Transport through cell membranes: Membrane structure, composition and permeability, Osmosis, Passive diffusion, Pressure diffusion, Facilitated transport, Facilitated diffusion of oxygen in haemoglobin solutions, Active transport, Pinocytosis.

UNIT IV
Compartment modeling: Pharmacokinetic models, The one-compartment and two-compartment open models. Structure and gross operational features of the respiratory system, Gas transport mechanisms in the lungs, Oxygen and carbon dioxide transfer in the blood, Modeling oxygen uptake in the pulmonary capillaries.

UNIT V
Structure and general features of operation of kidneys, Transport mechanisms in the tubules, Pore models of the glomerular tuft, Countercurrent mechanism of urine formation, Models of nephron function, Analytical model for Henle’s loop. Artificial kidney devices: Hemodialysis, types of hemodialyzers.

TEXT BOOKS:
2. Edwin N. Lightfoot, Transport phenomena and living systems – Biomedical aspects of momentum and mass transport, John Wiley, 1974
UNIT I
Introduction to Networks and Data Communications, Goals and Applications of Networks, Network structure and architecture, The Internet, Protocols and Standards, Layered Tasks, The OSI reference model, TCP / IP, Addressing, Line Coding Review.

UNIT II

UNIT III

UNIT IV

UNIT V
Application Layer: File Transfer, Electronic mail, Virtual Terminals, Cryptography, Network Security

TEXT BOOK:
1. Forouzan, Data Communication & Networking, McGrawhill Education
UNIT I

UNIT II
Blood Flow meters: Electromagnetic blood flow meter, ultrasonic blood flow meter, Doppler blood flow meter, NMR blood flow meter, cardiac output measurement – indicator dilution methods and impedance technique.

UNIT III
Pulmonary function analyzers: Pulmonary function measurement-spirometry, respiratory gas analyzers, pneumotachography – different types of pneumotachometers, respiratory rate meter, impedance plethysmograph / pneumograph. Blood gas analyzers: Blood pH measurement, pCO2 measurement, pO2 measurement, a complete blood gas analyzer. Different types of oximetry systems, pulse oximeter.

UNIT IV
Blood pressure and heart sound measurement: Measurement of blood pressure using sphygmomanometer instrument based on Korotkoff sound, indirect measurement of blood pressure, automated indirect measurement, and specific direct measurement techniques. Heart sound measurement – stethoscope, phonocardiograph.

UNIT V
Endoscopy: Introduction, various types of endoscopes, cystoscopes, laproscopes, fiber optic endoscopes and endoscopes with integral TV cameras.

TEXT BOOKS:
3. J. Webster, “Bioinstrumentation”, Wiley & Sons

REFERENCES:
4. Leslie Cromwell, “ Biomedical Instrumentation and Measurements”
UNIT I
Introduction: Basic definition, Structural and organization of tissues: Epithelial, connective; vascularity and angiogenesis, basic wound healing, cell migration, current scope of development and use in therapeutic and in-vitro testing.

UNIT II
Cell culture: Different cell types, progenitor cells and cell differentiations, different kind of matrix, cell-cell interaction. Aspect of cell culture: cell expansion, cell transfer, cell storage and cell characterization, Bioreactors.

UNIT III
Molecular biology aspects: Cell signaling molecules, growth factors, hormone and growth factor signaling, growth factor delivery in tissue engineering, cell attachment: differential cell adhesion, receptor-ligand binding, and Cell surface markers.

UNIT IV
Scaffold and transplant: Engineering biomaterials for tissue engineering, Degradable materials (collagen, silk and polylactic acid), porosity, mechanical strength, 3-D architecture and cell incorporation. Engineering tissues for replacing bone, cartilage, tendons, ligaments, skin and liver. Basic transplant immunology, stems cells: introduction, hepatopoiesis.

UNIT V
Case study and regulatory issues: Case study of multiple approaches: cell transplantation for liver, musculoskeletal, cardiovascular, neural, visceral tissue engineering. Ethical, FDA and regulatory issues of tissue engineering.

TEXT BOOK:

REFERENCE BOOKS:
UNIT - I

Production of X-rays Various components of radiographic systems Electrical circuit for X-ray unit filament circuits and mA control- ITV circuits - KV control exposure switching and control of exposure timers - types of X-ray tubes for various medical application. Rating charts of X-ray tubes.

UNIT - II


UNIT - III


UNIT - IV

Basic of digital angiography - Image processors for digital angiography - processor architecture - Temporal integration techniques for digital angiography - digital subtraction angiography

UNIT - V


References:
DEPARTMENTAL ELECTIVE VI

RBM084 DESIGN AND MODELLING OF BIOMEDICAL SYSTEMS

UNIT-I  SELECTION OF HARDWARE


UNIT-II

Simulation of Design on using Simulation Software.

UNIT-III  PCB DESIGN AND FABRICATION TECHNIQUES


UNIT-IV  RELIABILITY ASPECT OF BIOMEDICAL EQUIPMENTS

Basic Reliability related Definitions, Need of reliability in Medical Device, Medical device reliability and Associated areas, Basic reliability Mathematics and Concepts for Medical Devices, Reliability Configuration.

UNIT-V  SAFETY ASPECT OF BIOMEDICAL EQUIPMENTS & THEIR CALIBRATION AND TESTING


REFERENCE BOOKS:


UNIT I

UNIT II

UNIT III
Microwave communication systems: advantage, block diagram of a microwave radio system, microwave radio stations- Terminal station and repeater station.
Satellite Communication system: Satellite Orbits, launch vehicles, look angles, satellite parameters, satellite link model, personal communication systems- GPS services.

UNIT IV
Amount of information, Entropy, Information rate, Shannon’s theorem, Channel capacity, Bandwidth and S/N trade off, Introduction to error and error correction code.

UNIT V
Cellular concept, basic cellular concept and its operation, uniqueness of mobile radio environment- Performance metrics in cellular system-Elements of cellular mobile radio-Handoff-Frequency management and channel assignment- Introduction to various cellular standards like AMPS, GSM, GPRS, IS-95A, IS-95B, CDMA-2000 and WCDMA.

TEXT BOOK:

REFERENCE BOOKS:
UNIT-I

Introduction to Artificial neuron and neural networks, Feature selection. Types of learning, supervised and unsupervised learning. Supervised learning decision surfaces, Two, category separation, linearly separable sets, Multiple category classification problems, Relationship to neural network models, Comparison of methods, Applications.

UNIT-II


UNIT-III

Introduction, Foundation of Fuzzy system, Fuzzy systems at work; Fuzzy system design, Crisp V/s Fuzzy sets, Fuzzy sets to fuzzy event, Fuzzy logic, Practical fuzzy measures, Fuzzy set operations, properties of fuzzy sets, Fuzzification techniques, Relational inference, Compositional inference. Linguistic variables and logic operators, Inference using fuzzy variables, Fuzzy implication.

UNIT-IV

Fuzzy systems and algorithms, Defuzzification, Adaptive fuzzy system algorithms, Expert systems v/s fuzzy inference engines, Basic fuzzy inference algorithm, Overall algorithm, Input data processing, Evaluating antecedent fuzzy variables, Left hand side computations; Right hand side computations, Output processing.

UNIT-V

Introduction to Genetic Algorithm, Application of AI in biomedical engineering.

TEXT BOOKS:
