PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

I. To integrate concepts in mathematics, science and engineering to solve the problems at the interface of engineering and biology.
II. To gain knowledge about sensors and measurement techniques to acquire and analyse various vital physiological parameters.
III. To understand and analyse the principles of biomedical equipments used in health care.
IV. To prepare the students to apply their knowledge in design, development, simulation, modeling and research related to biomedical systems.
V. To motivate students to become entrepreneurs to develop indigenous biomedical solutions.

PROGRAMME OUTCOMES (POs):
On successful completion of the programme, graduates will demonstrate an ability to

1. Apply mathematical foundations, science and engineering to provide solutions for health care systems.
2. Design and conduct experiments for biomedical data acquisition, analysis and interpretation.
3. Identify, formulate and solve problems related to biomedical engineering.
4. Analyze, model, design and realize biomedical engineering devices, systems, components or processes.
5. Understand the professional and ethical responsibilities.
6. Function on multi-disciplinary teams.
7. Obtain broad education necessary to understand the impact of biomedical engineering solutions in global, economic, environmental and social context.
8. Design and develop low cost indigenous biomedical devices.
9. Pursue research in the field of Biomedical Engineering.
A broad relation between the programme objective and the outcomes is given in the following table:

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TOTAL NO. OF CREDITS: 71

FOUNDATION COURSES (FC)

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## PROFESSIONAL ELECTIVES (PE)

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**EMPLOYABILITY ENHANCEMENT COURSES (EEC)**

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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

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.

TEXT BOOKS:
REFERENCES:

MD7151胡人ANATOMY AND PHYSIOLOGY L T P C
3 0 0 3

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

UNIT II MUSCULOSKELETAL SYSTEM

UNIT III RESPIRATION, NUTRITION AND EXCRETORY SYSTEM

UNIT IV CARDIOVASCULAR AND ENDOCRINE SYSTEM

UNIT V NERVOUS SYSTEM AND SPECIAL SENSES

TOTAL: 45 PERIODS
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

REFERENCES:

MD7101 BIO MEDICAL INSTRUMENTATION

OBJECTIVES:
• To know the various functional blocks present is biosignal acquisition system so that the students 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 nonelectrical 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
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
ECG, EEG, EMG, PCG, EOG, ERG lead system and recording methods, typical waveform, frequency spectrum, abnormal waveform.

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

UNIT IV BLOOD FLOW METER AND BLOOD CELL COUNTER

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

TOTAL: 45 PERIODS

OUTCOMES:
By the completion of this course the student will to
  • Describe various functional blocks present is biosignal acquisition system and to design the data acquisition system.
  • Analyze different biopotential characteristics and recording methods of biosignals.
  • Develop measurement systems by selecting different types of sensors, signal conditioning circuits for acquiring and recording various physiological parameters.
  • Perform biochemical measurement with Confidence.
REFERENCES:

MD7102 BIO SIGNAL PROCESSING

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, non stationary process, fixed segmentation, adaptive segmentation, application in EEG, PCG and HRV signals, 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
Filtering – LMS adaptive filter, adaptive noise canceling in ECG, improved adaptive filtering in FECG, EEG and other applications in Biosignals, Wavelet detection in ECG – structural features, matched filtering, adaptive wavelet detection, detection of overlapping wavelets.

UNIT IV BIOSIGNAL CLASSIFICATION AND RECOGNITION
Signal classification and recognition – Statistical signal classification, linear discriminant function, direct feature selection and ordering, Back propagation neural network based classification. Application in Normal versus Ectopic ECG beats and other Biomedical applications

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

TOTAL: 45 PERIODS

OUTCOMES:
Upon the completion of this course, the students are able
- To analyse the different types of signals & systems
- To analyse signals in time series domain & estimate the spectrum
- To demonstrate the significance of wavelet detection applied in biosignal processing.
- To extract the features using multivariate component analysis.
REFERENCES:

MD7103 MEDICAL EQUIPMENTS

OBJECTIVES:
- To know the various functional blocks present is 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 – Need, different types, electrode types and placement, batteries for pacemakers, Design. AC defibrillators, DC defibrillators - asynchronous and synchronous, Types of waveforms, electrode types and placement, precautions, Patient monitoring system.

UNIT II NEUROLOGY EQUIPMENT

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-IEC-60601 standard, Physiological effects of current, Leakage current, Micro and macro electric shock, GFI units, Earthing Scheme, Electrical safety analyzer.

UNIT IV FIBER OPTICS AND LASER APPLICATIONS

UNIT V RECENT TRENDS
Principles of cryogenic Technique and application , Bio telemetry- Need, Frequency selection, Modulation schemes, Single channel, Multichannel, Multipatient telemetry, principles of Lithotripsy, ophthalmic equipment- slit Lamp, Tonometer, Retinal response Plotter.

TOTAL: 45 PERIODS

OUTCOMES:
On completion of this course the student will be able to:
- Describe the working of pacemakers and defibrillator and related circuits.
- Obtain the domain knowledge of Neurological equipment, Physiotherapy equipment and Laser and ultrasound equipment.
- Identify the electrical hazards in the hospital environment and make it shock free zone.
- Discuss the recent trends in field of diagnostic and therapeutic equipments.
REFERENCES:
1. Albert M Cook and Webster J G – Therapeutic medical devices Prentice Hall New York 1982
3. Leslie Cromwell , Fred J.Weibell and Erich A.Pfeiffer - Biomedical Instrumentation Prentice Hall New Delhi 2000

MD7111 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
1. Design and analysis of bioamplifier using circuit simulation tools
2. Design of preamplifier for acquiring bio signals.
3. Design of instrumentation amplifier using single IC and study of effect of offset potentials and contact impedance in bio potential recording.
4. Study of patient monitoring system and biotelemetry.
5. Recording of Electromyogram and measurement of nerve conduction velocity.
7. Performance and testing of surgical diathermy unit using diathermy analyser.
9. Study of different types of muscle stimulator waveforms.
10. Recording of ECG in standard lead systems.
11. Study of multi parameter simulator.
12. Recording and analysis of EEG in time and frequency domains.
13. Measurement of respiratory parameters using spirometer
TOTAL: 60 PERIODS

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

MM7251 MEDICAL IMAGE PROCESSING L T P C 3 0 0 3
OBJECTIVES:
• To provide information about various medical imaging modalities
• To understand the basic concepts of image enhancement, image restoration, morphological image processing, image segmentation, feature recognition in medical images
• To provide information about classification and image visualization in medical image processing projects
• To familiarize the student with the image processing facilities in Matlab and its equivalent open source tools
UNIT I  FUNDAMENTALS OF IMAGE PROCESSING  
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  BIO-MEDICAL IMAGE PREPROCESSING  
Image Enhancement operations – Image noise and modeling, Image restoration – Image 
degradation model, Inverse and Weiner filtering, Geometric transformations and correction.

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, Medical Imaging 
modalities – SPECT,PET, Molecular Imaging.

UNIT IV  IMAGE ANALYSIS AND CLASSIFICATION  
Image segmentation- pixel based, edge based, region based segmentation. Active contour models 
and Level sets for medical image segmentation, Image representation and analysis, Feature 
extraction and representation, Statistical, Shape, Texture, feature and statistical image 
classification.

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

OUTCOMES:  
Upon Completion of the course, the students should be able to:

- Implement basic medical image processing algorithms
- Familiar with the use of MATLAB and its equivalent open source tools
- Design and implement image processing applications that incorporates different concepts 
of medical Image Processing
- Critically analyze different approaches to implement mini projects in medical domain
- Explore the possibility of applying Image processing concepts in modern hospitals

REFERENCES:
1. Atam P.Dhawan, “Medical Image Analysis’, Wiley Interscience Publication, NJ S.Sridhar, 
   Education, 2008, New Delhi
   Learning 2011, India.
8. Kavyan Najarian and Robert Splerstor,” Biomedical signals and Image processing”,CRC – 
   Taylor and Francis, New York, 2006
9. John L.Semmlow, "Biosignal and Biomedical Image Processing Matlab Based applications" 
   Marcel Dekker Inc., New York,2004
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 AND COMPUTED TOMOGRAPHY  9

UNIT II  EMISSION IMAGING  9
Alpha, Beta, Gamma Emission, different types of Radiation Detectors, G.M. & Proportional Counters, Pulse Height Analysers, Isotopic, Scanners, Principle of PET and SPECT, PET/CT.

UNIT III  MAGNETIC RESONANCE IMAGING  9
Principle of MRI, Relaxation processes and their measurements, Pulse sequencing and MR image acquisition, MRI instrumentation, Magnets, gradient coils, Imaging Different Sections of the Body, Tissue Characterization, MR Spectroscopy, Functional MRI.

UNIT IV  ULTRASOUND IMAGING AND THERMOGRAPHY  9
Wave propagation and interaction in Biological tissues, Acoustic radiation fields, continuous and pulsed excitation, Transducers and imaging systems, Scanning methods, Imaging Modes-A, B & M, Principles and theory of image generation. Thermography- Principle, detectors and applications.

UNIT V  THERAPY USING X – RAYS AND ISOTOPES  9
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.

TOTAL: 45 PERIODS

OUTCOME:
- Will obtain domain knowledge in understanding various Medical Imaging techniques and Therapeutic applications of Radiation.

REFERENCES:
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 modeling

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

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

MD7001 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, PACS.

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
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

需对虚拟现实在医学中的应用，基本概念和类型，虚拟环境，人体因素和人类感知，计算机图形学原理在VR中的应用，建模和虚拟环境的现有工具，头戴式显示的使用。

TOTAL : 45 PERIODS

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

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

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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

UNIT II  ELECTROPHYSIOLOGICAL SOURCES

UNIT III  FEATURE EXTRACTION METHODS
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

Study of BCI Competition III – Dataset I, II, III, IV and V, Functional restoration using
Neuroprosthesis - Functional Electrical Stimulation, Visual Feedback and control - External
device controllers, Case study: Brain actuated control of mobile Robot. Ethical issues in BCI
research

TOTAL: 45 PERIODS

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

REFERENCES:
   and practice”, Edition 1, Oxford University Press, USA, January 2012
2. Special Issue on Brain Control Interfaces, IEEE Transactions on Neural Systems
4. Bernhard Graimann, Brendan Allison, Gert Pfurtscheller, “Brain-Computer Interfaces:
   Revolutionizing Human-Computer Interaction”, Springer, 2010
   Processing algorithms in brain–computer interfaces based on electrical brain
   signals” JOURNAL OF NEURAL ENGINEERING, VOL.4, 2007, PP.32-57
   Rato, Florida.
10. Wolpaw J.R, N.Birbaumer et al, “Brain control interface for Communication and
    EEG”, IEEE Transactions on biomedical Engineering, Vol 51, No.6, 2004 June.
    University, 2000.
    Artificial Neural Networks Laboratory, IIT Bombay, 1996.

MD7003  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, Ambulatory care.
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

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.

REFERENCES:
3. Hans Pfeiff, Vera Dammann (Ed.), Hospital Engineering in Developing Countries, Z Report, Eschborn, 1986

MD7004     HUMAN ASSIST DEVICES

OBJECTIVE:
The objective of this 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
Ventilator and its types-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

TOTAL: 45 PERIODS

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

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

MD7005  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        DECISION MAKING  9
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  9
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  9
Medical Networks - Java script programming - Web Design and programming - Design of Web
portal services in medicine

TOTAL: 45 PERIODS

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

REFERENCES:
1. Ramachandra Lele, Computers in Medicine Progress in Medical Informatics, Tata
McGraw Hill Publishing Company, New Delhi, 2005
New Delhi, 2005
2005
5. Ranjan Parekh, Principles of Multimedia, Tata McGraw Hill Publishing Company, New Delhi,
2006
Delhi, 2006
Education, New Delhi, 2007
TMH 2007

MD7006        WAVELET TRANSFORMS AND ITS APPLICATIONS  L T P C
3 0 0 3

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  9
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 space
UNIT II   MULTiresolution CONCEPT AND DISCRETE WAVELET
TRANSFORM  
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

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

REFERENCES:  

AP7074   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  

22
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

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

REFERENCES:

BO7071 BIO MATERIALS

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 Biomimetic Materials, Composites. Material preparation, chemical composition, Properties, uses in medicine and biosciences and failure mechanisms.

UNIT III STERILIZATION OF BIOMATERIALS

UNIT IV TESTING OF MATERIALS

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

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.

REFERENCES:

BO7251 BIO MECHANICS
L T P C
3 0 0 3

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
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.

TOTAL: 45 PERIODS
UNIT II MECHANICS OF CIRCULATION
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
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
Skeletal muscles servo mechanism, Cardio vascular control mechanism, respiratory control mechanism

UNIT V BIO MECHANICAL ASPECT OF ACCIDENT INVESTIGATION
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

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.

REFERENCES:
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
Hand and arm replacement, different types of models for externally powered limb prosthetics, Lower limb, Upper limb orthotics, materials for prosthetic and orthotic devices, mobility aids, wheel chair.

UNIT II AUDITORY AND SPEECH ASSIST DEVICES
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.

TOTAL: 45 PERIODS

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.

REFERENCES:
3. Levine, S. N. Editor, Advances in Bio Medical Engineering and Medical Physics, Inter University
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  8
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  9

UNIT III  OTHER NETWORKS  10

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
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

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.

REFERENCES:

MD7072 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

UNIT II BRAIN, BRAIN STEM AND SPINAL CORD 9

UNIT III NEURON TRACING 9

UNIT IV NERVE INJURY AND DISORDERS 9
UNIT V  NEURAL ENGINEERING


TOTAL: 45 PERIODS

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.

REFERENCES:

MD7073  BIO MEMS

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

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

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 dispenser, microneedle, micropumps-continuous flow system, micromixers , Case study: Design of elecrophoretic 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

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

REFERENCES:

MD7074 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 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 III PROCESSORS AND MEMORY

80X86 Processors - Architectures and Memory management - Overview of 80X86 based Mother boards
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 MEDICAL INSTRUMENTATION
FPGA Design Logics - Virtual Bio- Instrumentation in LAB view - Multisim Simulation with bio- amplifiers - Mixed signal SoC applications in biomedical application

TOTAL: 45 PERIODS

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

REFERENCES:
8. H M Dietel, Internet and World Wide Web, AB Goldberg publishers, New Delhi, 2007

MD7075 MEDICAL ETHICS AND STANDARDS

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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

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

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

MD7076 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
Refractio, 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, otorlaryngology, 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-octological applications of PDT - Biostimulation effect – applications.

TOTAL: 45 PERIODS

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

TEXT BOOKS:

REFERENCES

MD7077 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, cardio vascular disease studies, imaging and therapy of thrombosis, emerging Ethical issues and toxicology of nanomaterials
UNIT V  NANOTHERAPEUTICS  9
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

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

REFERENCES:

MD7078  PATTERN RECOGNITION TECHNIQUES AND APPLICATIONS  L T P C  3 0 0 3

OBJECTIVES:
• 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  9

UNIT II  UNSUPERVISED CLASSIFICATION  9
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

TOTAL: 45 PERIODS
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

REFERENCES:

MD7079 PHYSIOLOGICAL SYSTEMS MODELING AND SIMULATION  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 9

UNIT IV FEEDBACK 9
Feedback and Homeostasis, Review of system stability concepts, Hypophysis – Adrenal Feedback Control System, Thermoregulation, Pupil Control System.

UNIT V SIMULATION OF BIOLOGICAL SYSTEMS 9
Introduction to Simulation, Simulation of Respiratory mechanics, Cardiovascular Control System, Skeletal muscle servo mechanism, Oculomotor System, Hodgkin Huxley Model.

TOTAL : 45 PERIODS
OUTCOMES:
Provides an insight into and understanding of the utilization of models, system analysis and analog simulation in the field of bioengineering.

REFERENCES:

MD7080 PRINCIPLES OF GENETIC ANALYSIS L T P C

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

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

36
REFERENCES:

MD7081            TELEHEALTH TECHNOLOGY                      L T P C
                      3 0 0 3

OBJECTIVES:
• To teach the key principles for telemedicine and health.
• To make student understand telemedical technology.
• 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

OUTCOME:
The student is exposed to the
- Technologies applied in multimedia using telemedicine
- Protocols behind encryption techniques for secure transmission of data.
- Applications of telehealth in healthcare

REFERENCES:

MD7082  TISSUE ENGINEERING  L  T  P  C
3  0  0  3

OBJECTIVES:
- To understand basics of Tissue Engineering
- To understand fundamentals of cell mechanisms
- 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.
- 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 – Hem poetic 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
Synthetic components – Artificial organs – Joints and dental prostheses - Connective Tissue Engineering – Cardiovascular Tissue Engineering – Neural Tissue Engineering - Cell and Drug Delivery systems

TOTAL: 45 PERIODS

OUTCOMES:
By successfully completing this course, students will have the ability to:
- Identify the importance of tissue engineering in the field of biomedical engineering
- Explain the mechanisms involved in interaction of different materials with cells and tissues
- Explain different methods involved in characterization and preparation of biomaterials in tissue engineering.
- Apply the knowledge in creating new models in drug delivery systems using synthetic and natural scaffolds
- Analyse different types of stem cells and its application in tissue engineering

REFERENCES:
5. Develop new approaches to build new tissues using tissue engineering techniques

MD7083 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  ULTRASONIC APPLICATIONS
Ultrasound 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

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.

REFERENCES:
OBJECTIVES:
The student should be made to:
- Learn about wireless body area networks and different hardware related to it
- Study about sensors and its application in wearable systems

UNIT I INTRODUCTION
Definition, BAN and Healthcare, Technical Challenges- Sensor design, biocompatibility, Energy Supply, optimal node placement, number of nodes, System security and reliability, BSN Architecture – Introduction

UNIT II HARDWARE FOR BAN

UNIT III WEARABLE SENSORS
Need for wearable systems, Sensors for wearable systems-Inertia movement sensors, Respiration activity sensor, Inductive plethysmography, Impedance plethysmography, pneumography, Wearable ground reaction force sensor, GSR, Radiant thermal sensor, Wearable motion sensors, CMOS -Based Biosensors, E-Textiles, Bio compatibility.

UNIT IV SIGNAL PROCESSING
Wearability issues -physical shape and placement of sensor, Technical challenges - sensor design, signal acquisition, Constraint on sampling frequency for reduced energy consumption, light weight signal processing, Rejection of irrelevant information, Data mining

UNIT V APPLICATIONS
Monitoring patients with chronic disease, Hospital patients, Elderly patients, Cardiac arrhythmias monitoring, Multi patient monitoring systems, Multichannel Neural recording, Gait analysis, Sports Medicine, Electronic pill

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course, the student should be able to:
- Explain about working of wireless Body Area Network
- Discuss the applications of WBAN
- Explain need of wireless health systems and the application of wearable systems

TEXT BOOK:
REFERENCES: