# UNIVERSITY DEPARTMENTS
ANNA UNIVERSITY, CHENNAI 600 025
REGULATIONS - 2013
M.E. MEDICAL ELECTRONICS

CURRICULUM AND SYLLABUS I TO IV SEMESTERS (FULL TIME)

## SEMESTER I

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# M.E. Medical Electronics
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PROGRAMME OBJECTIVES:

The students will gain knowledge

- In the proper use of sensors and measurement of vital physiological parameters
- About the various imaging modalities in the hospital
- In the application of various basic and advanced processing techniques to these images and physiological parameters
- About the types of assist devices

Finally, the students will be able to apply the knowledge for the research, design, and development of new medical devices.
OBJECTIVES:
- To know the various functional blocks present in biosignal acquisition system so that the students are capable to design the data acquisition system.
- To understand the different biopotential characteristics and recording methods so as to enable to record various biosignals.
- To develop an understanding of the non-electrical parameters measurements so as to enable to record various non-electrical parameters.
- To study the biochemical measurements so as to create confidence in students to do biochemical measurement.

UNIT I  
BIOMEDICAL TRANSDUCERS AND AMPLIFIERS  
9
Categories and Characteristics of Transducer, Signal conditioning units, Multichannel data acquisition system, various types recorders, necessity for low noise pre amplifiers, Difference amplifier, Chopper amplifier, Different types of electrode and its equivalent circuits.

UNIT II  
BIOPOTENTIAL RECORDING  
9
ECG, EEG, EMG, PCG, EOG, ERG lead system and recording methods, typical waveform, frequency spectrum, abnormal waveform.

UNIT III  
NON ELECTRICAL PARAMETER MEASUREMENTS  
9
Respiration rate, Pulse rate, Temperature, Blood Pressure, O₂, CO₂ measurements, Respiratory volume measurement, BMR measurement, Plethysmography technique, Impedance technique-Bipolar and Tetrapolar circuits, Detection of various physiological parameters using impedance technique,

UNIT IV  
BLOOD FLOW METER AND BLOOD CELL COUNTER  
9

UNIT V  
BIO-CHEMICAL MEASUREMENTS & BIOSENSORS  
9
pH, pCO₂, pO₂, pHCO₃ and electrophoresis, colorimeter, spectrophotometer, flame photometer, autoanalyzer, Biosensors.

REFERENCES:
1. Geddes LA and Baker L.E Principals of Applied Biomedical Instrumentation , John Wiley and sons Newyork 1975

OUTCOMES:
By the completion of this course the student will to
- Know the various functional blocks present in biosignal acquisition system and to design the data acquisition system.
- To obtain the domain knowledge of different biopotential characteristics and recording methods. biosignals.
- Develop measurement systems by selecting different types of sensors, signal conditioning circuits for acquiring and recording various physiological parameters.
- With Confidence they can do biochemical measurement.
OBJECTIVES:
- To introduce the characteristics of different biosignals
- To discuss linear and non-linear filtering techniques to extract desired information
- To introduce techniques for automated classification and decision making to aid diagnosis

UNIT I SIGNAL, SYSTEM AND SPECTRUM

UNIT II TIME SERIES ANALYSIS AND SPECTRAL ESTIMATION
Time series analysis – linear prediction models, process order estimation, lattice representation, non stationary process, fixed segmentation, adaptive segmentation, application in EEG, PCG signals, Time varying analysis of Heart-rate variability, model based ECG simulator. Spectral estimation – Blackman Tukey method, periodogram, and model based estimation. Application in Heart rate variability, PCG signals,

UNIT III ADAPTIVE FILTERING AND WAVELET DETECTION

UNIT IV BIOSIGNAL CLASSIFICATION AND RECOGNITION

UNIT V TIME FREQUENCY AND MULTIVARIATE ANALYSIS
Time frequency representation, spectrogram, Wigner distribution, Time-scale representation, scalogram, wavelet analysis – Data reduction techniques, ECG data compression, ECG characterization, Feature extraction- Wavelet packets, Multivariate component analysis analysis-PCA, ICA

TOTAL: 45 PERIODS

REFERENCES:

OUTCOMES:
Upon the completion of this course, the students are able
- To come across the different types of signals & systems
- To analyse signals in time series domain & estimate the spectrum
- To understand the significance of wavelet detection applied in biosignal processing.
- To extract the features using multivariate component analysis.
OBJECTIVES:
- To know the various functional blocks present in cardiac care units so that the students can handle these equipments with care and safety.
- To understand the different types of neurology equipments so the students learn to use this equipment.
- To develop an understanding of the physiotherapy and diathermy equipment so that the student can learn to operate.

UNIT I  CARDIAC CARE UNIT
Pacemakers - different types, batteries for pacemakers. AC defibrillators, asynchronous and synchronous DC defibrillators, patient monitoring system.

UNIT II  NEUROLOGY EQUIPMENT
Evoked response - Auditory, Visual and Somato sensory Depth recording, Stereotaxy, EEG controlled Anesthetic monitor, Biofeedback equipments, Spinal reflex Measurement, Transcutaneous nerve stimulator

UNIT III  PHYSIOTHERAPY AND DIATHERMY EQUIPMENT
Physiological effects of HF radiation, Depth of Penetration, short wave, Ultrasonic and microwave diathermy, Surgical diathermy, Galvanic, Faradic Stimulators, Interferential therapy, Electrical safety-Leakage current, Micro and macro electric shock, GFI units, Earthing Scheme, Electrical safety Analyser

UNIT IV  LASER AND ULTRASONIC APPLICATION
Principles of Laser action, Different types and clinical applications of laser, ultrasonic frequency for medical application, different modes of Display A, B, and C ultrasonic probes, Real time echo and 2D scanner, Application of Ultrasonic for diagnosis.

UNIT V  RECENT TRENDS
Principles and application of thermography, Detection circuits, Principles of cryogenic Technique and application, principles of Fibre optics cables, Endoscopy, Laparoscopy, ophthalmic equipments- slit Lamp, Tonometer, Retinal response Plotter, principles of Bio telemetry, principles of Lithotripsy.

TOTAL: 45 PERIODS

REFERENCES:
1. Albert M Cook and Webster J G – Therapeutic medical devices Prentice Hall Nee York 1982
3. Leslie Cromwell , Fred J.Weibell and Erich A.Pfeiffer - Biomedical Instrumentation Prentice Hall New Delhi 2000

OUTCOMES:
On completion of this course the student will be able
- To know the working of pacemakers and defibrillator and related circuits.
- To obtain the domain knowledge of Neurological equipment, Physiotherapy equipment and Laser and ultrasound equipment.
- Capability to identify the electrical hazards in the hospital environment and make it shock free zone.
- To know the recent trends in field of diagnostic and therapeutic equipments.
OBJECTIVES:
- To encourage students to develop a working knowledge of the central ideas of linear algebra;
- To study and understand the concepts of probability and random variable of the various functions;
- Understand the notion of a Markov chain, and how simple ideas of conditional probability and matrices can be used to give a thorough and effective account of discrete-time Markov chains;
- To formulate and construct a mathematical model for a linear programming problem in real life situation;
- Introduce the Fourier Transform as an extension of Fourier techniques on periodic functions and to solve partial differential equations;

UNIT I  LINEAR ALGEBRA  9+3

UNIT II  ONE DIMENSIONAL RANDOM VARIABLES  9+3

UNIT III  RANDOM PROCESSES  9+3
Classification – Auto correlation - Cross correlation - Stationary random process – Markov process – Markov chain - Poisson process – Gaussian process.

UNIT IV  LINEAR PROGRAMMING  9+3

UNIT V  FOURIER TRANSFORM FOR PARTIAL DIFFERENTIAL EQUATIONS  9+3

TOTAL: 45+15=60 PERIODS

TEXT BOOKS:

REFERENCES:
OUTCOMES:
- On successful completion of this course, all students will have developed knowledge and understanding in the fields of linear algebra, probability, stochastic process, linear programming problem and Fourier transform.

MD8152 ANATOMY AND PHYSIOLOGY

OBJECTIVES:
- To understand basics of Human Anatomy and Physiology.
- To study the organs and systems involved in body functions.
- To apply this knowledge into Biomedical Engineering field.

UNIT I INTRODUCTION OF HUMAN BODY 8

UNIT II BUILDING BLOCKS OF HUMAN BODY 8

UNIT III RESPIRATION, NUTRITION AND EXCRETORY SYSTEM 10

UNIT IV CARDIOVASCULAR AND ENDOCRINE SYSTEM 9

UNIT V NERVOUS SYSTEM AND SPECIAL SENSES 10

TOTAL: 45 PERIODS

REFERENCES:
OUTCOMES:
By successfully completing this course, students will be able to:

- Describe and explain specific parts and key terms applied in anatomy and physiology
- Describe important physiological mechanisms involved in cell, tissue, and organ
- Understand organisation and functions of each organs and systems in human body

MD8111  BIO MEDICAL INSTRUMENTATION LABORATORY  L T P C
        0  0  4  2

OBJECTIVES :

- To understand the different biopotential characteristics and recording methods so as to enable to record various biosignals.
- To develop an understanding of the nonelectrical parameters measurements so as to enable to record various non electrical parameters.

LIST OF EXPERIMENTS

- Design of preamplifier for acquiring bio signals.
- Design of instrumentation amplifier using single IC and study of effect of offset potentials and contact impedance in bio potential recording.
- Study of patient monitoring system and biotelemetry.
- Recording of Electromyogram and measurement of nerve conduction velocity.
- Plotting of human auditory response using audiometer.
- Performance and testing of surgical diathermy unit using diathermy analyser.
- Measurement of blood flow velocity using ultrasound transducer.
- Study of different types of muscle stimulator waveforms.
- Recording of ECG in standard lead systems.
- Study of multi parameter simulator.
- Recording and analysis of EEG in time and frequency domains.
- Measurement of respiratory parameters using spirometer

OUTCOME:

- Students acquire knowledge about recording of bioelectric potentials, various physiological measurements used in medical field.

MD8201  MEDICAL IMAGE PROCESSING  L T P C
        3  0  0  3

OBJECTIVES:

- To study the image fundamentals and image transforms
- To study the image enhancement techniques
- To study the image restoration procedures
- To study the image compression procedures
UNIT I  IMAGE FUNDAMENTALS
Image perception, MTF of the visual system, Image fidelity criteria, Image model, Image sampling and quantization – two dimensional sampling theory, Image quantization, Optimum mean square quantizer, Image transforms – 2D-DFT and other transforms.

UNIT II  IMAGE PREPROCESSING

UNIT III  MEDICAL IMAGE RECONSTRUCTION
Mathematical preliminaries and basic reconstruction methods, Image reconstruction in CT scanners, MRI, fmRI, Ultra sound imaging., 3D Ultra sound imaging Nuclear Medicine Imaging Modalities- SPECT,PET, Molecular Imaging.

UNIT IV  IMAGE ANALYSIS AND CLASSIFICATION
Image segmentation- pixel based, edge based, region based segmentation. Image representation and analysis, Feature extraction and representation, Statistical, Shape, Texture, feature and image classification – Statistical, Rule based, Neural Network approaches

UNIT V  IMAGE REGISTRATION AND VISUALIZATION
Rigid body visualization, Principal axis registration, Interactive principal axis registration, Feature based registration, Elastic deformation based registration, Medical image fusion, Image visualization – 2D display methods, 3D display methods, virtual reality based interactive visualization.

TOTAL: 45 PERIODS

REFERENCES:

OUTCOME:
• This course provides in depth knowledge about the various digital image processing techniques applied in processing of the medical images.
OBJECTIVES:
- To study the production of x-rays and its application in medical imaging.
- To study the different types of Radio diagnostic techniques.
- To study the special imaging techniques used for visualizing the cross sections of the body.
- To understand the Radiation therapy techniques and also Radiation safety.

UNIT I  X – RAYS

UNIT II  TOMOGRAPHY
Principle, Plane of Movement, Multisection Radiography, Computerised Axial Tomography, Type of Detection, image reconstruction, Spiral CT, Transverse Tomography, 3D Imaging.

UNIT III  EMISSION IMAGING
Alpha, Beta, Gamma Emission, different types of Radiation Detectors, G.M. & Proportional Counters, Pulse Height Analysers, Isotopic, Scanners, Isotopic Diagnosis of RBC Destruction Rate, GI Bleedings Iron Concentration, Liver Functions, Functions of Gamma Camera, PET, SPECT, PET/CT.

UNIT IV  MAGNETIC RESONANCE IMAGING
Principle of MRI, MRI instrumentation, Imaging Different Sections of the Body, Tissue Characterization, MR Spectroscopy, Functional MRI.

UNIT V  THERAPY USING X – RAYS AND ISOTOPES
Direct and Indirect effects of high energy radiation, Units for radiation Exposure, Depth Dose curves, Linear Accelerator Betatron, Cobalt and Cesium Therapy, Computation of Absorbed Dose Level, Automatic Treatment Planning, Hazardous Effects of Radiation, Radiation measuring units, Allowed Levels, ICRP regulation Protection Methods.

REFERENCES:

OUTCOME:
- Will obtain domain knowledge in understanding various Medical Imaging techniques and Therapeutic applications of Radiation.
OBJECTIVE:
To study the various aspects of acquisition and analysis of bio signals and medical images
To understand the importance of electrical safety of medical equipments
To study practically the concepts of physiological modelling

LIST OF EXPERIMENTS
1. Acquisition and analysis of bio signals using workstation.
2. Study of auditory and visual evoked responses.
3. Electrical safety testing of medical equipment.
4. Development of software for basic telemedicine.
6. Acquisition and analysis of medical images.
9. Study of IDL as a tool for medical image analysis.
10. Study of DICOM standards.
12. Mini project (Should include hardware and software).

TOTAL: 60 PERIODS

OUTCOMES:
1. Ability to acquire and analyse any physiological signal and model the physiological systems
2. Apply the techniques of medical image analysis and providing security to medical data

MD8001 ADVANCES IN ELECTRONICS APPLIED TO HOSPITAL ENGINEERING

OBJECTIVES:
- To study about the aspects of clinical engineering
- To study about the various aspects of electronics used in hospitals

UNIT I CLINICAL ENGINEERING
Need for Standardization, Medical standards and recalibration, Hospital design, Hospital safety Regulations, hospital Management and Legal aspects.

UNIT II NETWORKING
Importance of networking, types of networking, LAN features, network topologies, LAN components, network operating system, basic data communication concept, application, LAN and multi-user system, planning and installing LAN in hospital set up.

UNIT III FIBRE OPTIC SENSORS FOR MEASURING PHYSIOLOGICAL PARAMETERS
Different optical sources, optical detectors, principle of fiber optic cables, single mode, multi mode, step index and graded index type, sensors based on polarisation, interferometer principle, magnetic sensors, application of the sensors in measuring pressure, temperature, flow, rotation and chemical activities, principles of smart sensors.
UNIT IV  EMI AND EMC APPLIED TO HOSPITAL EQUIPMENTS  9
Principles of EMI, sources of EMI, effects of EMI on medical devices, computation of EMI, measuring techniques to quantify the level of interference, method of suppressing and isolating the unit from interference.

UNIT VI  VIRTUAL REALITY APPLICATION  9
Need for virtual reality in medicine, Basic concepts and types of Virtual Environment, Human Factors and Human Perception, Computer graphics principles used in VR, Modeling of a Virtual Environment, Existing tools, Avatars, Sensors for Perception, Tracking, Camera, Head mount display used in VR, Applications of Virtual Reality in Medicine

TOTAL : 45 PERIODS

REFERENCES:
5. SK Basandia, Local Area Network, Golgota Publishing Pvt. Ltd., New Delhi, 1995

OUTCOMES:
- Know the role and importance of clinical engineer in the management of the hospital
- Know the importance of calibration of medical devices
- Ability to specify the type of networking facility to be provided in the hospital
- Capability to identify the electromagnetic effects on medical devices and to make the devices electromagnetically compatible
- Ability to specify the type of optic sensor for physiological measurement

MD8002  BRAIN CONTROL INTERFACES  L T P C
3 0 0 3

OBJECTIVES:
- To introduce the basic concepts of brain computer interface
- To study the various signal acquisition methods
- To study the signal processing methods used in BCI

UNIT I  INTRODUCTION TO BCI  9

UNIT II  ELECTROPHYSIOLOGICAL SOURCES  9

UNIT III  FEATURE EXTRACTION METHODS  9
Time/Space Methods – Fourier Transform, Wavelets, AR, MA, ARMA models, Bandpass filtering, Template matching, Kalman filter, PCA, Laplacian filter – Linear and Non-Linear Features
UNIT IV FEATURE TRANSLATION METHODS
Linear Discriminant Analysis – Nearest neighbours, Support Vector Machines – Regression – Learning Vector Quantization – Gaussian Mixture Modeling – Hidden Markov Modeling – Neural Networks

UNIT V APPLICATIONS OF BCI

TOTAL: 45 PERIODS

REFERENCES:

OUTCOMES:
- Capable of acquiring the brain signal in the format required for the specific application
- Well prepared for preprocessing the signal for signal enhancement
- Ability to extract the dominant and required features and classify the signal for applications

MD8003 HEALTH CARE, HOSPITAL AND EQUIPMENT MANAGEMENT L T P C
3 0 0 3

OBJECTIVE:
To develop an understanding of the various setups of hospital, health care codes and equipment management, so as to enable the student to work in the hospital environment.
UNIT I HEALTH SYSTEM
Health organisation of the country, the State, the Cities and the Region, Health Financing System, Health services, Functions of Hospitals, Types of Hospitals, Primary Health Care – An Introduction.

UNIT II HOSPITAL ORGANISATION AND MANAGEMENT
Management of Hospital Organisation, Nursing Sector, Medical Sector, Central Services, Technical Department, Definition and Practice of Management by Objective, Transactional Analysis Human Relation in Hospital, Importance of Team Work, Legal aspect in Hospital Management.

UNIT III REGULATORY REQUIREMENT AND HEALTH CARE CODES
FDA Regulation, Joint Commission of Accreditation for Hospitals, National Fire Protection Association Standard, IRPQ.

UNIT IV TRAINED TECHNICAL PERSONNEL
Function of Clinical Engineer, Role to be performed in Hospital, Manpower requirement for different types of hospitals, Professional Registration, Structure in Hospital.

UNIT V EQUIPMENT MAINTENANCE MANAGEMENT

TOTAL : 45 PERIODS

REFERENCES:

OUTCOME:
The students will be able to apprehend the organisation structure in hospitals, the duties of personnel & the health codes, the training required for technical work for equipment management.

MD8004 HUMAN ASSIST DEVICES

OBJECTIVE:
The objective of this is to know the principle, design and application of various human assist devices which includes extracorporeal devices, artificial heart, cardiac assist devices, respiratory devices and hearing aids. Additionally, a brief introduction to design aspects of prosthetic and orthotic devices for the disability will be given.

UNIT I HEART LUNG MACHINE AND ARTIFICIAL HEART
Condition to be satisfied by the H/L System. Different types of Oxygenators, Pumps, Pulsatile and Continuous Types, Monitoring Process, Shunting, The Indication for Cardiac Transplant, Driving Mechanism, Blood Handling System, Functioning and different types of Artificial Heart, Mock test setup for assessing its Functions.
UNIT II  CARDIAC ASSIST DEVICES  9
Synchronous Counter pulsation, Assisted through Respiration Right Ventricular Bypass Pump, Left Ventricular Bypass Pump, Open Chest and closed Chest type, Intra Aortic Balloon Pumping Veno Arterial Pumping, Prosthetic Cardio Valves, Principle and problem, Biomaterials for implantable purposes, its characteristics and testing.

UNIT III  ARTIFICIAL KIDNEY  9
Indication and Principle of Haemodialysis, Membrane, Dialysate, Different types of heamodialysers, Monitoring Systems, Wearable Artificial Kidney, Implanting Type.

UNIT IV  PROSTHETIC AND ORTHOTIC DEVICES  9
Hand and Arm Replacement - Different Types of Models Externally Powered Limb Prosthesis, Lower Limb and Upper limb orthotic devices, Functional Electrical Stimulation, Sensory Assist Devices, Materials for Prosthetic and orthotic devices, Haptic Devices

UNIT V  RESPIRATORY AND HEARING AIDS.  9
Intermittent positive pressure, Breathing Apparatus Operating Sequence, Electronic IPPB unit with monitoring for all respiratory parameters. Types of Deafness, Hearing Aids, Construction and Functional Characteristics.

REFERENCES:
3 Albert M.Cook and Webster J.G., Therapeutic Medical Devices, Prentice Hall Inc.,New Jersey, 1982

OUTCOMES:
At the end of this course the students will be able to
• Know the role and importance of Heart lung machine and artificial Heart.
• Know the importance of different types of assist devices and related issues.
• Ability to specify the type of assistive devices for rehabilitation.

MD8005  MEDICAL INFORMATICS  L T P C  3 0 0 3

OBJECTIVE
• To study the modern healthcare data standards
• To understand the use of latest technology to share medical records

UNIT I  MEDICAL INFORMATICS  9
Historical highlights and Evolution, Hospital Information System – its characteristics and functional online and offline modules, Health Informatics, Medical Informatics and its six levels of interfaces - Hardware and software requirements, Virtual Hospital, e – health services - Body Area Networks - Health Grid

UNIT II  MEDICAL DATA AND STANDARDS  9
Electronic Patient Record (EPR) - Integrated clinical data - Biosignal and Medical image formats - Medical data storage and retrieval techniques – Steganography, - Medical Standards – HL7, DICOM - IEEE 1073 - IRMA - LOINC - ICD10 - Medical standard organizations
UNIT III  SOFT COMPUTING
Fuzzy logic – its applications in Medicine, Physiological System Modeling and Simulation, Virtual Reality and Multimedia Applications in Medicine, Biometrics - Biometric Devices - Physiological Characteristic Devices - Behavioral Characteristic Devices - Feature extraction and Decision making - Social issues

UNIT IV  JAVA PROGRAMMING
Design and Development of Hospital Information Systems – Developing front-end, back-end and Client – Server interface programs in Java Environment – SQL

UNIT V  INTERNET AND WEB
Medical Networks - Java script programming - Web Design and programming - Design of Web portal services in medicine.

TOTAL: 45 PERIODS

REFERENCES:

OUTCOME:
The student understands the various aspects of informatics applied in health industry so that quality of health care is improved.

MD8006  WAVELET TRANSFORMS AND ITS APPLICATIONS

OBJECTIVE:
- To introduce the fundamentals concepts of wavelet transforms.
- To study system design using Wavelets
- To learn the different wavelet families & their applications.

UNIT I  INTRODUCTION TO WAVELETS
Introduction to Multirate signal processing- Decimation and Interpolation, Quadrature Mirror Filters, Subband coding, Limitations of Fourier transform, Short time Fourier transform and its drawbacks, Continuous Wavelet transform, Time frequency representation, Wavelet System and its characteristics, Orthogonal and Orthonormal functions and function spaces.
UNIT II   MULTIRESOLUTION CONCEPT AND DISCRETE WAVELET TRANFORM  
Multiresolution formulation of wavelet systems - signal spaces, scaling function, wavelet function and its properties, Multiresolution analysis, Haar scaling and wavelet function, Filter banks - Analysis and Synthesis, 1D and 2D Discrete wavelet transform, Wavelet Packets, Tree structured filter bank, Multichannel filter bank, Undecimated wavelet transform.

UNIT III   WAVELET SYSTEM DESIGN  
Refinement relation for orthogonal wavelet systems, Restrictions on filter coefficients, Design of Daubechies orthogonal wavelet system coefficients, Design of Coiflet and Symlet wavelets.

UNIT IV   WAVELET FAMILIES  

UNIT V   WAVELET APPLICATIONS  
Denoising of Signals and Images, Image enhancement, Edge detection, Image Fusion, Image compression, Wavelet based feature extraction, Analysis of phonocardiogram signals, Analysis of EEG signals, Speech enhancement for hearing aids.

TOTAL: 45 PERIODS

REFERENCES:

OUTCOME:  
The students will be able to apprehend the detailed knowledge about the Wavelet transforms & its applications.

AP8074   DSP INTEGRATED CIRCUITS   L T P C  
3 0 0 3

OBJECTIVES:
- To familiarize the concept of DSP and DSP algorithms.
- Introduction to Multirate systems and finite wordlength effects
- To know about the basic DSP processor architectures and the synthesis of the processing elements
- To gather an idea about the VLSI circuit layout design styles.
UNIT I  INTRODUCTION TO DSP INTEGRATED CIRCUITS  

UNIT II  DIGITAL FILTERS AND FINITE WORD LENGTH EFFECTS  
FIR filters, FIR filter structures, FIR chips, IIR filters, Specifications of IIR filters, Mapping of analog transfer functions, Mapping of analog filter structures, Multirate systems, Interpolation with an integer factor L, Sampling rate change with a ratio L/M, Multirate filters. Finite word length effects -Parasitic oscillations, Scaling of signal levels, Round-off noise, Measuring round-off noise, Coefficient sensitivity, Sensitivity and noise.

UNIT III  DSP ARCHITECTURES  
DSP system architectures, Standard DSP architecture-Harvard and Modified Harvard architecture. TMS320C54x and TMS320C6x architecture, Motorola DSP56002 architecture, Ideal DSP architectures, Multiprocessors and multicomputers, Systolic and Wave front arrays, Shared memory architectures.

UNIT IV  SYNTHESIS OF DSP ARCHITECTURES AND ARITHMETIC UNIT  
Synthesis: Mapping of DSP algorithms onto hardware, Implementation based on complex PEs, Shared memory architecture with Bit – serial PEs. 
Arithmetic Unit : Conventional number system, Redundant Number system, Residue Number System, Bit-parallel and Bit-Serial arithmetic, Digit Serial arithmetic, CORDIC Algorithm, Basic shift accumulator, Reducing the memory size, Complex multipliers, Improved shift-accumulator.

UNIT V  CASE STUDY-INTEGRATED CIRCUIT DESIGN  
Layout of VLSI circuits, Layout Styles, Case Study: FFT processor, DCT processor and Interpolator.

TOTAL: 45 PERIODS

REFERENCES:  

OUTCOMES:  
• Get to know about the Digital Signal Processing concepts and it’s algorithms  
• Get an idea about finite wordlength effects in digital filters  
• Concept behind multirate systems is understood.  
• Get familiar with the DSP processor architectures and how to perform synthesis of processing elements  
• Acquire an general idea about VLSI circuit layout design aspects
OBJECTIVES:
• To introduce concepts of materials, surface and tissue placement in biomaterial functions
• To understand diverse elements controlling biological responses to materials
• To provide contemporary biomaterial principles

UNIT I INTRODUCTION
Definition of biomaterials, mechanical properties, surface chemistry of materials, surface modification, Tissue Reaction, Wound Kinetics, Bio Compatibility.

UNIT II MATERIALS IN MEDICAL DEVICES
Metals, Ceramics, Polymers and Composites. Material preparation, chemical composition, Properties, uses in medicine and biosciences and failure mechanisms.

UNIT III STERILIZATION OF BIOMATERIALS

UNIT IV TESTING OF MATERIALS
Testing with Tissue Culture – in vitro and in vivo assessment of biocompatibility, Testing with Soft Tissues and testing at non Thrombogenic surface – blood compatibility and thrombogenicity.

UNIT V HARD AND SOFT REPLACEMENT
Cardiac Implants, Orthopedic Implants, Neuro Muscular Implants, Transcutaneous Implants, Intraocular lenses.

REFERENCES:

OUTCOMES:
• Widen rational design approaches to biomaterials engineering
• Identify significant gap required to overcome challenges and further development
• Develop critical analyses of biomaterials through proposal writing and review.

OBJECTIVES:
• To get the clear understanding of application of mechanics in medicine.
• To study the properties of blood, bone and soft tissues like articular cartilage tendons and ligaments,
• To gain necessary knowledge about accident and injuries.
UNIT I  INTRODUCTION 9
Introduction to bio-mechanics, relation between mechanics and Medicine, Newton's laws, stress, strain, shear rate, viscosity, visco elasticity, non Newtonian viscosity, soft tissue mechanics, mechanical properties of soft biological tissues. biofluid mechanics.

UNIT II  MECHANICS OF CIRCULATION 9
Flow properties of blood, effect of shear rate, hematocrit, temperature and protein Content of blood, rheology of blood and micro vessels, dynamics of circulatory system, turbulence flow around prosthetic heart valves.

UNIT III  MECHANICS APPLIED TO ORTHOPAEDICS 9
Orthopedic biomechanics, mechanical properties of bones, stress induced bone growth, kinematics and kinetics of joints, lubrication of joints, and analysis of force in orthopedic implants.

UNIT IV  MECHANISM OF BIOLOGICAL SYSTEMS 9
Skeletal muscles servo mechanism, Cardio vascular control mechanism, respiratory control mechanism

UNIT V  BIO MECHANICAL ASPECT OF ACCIDENT INVESTIGATION 9
Experimental and Analytical method of analysis, Clinical evaluation, Head Injury tolerance, rotational injury, spine injury – Accident reconstruction, Analysis of impact, skid analysis – Damage analysis.

TOTAL: 45 PERIODS

REFERENCES:

OUTCOMES:
The study of mechanical properties of biological tissues and the properties of blood give us a wide understanding about its structure and when it undergo wear and when it fails so many precautions can be given by ourselves to elders. The knowledge gained will be helpful in doing research in properties of hard tissues like bones and to generate a mathematical mode of bone structure etc.

BO8253  REHABILITATION ENGINEERING L T P C 3 0 0 3

OBJECTIVES:
• To develop an understanding of the various rehabilitation aid principle and its working.
• To give various information about rehabilitation medicine and Advocacy.

UNIT I  PROSTHETIC AND ORTHOTIC DEVICES 9
Hand and arm replacement, different types of models for externally powered limb prosthetics, Lower limb, Upper limb orthotics, and material for prosthetic and orthotic devices, mobility aids.

UNIT II  AUDITORY AND SPEECH ASSIST DEVICES 9
Types of deafness, hearing aids, application of DSP in hearing aids, Cochlear implants, Voice synthesizer, speech trainer.
UNIT III VISUAL AIDS
Ultra sonic and laser canes, Intra ocular lens, Braille Reader, Tactile devices for visually challenged, Text voice converter, screen readers.

UNIT IV MEDICAL STIMULATOR
Muscle and nerve stimulator, Location for Stimulation, Functional Electrical Stimulation, Sensory Assist Devices, Design issues.

UNIT V REHABILITATION MEDICINE AND ADVOCACY
Physiological aspects of Function recovery, Psychological aspects of Rehabilitation therapy, Legal aspect available in choosing the device and provision available in education, job and in day-to-day life.

REFERENCES:
3. Levine, S.N. Editor, Advances in Bio Medical Engineering and Medical Physics, Inter University Publication, New York 1968.

OUTCOME:
- By the end of this course the student will be able to design rehabilitation aid and apply them with confidence, to help the challenged people.

MD8071 ADVANCED NEURAL COMPUTING L T P C
3 0 0 3

OBJECTIVES:
The course will teach a variety of contemporary approaches to neural networks and introduce the theory underlying these approaches. The approaches to be covered will include such things as biological and statistical foundations of neural networks, Perception, MLPs, RBFN, SVM and competitive learning. Additionally, a brief introduction to optimization techniques using Genetic algorithm and its applications will be given.

UNIT I INTRODUCTION TO ARTIFICIAL NEURAL SYSTEMS
Biological Neurons and their Artificial models, Models of Artificial Neural Networks, Learning and Adaptation, Neural Network Learning Rules, Single Layer Perceptron Classifiers.

UNIT II BPN AND BAM

UNIT III OTHER NETWORKS
UNIT IV  GENETIC ALGORITHMS & IMPLEMENTATION TECHNIQUES  8
The Appeal of Evolution, Search Spaces and Fitness Landscapes, Elements of Genetic Algorithms,
Data Structures, Adaptive Encoding. Selective Methods, Genetic Operators, Fitness Scaling, GA
applications

UNIT V  ADVANCES AND APPLICATIONS  10
Support Vector Machines, R B F Network, Neocognitron Evolving neural networks using GA,
Applications of ANN in biomedical signal analysis and Medical image analysis
TOTAL :45 PERIODS

REFERENCES:
   1993.
2. David Goldberg, Genetic Algorithms in Search, Optimization and Machine Learning, Addison -
   Wesley USA,1997.
   1998.

OUTCOME:
• Upon completion of this course student gained knowledge about various neural networks that can
  be used for biomedical signal analysis and Medical image analysis & also about the genetic
  algorithms as well as techniques used in its implementation.

MD8072  ADVANCED NEURAL ENGINEERING  L T P C
3 0 0 3

OBJECTIVES :
• Neural engineering and rehabilitation research applies neuroscience and engineering methods to
  analyze central and peripheral nervous system function and to design clinical solutions to
  neurological disorders or injury.
• To study the basics of Nervous system
• To understand the development and arrangement of neural tissue
• To study the neuronal disorders and injuries
• To study the repairing and reconstruction mechanism of nervous system.

UNIT I  BASICS OF NERVE  9
Development of Nervous system – Neurotrophic Factors, Extracellular Matrix components in Nervous
system development – Neuron & Glial cells Structure, Classifications and Functions – Myelination –
Neurotransmitter; types & functions – Action potential - Transport of impulse and materials in
neurons – NMJ - Neural control of movement – Sensory Feedback Mechanism.

UNIT II  BRAIN, BRAIN STEM AND SPINAL CORD  9
Brain: Lobes - Cortical Areas – Brain Circuits – Memory – Sleep - Brains Stem: Structure and Control
areas – Cerebellum - dyslexia. Spinal cord: Structure and Functions. Concepts of Nuclei, Ganglia and
Neurophysiology and neural control of genitourinary function.
UNIT III  NEURON TRACING  9

UNIT IV  NERVE INJURY AND DISORDERS  9

UNIT V  NEURAL ENGINEERING  9

TOTAL: 45 PERIODS

REFERENCES:

OUTCOME:
Through this course of study application of basic science and engineering techniques, neural engineers can develop methods to record from and exert control over the nervous system and associated organ systems.

MD8073  BIOMEMS  L T P C
3 0 0 3

OBJECTIVES:
To understand
- Various MEMS fabrication techniques.
- Different types of sensors and actuators and their principles of operation at the micro scale level.
- Application of MEMS in different field of medicine.

UNIT I  MEMS MATERIALS AND FABRICATION  9
Typical MEMs and Microsystems, materials for MEMS - active substrate materials- Silicon and its compounds, Silicon piezoresistors, Gallium Arsenide, quartz, polymers. Micromachining-photolithography, thin film deposition, doping, etching, bulk machining, wafer bonding, LIGA

UNIT II  MECHANICAL AND THERMAL SENSORS AND ACTUATORS  9
Mechanics for MEMs design- static bending of thin plates, mechanical vibration, thermomechanics, fracture and thin film mechanics. Mechanical sensors and actuators – beam and cantilever – microplates, strain, pressure and flow measurements, Thermal sensors and actuators- actuator based on thermal expansion, thermal couples, thermal resistor, Shape memory alloys- Inertia sensor, flow sensor
UNIT III ELECTROSTATIC AND PIEZOELECTRIC SENSORS AND ACTUATORS
 Parallel plate capacitor, pull in effect, Electrostatic sensors and actuators- Inertia sensor, Pressure sensor, flow sensor, tactile sensor, comb drive. Properties of piezoelectric materials, Piezoelectric sensor and actuator – inchworm motor, inertia sensor, flow sensor. Case study: Design of electrostatic actuator

UNIT IV MICROFLUIDIC SYSTEMS
 Fluid dynamics, continuity equation, momentum equation, equation of motion, laminar flow in circular conduits, fluid flow in microconduits, in submicrometer and nanoscale. Microscale fluid, expression for liquid flow in a channel, fluid actuation methods, dielectrophoresis, microfluid dispensor, microneedle, micropumps-continuous flow system, micromixers , Case study: Design of electrophoretic microcapillary network system.

UNIT V APPLICATIONS OF MEMS IN MEDICINE
 CAD for MEMs, Biological MEMS materials, polymer based gas sensor, micro total analysis systems (MicroTAS) detection and measurement methods, microsystem approaches to polymerase chain reaction (PCR).DNA sensor, Drug delivery- Types of reservoirs, Case study: Design of BP sensor.

TOTAL: 45 PERIODS

REFERENCES:

OUTCOMES:
- Ability to specify the design issues related to different types of sensors and actuators at micro scale level
- Capability to specify the choice of the material for any application
- Capable of applying the concepts to the design of different types of micro systems with the help of CAD tools

MD8074 COMPUTER BASED MEDICAL INSTRUMENTATION

OBJECTIVES:
- To teach PC hardware and its related interfacing
- To give a complete overview of 80186, 80286, 80386 and 80486 microprocessors.
- To understand the basics of computerized data acquisition and programming.
- To enrich the students knowledge with biometrics and network security.
UNIT I PC HARDWARE AND OVERVIEW
System Unit - Overview of Mother Boards - Processors, Memory, Adapter cards, Ports, Power supply - BIOS – DOS interaction, POST, Functional and Architecture Block diagram of a PC, Mother Board logics - Memory and I/O map

UNIT II PROCESSORS AND MEMORY
80X86 Processors - Architectures and Memory management - Overview of 80X86 based Mother boards

UNIT III PERIPHERAL INTERFACING AND CONTROLLERS
Keyboard and Mouse Interfaces - Memory types - RAM - SDRAM and RDRAM, Cache memory, ROM and its types, Flash memory, CMOS semiconductor memory - Adapter Cards - Sound Card, Modem card, Video card, Network Card - I/O slots - ISA, PCI and AGP bus slots - Ports - Serial and Parallel ports, USB, FireWire port, MIDI, SCSI, IrDA, Bluetooth – Connectors - System Bus, ISA, EISA, PCI, AGP and PCI bus - Disk controllers

UNIT IV COMPUTERISED DATA ACQUISITION AND PROGRAMMING
Plug-in-data acquisition and Control Boards, - Data acquisition using GPIB and Serial Interfaces and Programming in C - DSP in Medical applications

UNIT V CAD IN MEDCAL INSTRUMENTATION
FPGA Design Logics - Virtual Bio- Instrumentation in LAB view - Multisim Simulation with bio-amplifiers - Mixed signal SoC applications in biomedical applications

TOTAL :45 PERIODS

REFERENCES:

OUTCOMES:
- Exposed to PC hardware as well as various microprocessor family
- Hardware behind data acquisition
- Scope of virtual reality in health care
- Develop an insight knowledge about the biometrics and network security

MD8075 MEDICAL ETHICS AND STANDARDS
OBJECTIVES:
- Achieve familiarity with some basic ethical framework& understand how these ethical frameworks can help us to think through contemporary questions in medical ethics.
- Students will be able to know about the legal and ethical principles and application of these principles in health care settings & gain knowledge about the medical standards that to be followed in hospitals.
UNIT I  
INTRODUCTION TO MEDICAL ETHICS  
Definition of Medical ethics, Scope of ethics in medicine, American medical Association code of ethics, CMA code of ethics- Fundamental Responsibilities ,The Doctor And The Patient, The Doctor And The Profession, Professional Independence, The Doctor And Society.

UNIT II  
ETHICAL THEORIES & MORAL PRINCIPLES  

UNIT III  
HOSPITAL ACCREDITATION STANDARDS  

UNIT IV  
HOSPITAL SAFETY STANDARDS  

UNIT V  
MEDICAL EQUIPMENT SAFETY STANDARDS  
General requirements for basic safety & essential performance of medical equipments.IEC 60601 standards- Base Standard-general requirement of electrical medical devices, Collateral Standards-EMC radiation protection &programmable medical device system, Particular Standards-type of medical device

REFERENCES  
4. Physical Environment Online: A Guide to The Joint Commission’s Safety Standards is published by HCPro, Inc. 2010  

OUTCOMES:  
Upon completion of this course the student should be able to demonstrate a measurable increase in their knowledge, skills and abilities related to:  
- Legal and professional guidelines for the health professions  
- Public duties and consent  
- Guidelines to obtain medical standards in hospitals

MD8076  
MEDICAL OPTICS  
L T P C  
3 0 0 3

OBJECTIVE:  
The objectives of this course are to: (i) provide a possibility for the student to acquire knowledge about the physical properties of light and its impact and interaction with biological tissue in terms of optical properties, instrumentation in photonics, through the use and design of appropriate optical components; (ii) understand the engineering and practical applications of optics related to diagnostics, sensing and therapeutics of the human body.
UNIT I   OPTICAL PROPERTIES OF THE TISSUES  
Refraction, Scattering, absorption, light transport inside the tissue, tissue properties, Light interaction with tissues, opto-thermal interaction, fluorescence.

UNIT II  INSTRUMENTATION IN PHOTONICS  
Instrumentation for absorption, scattering and emission measurements, excitation light sources – high pressure arc lamp, solid state LEDs, Lasers, optical filters, solid state detectors - optical detectors - time resolved and phase resolved detectors.

UNIT III  SURGICAL APPLICATIONS OF LASERS  
Laser in tissue welding, lasers in dermatology, lasers in ophthalmology, otolaryngology, urology.

UNIT IV  DIAGNOSTIC APPLICATIONS  
Optical coherence tomography, Elastography, Fluorescence Imaging, Raman Imaging, FLIM.

UNIT V  THERAPEUTIC APPLICATIONS  
Phototherapy, Photodynamic therapy (PDT) - Principle and mechanism - Oncological and non-oncological applications of PDT - Biostimulation effect – applications.

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES

OUTCOME:
• Able to know the various optical properties of tissue as well as application of lasers in medical fields

MD8077   NANOMEDICINE PRINCIPLES AND APPLICATIONS  L   T   P   C
3   0   0   3

OBJECTIVE:
• To know basic nanotechnological principles and characterization methods
• To understand the essential features of biology and nanotechnology that are converging to create the new areas of bionanotechnology and nanomedicine.

UNIT I    INTRODUCTION OF NANOPARTICLES  
Overview of nanotechnology from medical perceptive, different types of nanobiomaterials and nanostructure interactions. Synthesis, characterization, and properties smart nanomaterials, Surface modification, biofunctionalization of nanomaterials.Nanocarriers (e.g. liposomes, polymer capsules, polymer nanoparticles, porous materials, nanogels, dendrimers, microemulsions, inorganic nanoparticles, carbon nanotubes, lipoproteins, solid lipid nanoparticles)
UNIT II PROTEIN AS NANOSTRUCTURES
Protein based nanostructures building blocks and templates – Proteins as transducers and amplifiers – nanobioelectronic devices and polymer nanocontainers – microbial production of inorganic nanoparticles – magnetosomes.

UNIT III DNA AS NANOSTRUCTURES
DNA based nanostructures – Topographic and Electrostatic properties of DNA – Hybrid conjugates of gold nanoparticles – DNA oligomers – use of DNA molecules in nanomechanics

UNIT IV NANOPARTICLES IN DIAGNOSIS
Introduction to nanoparticles in diagnostics— nuclear imaging, optical imaging, PET, Micro PET, cardiovascular disease studies, imaging and therapy of thrombosis, emerging Ethical issues and toxicology of nanomaterials

UNIT V NANTHERAPEUTICS
Nanoparticles as carriers in drug delivery- design, manufacture and physiochemical properties, transport across biological barriers, nanotechnology in Cancer therapy, lung infectious disease, bone treatment, nano particles for oral vaccination and skin disease.

TOTAL: 45 PERIODS

REFERENCES:

OUTCOME:
The student will be able to follow the newest findings in the area of nanomedicine and implement the perspectives in own research.

MD8078 PATTERN RECOGNITION TECHNIQUES AND APPLICATIONS L T P C
3 0 0 3

OBJECTIVE:
• The objective of this course is to enable the students to understand the fundamentals of Pattern recognition.
• The students should learn to choose an appropriate feature, pattern classification algorithm for a pattern recognition problem, properly implement the algorithm.
• To enrich the students knowledge with fuzzy systems and its applications

UNIT I OVERVIEW OF PATTERN RECOGNITION

UNIT II UNSUPERVISED CLASSIFICATION
Clustering for unsupervised learning and classification, clustering concepts hierarchical clustering, Partitional clustering, k- means algorithm - Validity of clustering solutions.
UNIT III  FEATURE EXTRACTION AND STRUCTURAL PATTERN RECOGNITION  9

UNIT IV  FUZZY SYSTEMS  9

UNIT V  RECENT ADVANCES AND APPLICATIONS  9

REFERENCES:

OUTCOMES:
• Develop an idea about the fundamentals of Pattern recognition.
• Acquire the knowledge of fuzzy systems & its applications.
• Recent advancements in life science & technology using Fuzzy techniques

MD8079  PHYSIOLOGICAL MODELLING  L T P C
3 0 0 3

OBJECTIVES:
• To understand the fundamental engineering aspects of modelling Physiological systems
• To utilize concepts derived from biomedical research to aid in the design of engineering systems.
• To apply system techniques and methods to biomedical problems.

UNIT I  INTRODUCTION TO SYSTEM CONCEPTS  9

UNIT II  TRANSFER FUNCTION  9
System as an Operator, Transfer Function of First and Second Order system, Transfer Function and Concept of Impedance – Circuits into transfer function, Circuit Analog from transfer function.
UNIT III   SYSTEM RESPONSE CHARACTERISTICS

UNIT IV   FEEDBACK
Feedback and Homeostasis, Review of system stability concepts, Hypophysis – Adrenal Feedback Control System, Thermoregulation, Pupil Control System.

UNIT V   SIMULATION OF BIOLOGICAL SYSTEMS
Introduction to Simulation, Simulation of Respiratory mechanics, Cardiovascular Control System, Skeletal muscle servo mechanism, Oculomotor System, Hodgkin Huxley Model.

TOTAL : 45 PERIODS

REFERENCES:

OUTCOME:
- Provides an insight into and understanding of the utilization of models, system analysis and analog simulation in the field of bioengineering.

MD8080   PRINCIPLES OF GENETIC ANALYSIS

OBJECTIVE:
- Completion of this subject is expected to enhance a student's ability to understand the fundamental principles of genetics and to describe the experiments used to establish them. Students will develop skills to apply these principles to solve genetic problems and demonstrate how genetic analysis can be used to investigate aspects of biology.

UNIT I   GENETIC INHERITANCE
Organisation of DNA, Chromosomal inheritance, Eukaryotic genomes – repetitive and non repetitive sequence, Genetic mapping - restriction cleavage, RFLP and SNPs.

UNIT II   DNA AND PHENOTYPE
DNA structure and replication, DNA sequencing, amplification and hybridisation. DNA Polymorphism, RNA transcription and processing, translation and its post translation modification. Regulation of gene expression.

UNIT III   ENGINEERING OF GENES
Gene isolation and manipulation, mutations, repair and recombination, site directed mutagenesis, in vivo techniques of genetic manipulation, tools for analysing gene expression and genetically modified organisms.
UNIT IV  HUMAN GENOME PROJECT
Human Genome Project (HGP) – an overview of the project, goals of the project, major scientific strategies & approaches used in HGP, physical mapping, gene ontology, gene annotation, techniques in HGP – microsatellite markers, STS, EST, DNA sequencing and DNA microarray, scientific & medical benefits of this project.

UNIT V  IMPACT OF GENETIC VARIATION
Population Genetics, Quantitative Genetics, Evolution Genetics.

TOTAL: 45 PERIODS

REFERENCES:

OUTCOMES:
- Interpret different forms of inheritance patterns and identify them in genetic data
- acquire in depth knowledge in evolutionary analysis of genetic sequence
- Interpret and critically evaluate the outcomes of statistical analysis associated with the research project
- exploit relevant molecular genetic information with skill and confidence to conduct a research project involving the analysis of real molecular genetic data with minimal supervision

MD8081  TELEHEALTH TECHNOLOGY L T P C

OBJECTIVES:
1. To teach the key principles for telemedicine and health.
2. To make student understand telemedical technology.
3. To enable the students with the knowledge of telemedical standards, mobile telemedicine and its applications.

UNIT I  TELEMEDICINE AND HEALTH
History and Evolution of telemedicine, Functional diagram of telemedicine system, Telemedicine, Tele health, Tele care, Organs of telemedicine, Global and Indian scenario, Ethical and legal aspects of Telemedicine - Confidentiality, Social and legal issues, Safety and regulatory issues, Advances in Telemedicine.

UNIT II  TELEMEDICAL TECHNOLOGY
UNIT III  TELEMEDICAL STANDARDS


UNIT IV  MOBILE TELEMEDICINE

Tele radiology: Definition, Basic parts of teleradiology system: Image Acquisition system Display system, Tele pathology, multimedia databases, color images of sufficient resolution, Dynamic range, spatial resolution, compression methods, Interactive control of color, Medical information storage and management for telemedicine- patient information medical history, test reports, medical images diagnosis and treatment. Hospital information system - Doctors, paramedics, facilities available. Pharmaceutical information system.

UNIT V  TELEMEDICAL APPLICATIONS


TOTAL: 45 PERIODS

REFERENCES:

OUTCOME:
The student is exposed to the
1. Technologies applied in multimedia using telemedicine
2. Protocols behind encryption techniques for secure transmission of data.
3. Applications of telehealth in healthcare
OBJECTIVES:
1. To understand basics of Tissue Engineering
2. To understand fundamentals of cell mechanisms
3. To teach the Physical & biological principles that serve as the scientific basis for understanding the interactions of biological molecules and cells with biomaterials employed for the fabrication of permanent implantable prostheses and as matrices for tissue engineering.
4. To understand application of Tissue Engineering

UNIT I  BASICS OF TISSUE ENGINEERING

UNIT II  FUNDAMENTALS OF CELL MECHANISMS

UNIT III  BIOMATERIALS IN TISSUE ENGINEERING

UNIT IV  STEM CELLS IN TISSUE ENGINEERING
Introduction of Stem cells – Hemopoetic Stem cells - Embryonic Stem cells - Adult stem cells – Cancer Stem cells – Cord Blood cells – Induced Pluripotent Stem cells - Stem cell identification - Surface markers & FACS analysis – Differentiation, Dedifferentiation and Immortalization – Application of stem cells in tissue Engineering.

UNIT V  TISSUE ENGINEERING APPLICATIONS

REFERENCES:

OUTCOMES:
By successfully completing this course, students will have the ability to:
1. Understand the importance of tissue engineering in the field of biomedical engineering
2. Understand the mechanisms involved in interaction of different materials with cells and tissues
3. Explain different methods involved in characterization and preparation of biomaterials in tissue engineering.
4. Apply the knowledge in creating new models in drug delivery systems using synthetic and natural scaffolds
5. Understand different types of stem cells and its application in tissue engineering
6. Develop new approaches to build new tissues using tissue engineering techniques

MD8083    ULTRASOUND PRINCIPLES AND APPLICATIONS IN MEDICINE         L  T  P  C
                                                     3  0  0  3

OBJECTIVES:
- To teach the principles of Ultrasonics and its interaction with tissue.
  Students will be able to know about the scanning techniques and real time scanners
- Principles and application of these principles in health care settings & gain knowledge about the various applications of ultrasound in medicine.

UNIT I     PRINCIPLES OF ULTRASONICS

UNIT II    TISSUE-ULTRASOUND INTERACTION
Introduction, Absorption in biological tissues, Tissue-Ultrasound interaction cross sections, Theory of mechanisms for the absorption of ultrasonic longitudinal waves, Measurement of attenuation and Absorption Coefficients in tissues, Acoustic properties reflecting different levels of tissue organization, Molecular aspects of soft tissue mechanics, Structural contribution to bulk and shear acoustic properties of tissues. Relevance to tissue characterization, Ultrasound quantitation and tissue characterization.

UNIT III   SCANNING TECHNIQUES

UNIT IV    REAL TIME ULTRASONIC SCANNERS
Different modes of display-A mode, B mode, M mode, B-scan System, The Principles of Ultrasound Motion Detection, Techniques for Measuring Target Velocity, Phase Fluctuation (Doppler Methods), Envelope Fluctuation Methods, Phase Tracking Methods, Envelope Tracking Techniques, Ultrasound Imaging Systems, Considerations Specific To Color Flow Imaging, Angle Independent Velocity Motion Imaging, Tissue Elasticity & Echo Strain Imaging, Performance Criteria, Use of Contrast Media, Real Time Echo, 2-D and 3-D Scanners, Color Doppler.

UNIT V     ULTRASOUND APPLICATIONS
Ultrasonic diagnosis in Abdomen, Breast, Thyroid, Heart, Chest, Eye, Kidney, Skull, Pregnant and Non Pregnant uterus, 3-Dimensional Ultrasonic Imaging of The Fetus, Advantages And Limitations of 3-Dimensional Ultrasound.

TOTAL: 45 PERIODS
REFERENCES:

OUTCOMES:
- In-depth knowledge about the Ultrasound imaging systems and its interaction with living systems.
- Ability to specify method of ultrasonic scanning method for imaging different organs
- Proficient knowledge about Real time Scanners and their applications.