PROGRAMME OBJECTIVES

The students will learn and gain knowledge:
1. In the use of different types of sensors and measurement of various physiological parameters
2. About various imaging modalities used in the hospitals
3. In the application of basic processing techniques for the analysis of these signals
4. About the functions of biomedical engineer in the hospital for the proper functioning and management of hospital
5. In some of the latest techniques that can be applied to research.
### Semester I

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UNIT I  FUZZY LOGIC
Classical logic – Multivalued logics – Fuzzy propositions – Fuzzy quantifiers.

UNIT II  MATRIX THEORY

UNIT III  ONE DIMENSIONAL RANDOM VARIABLES

UNIT IV  DYNAMIC PROGRAMMING

UNIT V  QUEUEING MODELS

REFERENCES:

MX7101  HUMAN 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 TO HUMAN ANATOMY & PHYSIOLOGY
UNIT II BUILDING BLOCKS OF HUMAN BODY

UNIT III ENERGY PRODUCING SYSTEMS IN HUMAN BODY

UNIT IV TRANSPORTER AND EXCRETORY SYSTEM

UNIT V CONTROLLING AND COORDINATING SYSTEMS IN HUMAN BODY

TOTAL: 45 PERIODS

OUTCOME:
The student will be in a position to specify the anatomy of organs and the physiology of various systems of the body.

REFERENCES:

DS7002 BIO SIGNAL PROCESSING

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-PCA, ICA

TOTAL: 45 PERIODS

REFERENCES:

BM7101  BIOMEDICAL SENSORS AND INSTRUMENTATION

OBJECTIVES:
- To study the basic characteristics of measurement system.
- To study the different types of transducers, electrodes and signal conditioning circuits.
- To study the techniques used for measurement of various non electrical physiological parameters.
- To know the different types of display and recording devices.
UNIT I  TRANSDUCERS
Characteristics - Static, Dynamic, Errors in the measurements, Classification of transducers - Resistive, Capacitive, Inductive, Photoelectric, piezoelectric and mechno-electronics.

UNIT II  ELECTRODES & AMPLIFIERS

UNIT III  CHEMICAL AND OPTICAL TRANSDUCERS
PH, PO2, PCO2, HCO3 electrodes, Ion sensor, Anion and Cation sensor, Liquid and solid ion exchange membrane electrode, Enzyme electrode, Principle of fiber optic cable, fiber optic sensors, Photo acoustic sensors.

UNIT IV  NON ELECTRICAL PARAMETERS MEASUREMENTS
Measurements of Respiration Rate, Temperature, Pulse rate, Blood pressure Measurements- Direct, Indirect, Blood flow Measurements – Invitro, Invivo, Gas flow measurements.

UNIT V  BIO POTENTIAL RECORDING
ECG, EEG, EMG, PCG, EOG, lead system and recording methods, typical waveform, frequency spectrum, abnormal waveforms. Evoked response.

TOTAL: 45 PERIODS

OUTCOME:
Will get the clear domain knowledge about various measurement systems includes different types of sensors, electrodes, signal conditioning circuits for acquiring and recording various physiological parameters.

REFERENCES:

BM7102  MEDICAL IMAGING SYSTEMS  L T P C
3 0 0 3

OBJECTIVE
• To study the production of x-rays and its application to different medical Imaging techniques.
• 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 study the imaging of soft tissues using ultrasound technique.
UNIT I PRINCIPLES OF RADIOGRAPHIC EQUIPMENTS  8
X-Ray tubes, cooling systems, removal of scatters, construction of image Intensifier tubes, angiographic setup, digital radiology.

UNIT II COMPUTER AIDED TOMOGRAPHY  10
Need for sectional images, Principles of sectional scanning, Method of convolution and Back-Propagation, Methods of reconstruction, Artifacts, Principle of 3D imaging

UNIT III RADIO ISOTOPIC IMAGING  9
Radiation detectors, Radio isotopic imaging equipments, scanners, Principle of semiconductor detectors, Gamma ray camera, Positron Emission tomography. SPECT.

UNIT IV ULTRASONIC SYSTEMS  9
Wave propagation and interaction in Biological tissues, Acoustic radiation, continuous and pulsed excitation, Transducers and imaging systems, Scanning methods, Principle of image generation.

UNIT V MAGNETIC RESONANCE IMAGING  9
Principles of MRI, Relaxation processes and their measurements, Pulse sequencing and MR image acquisition.

TOTAL: 45 PERIODS

OUT COME
• Will get the clear domain knowledge in understanding the various Medical Imaging techniques and its diagnostic applications.

REFERENCES:

BM7111 CLINICAL INSTRUMENTATION LABORATORY  L T P C
0 0 3 2

OBJECTIVES:
• To enable the students to know about the measurements and recording of Bioelectric and Bio Chemical Signals.
• To study the different preamplifiers used for amplifying the Bio Signals

LIST OF EXPERIMENTS
1. Operational Amplifier-various amplifier configurations
2. Study of Timer circuit, Study of FSK modulation and demodulation
3. Design and testing of Bio-Amplifiers
4. Recording of ECG signal
5. Recording of Electromyogram.
6. Study of ECG machine, Study of EEG machine
7. Audiometer
8. Recording of various physiological parameters using patient monitoring system and telemetry units
9. Study and analysis of functioning and safety aspects of surgical diathermy
10. Bio-chemical measurements

TOTAL: 45 PERIODS
OUTCOMES:
- Able to measure some of Bio-Chemical Signals
- Able to analyse the bio signals

BM7201 Applied Medical Image Processing

OBJECTIVES:
- To understand the fundamentals of medical image processing techniques.
- To develop computational methods and algorithms to analyze and quantify biomedical data

UNIT I IMAGE FUNDAMENTALS AND PRE-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. Image enhancement – point operation, Histogram modeling, spatial operations, Transform operations,

UNIT II BASICS OF MEDICAL IMAGE SOURCES
- Radiology- The electromagnetic spectrum-Computed Tomography-Magnetic Resonance Tomography – ultrasound-nuclear medicine and molecular imaging-other imaging techniques-radiation protection and dosimetry.

UNIT III MEDICAL IMAGE REPRESENTATION
- Pixels and voxels – algebraic image operations - gray scale and color representation- depth-color and look up tables - image file formats- DICOM- other formats- Analyze 7.5, NifTI and Interfile, Image quality and the signal to noise ratio- MATLAB based simple operations.

UNIT IV MEDICAL 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 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.

TOTAL: 45 PERIODS

OUTCOMES:
- Students will be able to apply image processing concepts for medical images.
- Will be able to analyze Morphology, Segmentation techniques and implement these in images.
- Enables quantitative analysis and visualization of medical images of numerous modalities such as PET, MRI, CT, or microscopy.
REFERENCES:

BM7202 DIAGNOSTIC AND THERAPEUTIC EQUIPMENTS

OBJECTIVES:
1. To know the various biopotential recordings so as to enable students to record various biosignals.
2. To know the various functional blocks present in cardiac care units so that the students can handle these equipments with care and safety.
3. To develop an understanding of the physiotherapy and diathermy equipment so that the student can learn to operate.
4. To study the concept of various assist devices so as to enable the students to develop new assist devices.
5. To introduce the recent trends in field of diagnostic and therapeutic equipments.

UNIT I CARDIAC CARE UNITS
Pacemakers – Need for pacemaker, different types and their comparison, batteries for pacemakers. Defibrillator- Need, AC defibrillators and demerits, DC Defibrillator, asynchronous and synchronous DC defibrillators, Hazards and safety issues, patient monitoring system.

UNIT II ASSIST DEVICES

UNIT III STIMULATORS
Electrical stimulators: Strength-duration curve, types of stimulators, an electrodiagnostic / therapeutic stimulator. Nerve-muscle stimulator: peripheral nerve stimulator, Ultrasonic stimulators, stimulators for pain and relief.
UNIT V   PATIENT MONITORING SYSTEMS

UNIT V   RECENT DEVICES
Principles and application of thermography, Detection circuits, Principles of cryogenic Technique and application, principles of Fiber optics cables, Endoscopy, Laparoscopy, principles of Lithotripsy.

TOTAL: 45 PERIODS

OUTCOME:
The student will have knowledge in the use of medical equipment in the hospitals

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

BM7203   BIO MECHANICS

OBJECTIVES
To Study the deformability, strength, and visco elasticity of hard and flexible tissues, modes of loading and failure and the mechanics of skeletal joints, concussion and head injuries, mechanics of orthopedic implants and joint replacement, mechanical properties of blood vessels and Alveoli mechanics

UNIT I   INTRODUCTION
Use of statics, kinetics – rigid and non rigid bodies – Forces and motion – Newtons laws – Moment of force – Static equilibrium – Centre of gravity – Stability of equilibrium - Steps in analyzing a biomechanical problem – Graphical methods – contact forces – resolution of forces

UNIT II   MECHANICAL PROPERTIES OF BONES
UNIT III  MECHANICS OF THE ELBOW  9
Skeletal joints, skeletal muscles, basic considerations, basic assumption and limitations, forces and
stresses in human joints, mechanics of the elbow, shoulder, spinal column, hip, knee and ankle.
Human locomotion, gait analysis and goniometry, Ergonomics, Foot Pressure measurements –
Pedobarograph, Force platform, mechanics of foot. Total Hip Prosthesis: requirements, different types
of components, Stress analysis & instrumentation, Knee Prosthesis.

UNIT IV  ALVEOLI MECHANICS  9
Alveoli mechanics, interaction of blood and lung, P-V curve of lung, breathing mechanism, airway
resistance, physics of lung diseases.

UNIT V  MECHANICAL PROPERTIES OF BLOOD VESSELS  9
Mechanical properties of blood vessels – arteries, arterioles, capillaries, veins, physics of cardio
vascular diseases, prosthetic heart valves and replacement. Fluids – density – pressure – blood
pressure and gravity – buoyancy – moments of force and stability – movement in water - Rheological
properties of blood, laminar flow, Couette flow and Hagen-poiseuille equation, turbulent flow.

TOTAL: 45 PERIODS

OUTCOME:
The student will have clear understanding of
- of application of mechanics in medicine.
- the properties of blood, bone and soft tissues like articular cartilage tendons and ligaments

TEXT BOOKS:
1. Frank Bell, Principles of Mechanics and Biomechanics, Stanley Thorne (Publishers) Ltd.,
   1998
2. Donald R. Peterson and Joseph D. Bronzino, Biomechanics Principles and applications,
   CRC press, Taylor & Francis Group, LLC, 2008
   2007

BM7211  BIO SIGNAL AND IMAGE PROCESSING LABORATORY  L T P C
        0 0 3 2

Course objectives:
- To advance the art and science of extracting clinically significant information from physiologic
  signals
- Develop innovative techniques of signal processing for computational processing, analysis,
  understanding, and classification of biomedical signals and data.
- develop image processing algorithm as image segmentation, feature extraction and
  classification for biomedical applications.

List of Experiments:
1. Design of FIR filter using MATLAB and DSP kit
2. Design of IIR filter using MATLAB and DSP kit
3. Simulation of ECG waveform, removal of artifacts like line frequency, baseline wandering etc
   and study of abnormalities in ECG pattern
4. Analysis of EEG waveform
5. Analysis of EMG Signal
6. Processing of biosignals using adaptive filters
7. Image processing for contrast enhancement and sharpening the edges
8. MR Image Processing
9. Data Compressions of biosignals (ECG, EEG, EMG etc.) using DCT and wavelet transforms.

COURSE OUTCOMES:
After completing the course the students are able to independently:

- Describe, apply and evaluate physical, electrical and mathematical models for the origin of bioelectrical signals in the cell, and their conduction in nerves and in tissue.
- Give an in-depth description of bioelectricity in the heart and in the central and peripheral nervous system.
- Describe and evaluate the most important bioelectrical measurement methods: The ECG, the EEG and the EMG, in relation to normal and pathological conditions.
- Apply and evaluate different methods for signal processing of the ECG, the EEG and the EMG, with respect to time- and frequency domain analysis.

TOTAL: 45 PERIODS

BM7301 REHABILITATION ENGINEERING L T P C
3 0 0 3

OBJECTIVE:
- To develop an understanding of the various rehabilitation aids so as to enable the student to design and apply them with confidence, to help the challenged people.

UNIT I INTRODUCTION TO REHABILITATION

UNIT II ORTHOTICS & PROSTHETICS IN REHABILITATION:
Types of orthosis-FO,AFO,KAFO,HKAFO and prosthesis, Partial Foot Prostheses- Foot-ankle assembly, Trans femoral Prostheses, Prosthetic Hand, Advance and automated prosthetics and orthosis, Externally powered and Controlled orthotics & prosthetics, -FES system, Restoration of Hand function, Restoration of standing and walking.

UNIT III MOBILITY AIDS:
Electronic Travel Appliances (ETA) : Path Sounder, Laser Cane, Ultrasonic Torch, Sonic Guide, Light Probes, Nottingham Obstacle Sensors, Electro cortical Prosthesis, Polarized Ultrasonic Travel aids, Materials used for wheel chairs, Type of Wheel Chairs, design of wheel Chair, Walking frames, Parallel bars, Rollators, Quadripods, Tripods & walking sticks, Crutches.

UNIT IV AUDITORY AND SPEECH ASSIST DEVICES:
Types of deafness, hearing aids, application of DSP in hearing aids, Cochlear implants, Voice synthesizer, speech trainer
UNIT V  SENSORY AUGMENTATION AND SUBSTITUTIONS: 9
Classification of Visual Impairments, Prevention and cure of visual impairments, Visual Augmentation, Tactile vision substitution, auditory substitution and augmentation, tactile auditory substitution, Assistive devices for the visual impaired

REFERENCES:

BM7001 PRINCIPLES OF GENETIC ANALYSIS  L T P C
3 0 0 3

OBJECTIVES:
- To describe methods both used in and resulting from the sciences of genetics and molecular biology, or to applications resulting from this research and may be done to identify genetic/inherit disorders
- To make a differential diagnosis in certain somatic diseases such as cancer. Genetic analyses of cancer include detection of mutations, fusion genes, and DNA copy number changes.

UNIT I  INHERITANCE - GENETIC ANALYSIS 9
Basic principles of Heredity, Pattern of inheritance, Mendelian principles of Inheritance Chromosomal basis of inheritance, Chromosome mapping by recombination, Genetics of Bacteria and viruses.

UNIT II  DNA AND PHENOTYPE 9
F DNA structure and replication- DNA sequencing, DNA Amplification, DNA Hybridisation and DNA Polymorphism, RNA transcription and processing, Protein synthesis and regulation of gene expression. Pedigree analysis & Applications, From Gene to Phenotype, molecular mechanism behind phenotypic expressions

UNIT III  GENOME STRUCTURE AND GENETIC ENGINEERING 9
Gene isolation and manipulation, Genomics, mutations, Types of Mutations, molecular basis of Mutation, repair and recombination, site directed mutagenesis, large-scale chromosomal changes and genetic polymorphism

UNIT IV  GENETIC PROCESSES 9
Gene function, Genetic organization, Genetic regulation, Genetic morphology of normal and cancer cells, Genetic basis of development
UNIT V  IMPACT OF GENETIC VARIATION  9
Population Genetics, Quantitative Genetics, Evolution Genetics and their impact in variation.

REFERENCES:

BM7002  PHYSICS IN MEDICINE  L T P C
3 0 0 3

OBJECTIVES:
- To understand the principles of nuclear physics
- To gain knowledge in the field of radiation effects in tissue
- To know about the use of lasers in therapy

UNIT I  PRINCIPLES OF NUCLEAR PHYSICS  9
Traditional definition of atom, periodic system of elements, mechanical properties of atom, emission of light and its frequencies. Electromagnetic spectra, Natural radioactivity, Decay series, type of radiation and their applications, artificially produced isotopes and its application, accelerator principles; Radio nuclides used in Medicine and technology.

UNIT II  INTERACTION WITH LIVING CELLS  9
Target theory, single hit and multi target theory, cellular effects of radiation, DNA damage, depression of Macro molecular synthesis, Chromosomal damage.

UNIT III  SOMATIC EFFECT OF RADIATION  9
Radio sensitivity protocol of different tissues in human, LD 50/30 effect of radiation on skin, blood forming organs, lenses of eye, embryo and Endocrinal glands.

UNIT IV  GENETIC EFFECT OF RADIATION  9
Threshold of linear dose effect, relationship, factors affecting frequency of radiation induced mutation, Gene controlled hereditary diseases, biological effect of microwave, RF wave and UV radiation. Variation in dielectric constant and specific conductivity of tissues. Penetration and propagation of signals, effects in various vital organs, Protection standards.

UNIT V  LASER PHYSICS AND PHOTOMEDICINE  9
Characteristics of laser radiation, Laser speckle, biological effects, laser safety management Synthesis of vitamin D in early and late cutaneous effects, Phototherapy, photo hemotherapy, exposure level, hazards and maximum permissible exposures.

TOTAL :45 PERIODS
OUTCOME
The student will have clear understanding of the effects and safe use of radiation and also will have knowledge in the therapeutic application of laser radiation.

REFERENCES:
1. Moselly, ‘Non ionising Radiation’ Adam Hilgar Brustol 1988

OBJECTIVES:
To gain a solid appreciation for the special significance of the word biomaterial as well as the rapid and exciting evolution and expansion of biomaterials science and its applications in medicine.

UNIT I INTRODUCTION
Introduction to biomaterials, uses of biomaterials, biomaterials in organs & body systems, materials for use in the body, performance of biomaterials

UNIT II METALLIC AND CERAMIC BIOMATERIALS
Introduction, Stainless steel, Cobalt-Chromium alloy, Titanium alloys, Titanium-Nickel alloys, Dental metals, Corrosion of metallic implants, Manufacturing of implants, nonabsorbable/relatively bioinert bioceramics, biodegradable/resorbable ceramics, bioreactive ceramics, deterioration of ceramics, bioceramic manufacturing techniques

UNIT III POLYMERIC AND COMPOSITE BIOMATERIALS
Introduction, polymerization and basic structure, polymers used as biomaterials, sterilization, surface modifications to improve biocompatibility. Structure, bounds on properties, anisotropy of composites, particulate composites, fibrous composites, porous materials, biocompatibility and synthetic biodegradable polymers, collagen.

UNIT IV PRESERVATION TECHNIQUES FOR BIOMATERIALS
Phase behavior, nonfreezing storage-hypothermic, freeze-thaw technology, freeze-drying, vitrification.

UNIT V TESTING AND IMPLANTS OF MATERIALS
Testing with Tissue Culture, Testing with Soft Tissues and Testing at non Thrombogenic surface and implants of Biomaterial in Cardiac, Orthopedics, Muscular and Ocular region.

TOTAL: 45 PERIODS

REFERENCES
OBJECTIVES:
The objective of Biostatistics is to advance statistical science and its application to problems of human health and disease, with the ultimate goal of advancing the public’s health.

UNIT I INTRODUCTION

UNIT II STATISTICAL PARAMETERS
Statistical parameters p-values, computation, level chi square test and distribution and hypothesis testing -single population proportion, difference between two population proportions, single population variance, ratio of two population variances and tests of goodness of fit, tests of independence, tests of homogeneity.

UNIT III REGRESSION AND CORRELATION ANALYSIS
Introduction, regression model, sample regression equation, evaluating the regression equation, using the regression equation, correlation model, correlation coefficient.

UNIT IV INTERPRETING DATA
Interpreting life tables clinical trails, epidemical reading and interpreting of epidemical studies, application in community health.

UNIT V META ANALYSIS AND ANALYSIS OF VARIANCE
META analysis for research activities, purpose and reading of META analysis, kind of data used for META analysis, completely randomized design, randomized complete block design, repeated measures design, factorial experiment.

TOTAL: 45 PERIODS

REFERENCES:
3 Ronald N Forthofer and Eun Sul Lee “Introduction to Biostatistics”, Academic Press

UNIT I HEALTH INFORMATICS
Historical highlights and Evolution, Hospital Information System – its characteristics and functional online and offline modules, e – health services, Medical Standards – HL7 – DICOM – PACS, Medical data formats – Bioethics.
UNIT II  MEDICAL INFORMATICS  9
Medical Informatics and its six levels of interfaces, Electronic Patient Record (EPR), Medical data storage and retrieval techniques – Steganography, Evidence based Medicine- Virtual Hospital

UNIT III  SOFT COMPUTING  9
Fuzzy logic – its applications in Medicine, Physiological System Modeling and Simulation, Virtual Reality and Multimedia Applications in Medicine, Surgical Simulation, Clinical Expert Systems, Issues related to Web based Health Care Systems design, development and implementation.

UNIT IV  JAVA PROGRAMMING  9
Genesis of JAVA, Data types, Operators, Control statements, Classes – Inheritance – packages and interfaces – I/O applets, String handling Applet Classes – AWT and Swing classes - Java applets, Java servelets, Java script programming, Creating events, interactive forms, frames, documents, spread sheets and windows- Client – Server programming

UNIT V  INTERNET AND WEB  9

TOTAL : 45 PERIODS

REFERENCES:

MX7001  TISSUE ENGINEERING  L T P C
3 0 0 3

OBJECTIVES:
Tissue engineering is a new field of biomedical engineering, in which synthetic materials are used together with biological components such as tissue fragments, cells, proteins to encourage tissue regeneration, regrowth, and repair
UNIT I   FUNDAMENTAL OF TISSUE ENGINEERING
Introduction: Basic definition, Structural and organization of tissues: Epithelial, connective; vascularity and angiogenesis, basic wound healing, cell migration, current scope of development and use in therapeutic and in-vitro testing.

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

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

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

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

TOTAL : 45 PERIODS

REFERENCES:

MX7008  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

REFERENCES:
UNIT I INTRODUCTION
Definition of nanotechnology, Objective and goal of Nanotechnology, Importance of Nanoscale, revolution of Nanotechnology, Silicon based Technology.

UNIT II NANOMATERIALS

UNIT III EXPERIMENTAL TECHNIQUES
Fabrication – lithography, Characterisation – X-ray diffraction (XRD), Scanning electron Microscopy, Atomic force microscopy, Scanning Tunneling microscopy (STM), Scanning probe microscopy (SPM), Optical and Raman spectroscopy.

UNIT IV NANOSCIENCE
Nanomachine, nanorobots, nanodevice, nanomedicine – regenerative and replacement medicine, nano pharmacology, Nanotechnology in defense, environmental application

UNIT V R & D IN NANOTECHNOLOGY
Nanotechnology current and future perspectives, research areas in nanotechnology, development of nanotechnology in India, Ethical issues and socioeconomic challenges in nanotechnology.

REFERENCES:

OBJECTIVE:
To study the aspects of managing the hospital in terms of staff, marketing and the use of computers

UNIT I FORMS OF ORGANISATION
Sole proprietorship, Partnership, Company-public and private sector enterprises, Principles of management, Evolution of management.

UNIT II PRINCIPLE OF HOSPITAL MANAGEMENT
Importance of management and Hospital, Management control systems. Forecasting techniques decision-making process
UNIT III STAFFING
Staffing pattern in hospitals, Selection, Recruiting process, Training of staff, Organizational structures, Career development

UNIT IV MARKETING AND MANAGEMENT
Basic concepts marketing, Principles of social marketing, Social marketing in health sector, Consumer behavior and research health, Advertising in Health Sector, Relevance of e-marketing of Health care services

UNIT V COMPUTER AND HOSPITAL
System Development life cycle, Reasons to use computers in hospital, main categories of information systems in hospitals

TOTAL: 45 PERIODS

REFERENCES:

BM7007 FINANCE MANAGEMENT IN HOSPITAL

OBJECTIVE
To study the aspects of managing the finance for proper functioning of the hospital

UNIT I INTRODUCTION

UNIT II ACCOUNTING TECHNIQUES

UNIT III COSTING AND HOSPITALS
Nature & Scope of Cost Accounting – Cost analysis & Classification - Cost Calculation, significance of internal billing in Hospital -Necessary for internal & external controlling cost, cost unit calculation.

UNIT IV MANAGEMENT ACCOUNTING
Budgeting & Budgetary control – Cost – Volume – Profit analysis.

UNIT V FINANCING DECISIONS

TOTAL: 45 PERIODS
REFERENCES:

BM7008 HUMAN RESOURCE MANAGEMENT IN HOSPITALS

OBJECTIVE
To study the aspects of managing the resources for proper functioning of the hospital

UNIT I PERSPECTIVES OF HUMAN RESOURCE MANAGEMENT

UNIT II THE CONCEPT OF BEST FIT EMPLOYEE

UNIT III TRAINING & EXECUTIVE DEVELOPMENT
Types of Training methods and their benefits - Executive development Programme - common practices - Benefits, self-development - knowledge Management.

UNIT IV SUSTAINING EMPLOYEE INTEREST

UNIT V PERFORMANCE APPRAISAL

REFERENCES:
OBJECTIVE
To study the basic issues involved in the design of a hospital

UNIT I  INTRODUCTION TO HEALTH CARE SYSTEM:  9
International and National level policy framework for healthcare facilities – Types of healthcare facilities based on public and private ownership, bed size and type of health care services based on outpatient, inpatient and diagnostic care - Organizational, function and structure of the hospital

UNIT II  HOSPITAL PLANNING  9
Principles of planning, regionalization, hospital planning team, planning process, size of the hospital, site selection, hospital architect, architect report, equipping a hospital, interiors & graphics, construction & commissioning, planning for preventing injuries, electrical safety.

UNIT III  PLANNING & DESIGNING OF DIFFERENT SERVICES IN HOSPITALS  9
Planning and designing of administrative services, medical and ancillary services, nursing services, supportive services, public areas and staff services, hospital services

UNIT IV  STANDARDS AND NORMS FOR HOSPITALS  9

UNIT V  FACILITIES FOR SUPPORTIVE SERVICES  9
Transport, Information system, Communication, Food services, Mortuary, Heating Ventilation and Air Conditioning, Medical gases, House Keeping, Laundry

OUTCOMES:
The student will have knowledge in the essential services to be provided by the hospitals and the proper design of hospital

REFERENCES:

TOTAL : 45 PERIODS
UNIT I  PC HARDWARE AND OVERVIEW
Hardware – BIOS – DOS interaction, POST, Functional and Architecture Block diagram of a PC, Mother Board – I/O slots – Mother Board logics- Memory and I/O map, Peripheral interfacing and controllers- Serial and Parallel interface – CRT Display Adapter – FDC – HDC – PC buses

UNIT II  PENTIUM MICROPROCESSORS

UNIT III  COMPUTER ASSISTED MEDICAL IMAGING AND DECISION MAKING

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, Virtual reality – Multimedia - Telemedicine – Computers in Critically Care Units and radiological centres

UNIT V  BIOMETRICS FOR NETWORK SECURITY
Introduction to Biometrics and its characteristics, Finger print technology, feature extraction and classification, Face recognition and hand geometry - feature extraction and classification, Biometric authentication system

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

TOTAL:45 PERIODS
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 AND MICROSYSTEMS
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.

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 ,

UNIT V BIO MEMS
Drug delivery, micro total analysis systems (MicroTAS) detection and measurement methods, microsystem approaches to polymerase chain reaction (PCR), DNA hybridization, Electronic nose, Bio chip.

OUTCOMES:
Students will be able to
1. Understand the operation of different types of sensors and actuators at microscale level
2. Understand the design issues at microscale level
3. Choose the material for any application
4. Apply the concepts to the design of different types of micro systems
5. Apply the knowledge of CAD tools for MEMS design

REFERENCES:
UNIT I  GENERAL INTRODUCTION


UNIT II  BEAM ELEMENTS AND SCALAR PROBLEM IN 2D:


UNIT III  APPLICATIONS TO FIELD PROBLEMS

Higher Order Elements. Natural co-ordinate systems – Isoparametric elements – Shape functions for isoparametric elements – One, two and three dimensions – Serendipity elements – Numerical integration and application to plane stress problems transformation in $\xi, \eta$ and $\zeta$ – coordinates- Jacobian of transformation-order of convergence- numerical integration –example problems- shape functions in natural coordinates- rectangular elements- Lagrange family- Serendipity family- rectangular prisms- tetrahedral elements-

UNIT IV  ISOPARAMETRIC FORMULATION AND MISCELLANEOUS TOPICS

Introduction to elasticity equations – stress strain relations – plane problems of elasticity – element equations Plane stress, plane strain and axisymmetric problems – stress-strain-time or constitutive equations for soft connective tissue components Modelling and force analysis of musculoskeletal systems– Stress calculations - Plate and shell elements – Introduction to flow problems- solution of problems in fluid mechanics- numerical examples -plates and shells

UNIT V  NON-LINEAR ANALYSIS

Introduction to Non-linear problems - some solution methods- computational procedure- simple material nonlinearity, stress stiffening, contact interfaces- problems of gaps and contact- geometric non-linearity- modeling considerations- Impact analysis. Mechanical properties of biological and commonly used biomedical engineering materials -. Critical reviews of finite element analysis in biomechanical research.

TOTAL : 45 PERIODS

TEXT BOOKS:

OBJECTIVES:

• To 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;
• To 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:

UNIT I  HEALTH SYSTEM
Health organization of the country, the state and cities, health financial system, teaching cum research hospitals, General Hospital, PHC reference system.
UNIT II  HOSPITAL PLANNING  9
Technical consideration, size & kind of hospitals, principles of planning, selection, site of orientation, equipment plan, communication and information system, Power supply, Air-conditioning, Water supply, elevators.

UNIT III  NATIONAL HEALTH POLICY  9
Need for evaluating a health policy, need for providing primary health care, Health education, health insurance, health legislation, inter sectoral cooperation.

UNIT IV  EQUIPMENT MAINTENANCE MANAGEMENT  9
Organizing the maintenance operation, biomedical equipment procurement procedure, proper selection, compatibility, testing and installation, purchase and contract procedure, trained medical staff, on proper use of equipment and operating instructions. Maintenance job planning, preventive maintenance, maintenance budgeting, contract maintenance.

UNIT V  LOGISTIC SUPPORT & RELIABILITY  6
Maintenance equipment and Tools, failure analysis, spare parts and maintenance materials. Reliability fundamentals.

UNIT VI  EMI TO HOSPITAL EQUIPMENTS  6
Principles of EMI, computation of EMI, Method of suppressing and isolating the unit from interference.

TOTAL :45 PERIODS

REFERENCES:

BM7013  HOSPITAL WASTE MANAGEMENT  L T P C
3 0 0 3

OBJECTIVES:
Hospital wastes are among hazardous wastes, and special treatment methods are needed for their disposal. Having information about present status of medical waste management systems is of great importance in finding weak, and for future planning

UNIT I  INTRODUCTION  9
Introduction, definition of general and hazardous health care waste and diseases, Infectious waste, genotoxic waste, waste sharps, biomedical waste categories categorization and composition of Biomedical waste

UNIT II  PRINCIPLES OF STERILIZATION  9
Disease Transmission - Disinfection methods – Sterilization - steam sterilizing (Auto claving) - Microwave (Non-burn treatment technology). Mechanical Treatment &Chemical Disinfections

UNIT III  DISPOSAL OF WASTE  9
Disposal methods - Incinerator - Hazardous waste, radioactive waste, liquid waste destruction - landfill.
UNIT IV       CONTROLS APPLIED TO WASTE MANAGEMENT
Environmental pollution, its causes, consequences, mitigation and remedies. Emission control, Instrumentation and monitoring, Crematories

UNIT V       ENVIRONMENTAL SAFETY, RISKS & PUBLIC ISSUES.

TOTAL: 45 PERIODS

REFERENCES:
2. C.R.BRUNNER, Incenrated Consultant in Corporated Incenration System Hand Book, Virginia

BM7014                 QUALITY ASSURANCE AND SAFETY IN HOSPITALS                           L T P C
                                                                                     3 0 0 3

OBJECTIVE:
- To provide basic knowledge on the concept of Healthcare Quality management towards continuous improvement of patient care .
- To make the students aware of the role of biomedical engineer in hospitals, especially in the management of electrical supply, maintenance of electrical safety.

UNIT I       STANDARDIZATION OF QUALITY MEDICAL CARE IN HOSPITALS
Define Quality- Need for Standarization & Quality Management, TQM in Health care organization- Quality assurance methods ,QA in (Medical Imaging & Nuclear medicine) Diagnostic services – Classification of equipments

UNIT II      REGULATORY REQUIREMENT FOR HEALTH CARE
FDA regulations, Accreditation for hospitals - JCI, NABH and NABL, Other regulatory Codes.

UNIT III     HOSPITAL SAFETY
Security & Safety of Hospital -Property, Staff & Patients, Radiation safety, Safety precautions, hazardous effects of radiation, allowed levels of radiation, ICRP regulations for radiation safety, Disposal of Biological waste.

UNIT IV     ELECTRICAL & FIRE SAFETY
Sources of shocks, macro & micro shocks -Hazards, monitoring and interrupting the Operation from leakage current- Elements of fire, causes of fire , Action to be taken in case of fire in a Hospital.

UNIT V       ASSESSING QUALITY HEALTH CARE
Patient Safety Organization- Governmental & Independent,Measuring Quality care – Evaluation of hospital services – six sigma way, Quality Assurance in Hospitals Sop’s – Patient Orientation for Total Patient Satisfaction. 5S techniques

TOTAL :45 PERIODS
OUTCOMES:
The purpose of this course is to help students to develop knowledge and insight into the procedures used in quality control and assurance activities as well as safety measures to be followed in hospitals.

REFERENCES:
3. B.M.Sakharkar, Principles of Hospital administration and Planning, JAYPEE Brothers, Medical Publishers (P) Ltd.
6. Sharon Myers “Patient Safety & Hospital Accreditation - A Model for Ensuring Success” Springer Publishers 2012

MX7002 MEDICAL ETHICS AND STANDARDS

OBJECTIVES:
- Achieve familiarity with some basic ethical framework & understand how these Ethical frameworks can help us 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 healthcare 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
- Bioethical issues including genetic engineering, abortion, and life and death issues
- Guidelines to obtain medical standards in hospitals

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

MX7005 ADVANCED NEURAL COMPUTING

OBJECTIVES:
- To learn the theory and implementation of neural networks
- To introduce neural computing as an alternative knowledge acquisition/representation paradigm,
- To explain its basic principles and their relationship to neurobiological models,
- To describe a range of neural computing techniques and their application areas.

UNIT I BASIC CONCEPTS OF NEURAL COMPUTING

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 NEURAL NETWORKS

UNIT IV GENETIC ALGORITHMS & IMPLEMENTATION TECHNIQUES 9

UNIT V ADVANCES AND APPLICATIONS 9

OUTCOMES:
• Able to demonstrate an understanding of the principles of Neural Networks and a knowledge of their main areas of application;
• Ability to design, implement and analyse the behaviour of simple neural networks.
• Ability to use a neural network to solve real-world problems,

TEXT BOOKS:

REFERENCES:

AP7013 PATTERN RECOGNITION L T P C 3 0 0 3

OBJECTIVES:
• To know about Supervised and unsupervised Learning.
• To study about feature extraction and structural pattern recognition.
• To explore different classification models.
• To understand Fuzzy Pattern Classifiers and Perception.

UNIT I PATTERN CLASSIFIER 9

UNIT II CLUSTERING 9
Clustering for unsupervised learning and classification – Clustering concept – C Means algorithm – Hierarchical clustering – Graph theoretic approach to pattern Clustering – Validity of Clusters.
UNIT III FEATURE EXTRACTION AND STRUCTURAL PATTERN RECOGNITION


UNIT IV HIDDEN MARKOV MODELS AND SUPPORT VECTOR MACHINE


UNIT V RECENT ADVANCES

Fuzzy logic – Fuzzy Pattern Classifiers – Pattern Classification using Genetic Algorithms – Case Study Using Fuzzy Pattern Classifiers and Perception.

TOTAL: 45 PERIODS

OUTCOMES:
Upon Completion of the course, the students will be able to
- Classify the data and identify the patterns.
- Extract feature set and select the features from given data set.

REFERENCES:

CU7006 WAVELET TRANSFORMS AND APPLICATIONS

OBJECTIVES:
- To study the basics of signal representation and Fourier theory
- To understand Multi Resolution Analysis and Wavelet concepts
- To study the wavelet transform in both continuous and discrete domain
- To understand the design of wavelets using Lifting scheme
- To understand the applications of Wavelet transform

UNIT I FUNDAMENTALS


UNIT II MULTI RESOLUTION ANALYSIS

Definition of Multi Resolution Analysis (MRA) – Haar Basis – Construction of Generalthonormal MRA – Wavelet Basis for MRA – Continuous Time MRA Interpretation for the DTWT – Discrete Time MRA – Basis Functions for the DTWT – PRQMF Filter Banks.
UNIT III  CONTINUOUS WAVELET TRANSFORMS  
Wavelet Transform – Definition and Properties – Concept of Scale and its Relation with Frequency – Continuous Wavelet Transform (CWT) – Scaling Function and Wavelet Functions (Daubechies Coiflet, Mexican Hat, Sinc, Gaussian, Bi Orthogonal)– Tiling of Time – Scale Plane for CWT.

UNIT IV  DISCRETE WAVELET TRANSFORM  

UNIT V  APPLICATIONS  

OUTCOMES:  
Upon Completion of the course, the students will be able to
- Use Fourier tools to analyse signals
- Gain knowledge about MRA and representation using wavelet bases
- Acquire knowledge about various wavelet transforms and design wavelet transform
- Apply wavelet transform for various signal & image processing applications

TEXT BOOKS:  

REFERENCES:  
UNIT I  INTRODUCTION

UNIT II  TRANSFER FUNCTION

UNIT III  PERIODIC SIGNALS
Sinusoidal Functions, Sinusoidal Analysis of Instrumentation System, Evaluation of Transfer Functions from Frequency Response, Relationship between Phase Lag and Time Delay Transient Response of an Undamped Second Order system, General Description of Natural Frequency Damping, Physical Significance of Under Damped Responses.

UNIT IV  FEEDBACK

UNIT V  SIMULATION OF BIOLOGICAL SYSTEMS
Simulation of Skeletal muscle servomechanism, thermo Regulation, cardiovascular control System, Respiration controls, Occulo Motor System, Endocrine control system and Modeling of receptors.

OUTCOME:
The student will have knowledge in the analysis of any physiological systems through the models

REFERENCES: