PROGRAMME OBJECTIVES:

The students will gain knowledge

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

Finally the students will be able to apply the knowledge for the research, design and development of new medical devices.

AFFILIATED INSTITUTIONS

ANNA UNIVERSITY, CHENNAI

REGULATIONS - 2013

M.E. MEDICAL ELECTRONICS

I TO IV SEMESTERS CURRICULA AND SYLLABI (FULL TIME)

SEMESTER I

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	MA7157	Applied Mathematics for Electronics Engineers	3	1	0	4
2	MX7101	Human Anatomy and Physiology	3	0	0	3
3	DS7002	Bio Signal Processing	3	0	0	3
4	MX7102	Biomedical Instrumentation	3	0	0	3
5	MX7103	Biomedical Equipment	3	0	0	3
6		Elective I	3	0	0	3
PRACTICAL						
7	MX7111	Bio Medical Instrumentation Laboratory	0	0	4	2
		TOTAL	**18**	**1**	**4**	**21**

SEMESTER II

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	BM7201	Applied Medical Image Processing	3	0	0	3
2	MX7201	Medical Imaging and Radio Therapy	3	0	0	3
3	MX7202	Medical Informatics	3	0	0	3
4		Elective II	3	0	0	3
5		Elective III	3	0	0	3
6		Elective IV	3	0	0	3
PRACTICAL						
7	MX7211	Data Acquisition and Processing Laboratory	0	0	4	2
		TOTAL	**18**	**0**	**4**	**20**

SEMESTER III

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	MX7301	Human Assist Devices	3	0	0	3
2		Elective V	3	0	0	3
3		Elective VI	3	0	0	3
PRACTICAL						
4	MX7311	Project Work (Phase I)	0	0	12	6
		TOTAL	**9**	**0**	**12**	**15**

SEMESTER IV

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
PRACTICAL						
1	MX7411	Project Work (Phase II)	0	0	24	12
		TOTAL	**0**	**0**	**24**	**12**

TOTAL NO. OF CREDITS TO BE EARNED FOR THE AWARD OF DEGREE : 68

ELECTIVES LIST

ELECTIVE I

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
1.	MX7001	Tissue Engineering	3	0	0	3
2.	BM7001	Principles of Genetic Analysis	3	0	0	3
3.	BM7003	Bio Materials	3	0	0	3
4.	MX7002	Medical Ethics and Standards	3	0	0	3

ELECTIVE II

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
5.	BM7011	Biomedical Optics	3	0	0	3
6.	MX7003	Bio MEMS	3	0	0	3
7.	BM7005	Nanotechnology and Applications	3	0	0	3
8.	BM7010	Finite Element Methods for Bio Mechanical Analysis	3	0	0	3
9.	VL7102	VLSI Design Techniques	3	0	0	3

ELECTIVE III

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
10.	MX7004	Computer Based Medical Instrumentation.	3	0	0	3
11.	BM7203	Bio Mechanics	3	0	0	3
12.	CU7001	Real Time Embedded Systems	3	0	0	3
13.	BM7301	Rehabilitation Engineering	3	0	0	3

ELECTIVE IV

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
14.	MX7005	Advanced Neural Computing.	3	0	0	3
15.	CU7006	Wavelet Transforms and Applications	3	0	0	3
16.	MX7006	Physiological Modeling	3	0	0	3
17.	BM7004	Bio Statistics	3	0	0	3

ELECTIVE V

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
18.	MX7007	Brain Control Interfaces	3	0	0	3
19.	AP7013	Pattern Recognition	3	0	0	3
20.	MX7008	Tele Health Technology	3	0	0	3
21.	AP7008	DSP Integrated Circuits	3	0	0	3

ELECTIVE VI

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
22.	MX7009	Advances in Electronics Applied to Hospital Engineering	3	0	0	3
23.	MX7010	Health Hospital and Equipment Management.	3	0	0	3
24.	BM7014	Quality Assurance and Safety in Hospitals	3	0	0	3
25.	AP7301	Electromagnetic Interference and Compatibility	3	0	0	3

MA7157 APPLIED MATHEMATICS FOR ELECTRONICS ENGINEERS L T P C
3 1 0 4

UNIT I FUZZY LOGIC 12

Classical logic – Multivalued logics – Fuzzy propositions – Fuzzy quantifiers.

UNIT II MATRIX THEORY 12

Some important matrix factorizations – The Cholesky decomposition – QR factorization – Least squares method – Singular value decomposition - Toeplitz matrices and some applications.

UNIT III ONE DIMENSIONAL RANDOM VARIABLES 12

Random variables - Probability function – moments – moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a Random Variable.

UNIT IV DYNAMIC PROGRAMMING 12

Dynamic programming – Principle of optimality – Forward and backward recursion – Applications of dynamic programming – Problem of dimensionality.

UNIT V QUEUEING MODELS 12

Poisson Process – Markovian queues – Single and Multi-server Models – Little's formula - Machine Interference Model – Steady State analysis – Self Service queue.

L = 45: T=15; TOTAL: 60 PERIODS

REFERENCES:

1. George J. Klir and Yuan, B., Fuzzy sets and fuzzy logic, Theory and applications, Prentice Hall of India Pvt. Ltd., 1997.
2. Moon, T.K., Sterling, W.C., Mathematical methods and algorithms for signal processing, Pearson Education, 2000.
3. Richard Johnson, Miller & Freund's Probability and Statistics for Engineers, 7th Edition, Prentice – Hall of India, Private Ltd., New Delhi (2007).
4. Taha, H.A., Operations Research, An introduction, 7th edition, Pearson education editions, Asia, New Delhi, 2002.
5. Donald Gross and Carl M. Harris, Fundamentals of Queuing theory, 2nd edition, John Wiley and Sons, New York (1985).

MX7101 HUMAN 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 TO HUMAN ANATOMY & PHYSIOLOGY 8

Organization of human body, tissues and cavities – Anatomical planes, positions and sections - Cell: Structure and organelles structure – Functions of Each components in the cell. Cell membrane Transport, Resting membrane potential and ionic basis of potentials, Recording of Action potentials, - Homeostasis.

UNIT II BUILDING BLOCKS OF HUMAN BODY 8

Muscular System: Types of Muscle – Structure & Functions of Skeletal Muscle - Skin and Appendages. Skeletal System: Structure, Type and Functions of Bone - Axial and Appendicular Skeleton. Joints: Definition, Types and functions. Cartilage: An overview - types and functions.

UNIT III ENERGY PRODUCING SYSTEMS IN HUMAN BODY 10

GI Tract: Organization of structures and functions of GI tract - Accessory Organs of GI Tract: Salivary glands, Liver, Pancreas, Gall bladder, Teeth and Tongue. Ingestion, Digestion and Absorption – Factors regulating Movements and Digestion in GI tracts. Respiratory System: Organization structures and functions of respiratory system – Mechanism of Breathing – Respiratory Volumes, Measurements and Artificial Respiration.

UNIT IV TRANSPORTER AND EXCRETORY SYSTEM 9

Cardiovascular System: Blood vessel - internal structure - Cardiac Muscle: Structure and functions – Structure and Components of Heart - Conducting System of Heart – Heart Sounds – Blood Pressure – Regulation of Blood Pressure and Measurements. Urinary System: Structure of Kidney, Nephron, Ureter and Urinary bladder. Urine formation and Micturition reflex.

UNIT V CONTROLLING AND COORDINATING SYSTEMS IN HUMAN BODY 10

Nervous system: Organization of Nervous system. Structure, Types and Properties of Neurons - Action potential of Neuron - Neuroglial Cells - Brain, Lobes and Cortical Areas – Spinal cord arrangement and Plexus formation. Autonomic Nervous System: Divisions and control on each system - Reflex Mechanism. Endocrine System: Hormone – General Action – Second Messenger – Anterior and Posterior Pituitary Gland Hormones. Special Senses: Structure of Eye and Ear - Functions and clinical conditions of Eye & Ear.

L = 45 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:

1. Anatomy & Physiology, Gary A.Thibodeau, Kevin T.Patton – 7th Edition, Mosby Publisher 2009.
2. The Human Body, Gillian Pocock & Christopher D.Richards, Oxford University Press, 2009.
3. Guyton 'Text book of Medical Physiology – WB Jaunder company Philadelphia - 10th edition 2002.
4. Tobin C.E., "Basic Human Anatomy", McGraw – Hill Publishing Co., Ltd., Delhi 1997.
5. Gibson.J., "Modern Physiology & Anatomy for Nurses", Blackwell SC Publishing 1981.
6. Essential of Human Anatomy and Physiology, Elaine.N.Marieb Eight Edition, Pearson Education, New Delhi, 2007.

DS7002 BIO SIGNAL PROCESSING L T P C

3 0 0 3

UNIT I SIGNAL, SYSTEM AND SPECTRUM 9

Characteristics of some dynamic biomedical signals, Noises- random, structured and physiological noises. Filters- IIR and FIR filters. Spectrum – power spectral density function, cross-spectral density and coherence function, cepstrum and homomorphic filtering. Estimation of mean of finite time signals.

UNIT II TIME SERIES ANALYSIS AND SPECTRAL ESTIMATION 9

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 9

Filtering – LMS adaptive filter, adaptive noise canceling in ECG, improved adaptive filtering in FECG, Wavelet detection in ECG – structural features, matched filtering, adaptive wavelet detection, detection of overlapping wavelets.

UNIT IV BIOSIGNAL CLASSIFICATION AND RECOGNITION 9

Signal classification and recognition – Statistical signal classification, linear discriminate function, direct feature selection and ordering, Back propagation neural network based classification. Application in Normal versus Ectopic ECG beats.

UNIT V TIME FREQUENCY AND MULTIVARIATE ANALYSIS 9

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

REFERNCES:

1. Arnon Cohen, Bio-Medical Signal Processing Vol I and Vol II, CRC Press Inc., Boca Rato, Florida 1999.
2. Rangaraj M. Rangayyan, 'Biomedical Signal Analysis-A case study approach', Wiley-Interscience/IEEE Press, 2002
3. Willis J. Tompkins, Biomedical Digital Signal Processing, Prentice Hall of India, New Delhi, 2003.
4. Emmanuel C. Ifeachor, Barrie W.Jervis, 'Digital Signal processing- A Practical Approach' Pearson education Ltd., 2002
5. Raghuveer M. Rao and Ajith S.Bopardikar, Wavelets transform – Introduction to theory and its applications, Pearson Education, India 2000.

MX7102 BIOMEDICAL INSTRUMENTATION L T P C
3 0 0 3

OBJECTIVES:

1. To know the various functional blocks present in biosignal acquisition system
2. To understand the different biopotential characteristics and recording methods
3. To develop an understanding of the nonelectrical parameters measurements
4. To study the biochemical measurements so as to create confidence in students to do biochemical measurement.

UNIT I BIOMEDICAL TRANSDUCERS AND AMPLIFIERS 9

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

UNIT II BIOPOTENTIAL RECORDING 9

ECG, EEG, EMG, EOG, ERG lead system and recording methods, typical waveform, frequency spectrum, abnormal waveform, block schematic of ECG recorder and other Bio potential recorder

UNIT III NON ELECTRICAL PARAMETER MEASUREMENTS 9

Respiration rate, Pulse rate, Temperature, Blood Pressure-Characteristics of blood flow-Heart sounds, Measurement of blood pressure-Direct and indirect methodO_2 , CO_2 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 9

EM and ultrasonic blood flow meters, indicator dilution method, Thermodilution method, Manual and Automatic Counting of RBC, WBC and Platelets.

UNIT V BIO-CHEMICAL MEASUREMENTS& BIOSENSORS 9

pH, pC02, p02, pHCO3 and electrophoresis, colorimeter, spectrophotometer, flame photometer, autoanalyser, Biosensors.

L = 45 TOTAL: 45 PERIODS

OUTCOME:

The student will be capable of designing biosignal (both electrical and non electrical) data acquisition system.

REFERENCES:

1. Geddes LA and Baker L.E Principals of Applied Biomedical Instrumentation , John Wiley and sons Newyork 1975
2. Webster J.G Medical Instrumentation application and design – John Wiley and sons New York 3rd edition 1999
3. Khandpur R.S Hand Book of Biomedical Instrumentation – Tata Mc Graw Hill publication , New Delhi 2nd edition 2003
4. Joseph J Carr and John m Brown – Introduction to Biomedical equipment Technology - Pearson Education 4th edition New Delhi 2001 Cromwell Leslie, Fred Erich A.Pfeiffer - Biomedical Instrumentation Prentice Hall New Delhi 2000
5. John Webster. Medical Instrumentation.- Application and Design. John Wiley and Sons. Inc., New York. Thirdedition 2003.

MX7103 BIOMEDICAL EQUIPMENT L T P C

3 0 0 3

OBJECTIVES:

1. To know the various functional blocks present and the function of various equipment used in hospitals
2. To enrich students' knowledge with laser and ultrasonic applications.
3. To introduce the recent trends in field of diagnostic and therapeutic equipments.

UNIT I CARDIAC CARE UNITS 9

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 NEUROLOGY EQUIPMENT 9

Evoked response - Need, Auditory, Visual and Somato sensory, Depth recording, Stereotaxy unit and its advancement , EEG controlled Anesthetic monitor, Biofeedback equipment, Spinal reflex Measurement, Transcutaneous nerve stimulator

UNIT III PHYSIOTHERAPY AND DIATHERMY EQUIPMENT 9

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

UNIT IV LASER AND ULTRASONIC APPLICATION 9

Principles of Laser action, Different types and clinical applications of laser, ultrasonic frequency for medical application, different modes of Display A, B and M, ultrasonic probes, Real time echo and 2D scanner, Application of Ultrasonic for diagnosis- ophthalmology, brain, abdomen, obstetrics and gynaecology, cardiology

UNIT V RECENT TRENDS **9**

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

L = 45 TOTAL: 45 PERIODS

OUTCOME:

The student will be in a position to use any essential equipment in the hospital

REFERENCES:

1. Albert M Cook and Webster J G – Therapeutic medical devices Prentice Hall Nee York 1982
2. Khandpur R.S Hand Book of Biomedical Instrumentation – Tata Mc Graw Hill publication , New Delhi 2nd edition 2003 J.Weibell and
3. Cromwell Leslie, Fred Erich A.Pfeiffer - Biomedical Instrumentation Prentice Hall New Delhi 2000
4. Wolbasrsht . M. L, Laser Application in Medicine and Biology plenum press New York 1989.
5. John Webster. Medical Instrumentation.- Application and Design. John Wiley and Sons. Inc., New York. Thirdedition 2003.
6. Bronzino, Joseph; Handbook of Biomedical Engineering. 2nd edition, CRC Press, 2000.
7. Welkowitz, Walter & Others Bio-Medical Instruments Theory & Design., 2nd Edition, Academic Press, 1991

MX7111 BIO MEDICAL INSTRUMENTATION LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES:

- To design and build any biosignal acquisition system
- To study the methods of physiological parameter measurement

LIST OF EXPERIMENTS:

1. Construction and testing of pre amplifier to acquire bio signal
2. Recording of ECG in bipolar configuration and computation of heart rate
3. Study of Pacemaker with simulator circuit
4. Study of EEG system and Characterization of Amplifier with simulator
4. Measurement of Blood Flow Velocity using Ultrasonic blood flow Monitor
5. Characteristics of EMG Amplifier
6. Study of PCG (Phonocardiograph) for Measurement of Heart Sound
7. Study of EMG /ECG amplifier Isolation of Bio-signal using analog circuit
8. Study of Galvanic Skin Resistance using GSR System
9. Determination of Pulmonary Function Using Spirometer
10. Measurement of physiological parameters using patient monitoring system

11 Study of Ultrasound diathermy, Short wave Diathermy

TOTAL: 60 PERIODS

OUTCOMES:

The student will be in a position to design and test any physiological parameter measurement system

BM7201 APPLIED MEDICAL IMAGE PROCESSING L T P C
3 0 0 3

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 9

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 9

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 9

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 9

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 9

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:

1. Wolfgang Birkfellner, ‘Applied Medical Image Processing – A Basic course’, CRC Press, 2011.
2. Atam P.Dhawan, ‘Medical Image Analysis’, Wiley Interscience Publication, NJ, USA 2003.
3. R.C.Gonzalez and R.E.Woods, ‘Digital Image Processing’, Second Edition, Pearson Education, 2002.
4. Anil. K. Jain, ‘Fundamentals of Digital Image Processing’, Pearson education, Indian Reprint 2003.
5. Alfred Horowitz, ‘MRI Physics for Radiologists – A Visual Approach’, Second edition Springer Verlag Network, 1991.
6. Kavyan Najarian and Robert Splerstor,” Biomedical signals and Image processing”,CRC – Taylor and Francis,New York,2006
7. John L.Semmlow,”Biosignal and Biomedical Image Processing Matlab Based applications” Marcel Dekker Inc.,New York,2004
8. Jerry L.Prince and Jnathan M.Links,” Medical Imaging Signals and Systems”- Pearson Education Inc. 2006

MX7201 MEDICAL IMAGING AND RADIO THERAPY L T P C
3 0 0 3

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 9

Principle and production of soft X – Rays, Selection of anodes, heel pattern, Scattered Radiation, Porter-Bucky systems, Cooling System, Testing for various parameters of the unit, principles of Angiography and Fluoroscopic Techniques, Image Intensifiers, Single plane and bi plane recording units, digital subtraction angiography,mammography,dental X- ray units.

UNIT II TOMOGRAPHY 9

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

UNIT III EMISSION IMAGING 9

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

UNIT IV MAGNETIC RESONANCE IMAGING 9

Principle of MRI, MRI instrumentation, Imaging Different Sections of the Body, Tissue Characterization, MR Spectroscopy, Functional MRI.

UNIT V THERAPY USING X – RAYS AND ISOTOPES 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:

1. Chesney D.N~ and Chesney M.O., X-Ray Equipments for Students Radiographer, Blackwell Scientific Publications, Oxford, 1971
2. Alexander, Kalender and Linke, Computer Tomography, John Wiley, Chich~ster, 1986.
3. Steve Webb, The Physics of Medical Imaging, Adam Hilger, Philadelpia,1988.
4. Peggy. W, Roger.D.Ferimarch, MRI for Technologists, Mc Graw Hill Publications, New York,1995.
5. Donald Graham, Paul Cloke, Martin Vosper -Principles of Radiological physics, Churchill Livingston, 5th Edition.
6. Donald W.McRobbice, Elizabeth A.Moore, Martin J.Grave and Martin R.Prince MRI from picture to proton ,Cambridge University press, New York 2006.
7. Jerry L.Prince and Jnathan M.Links," Medical Imaging Signals and Systems"- Pearson Education Inc. 2006

MX7202 MEDICAL INFORMATICS L T P C
3 0 0 3

UNIT I HEALTH INFORMATICS 9

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

Web Design and programming, HTTP protocol, Web browsers Netscape, Internet explorer, Web site and web page design, HTML,XHTML, XML, CSS, Dynamic HTML, CGI. Data base design and programming, SQL introduction – Queries – Tables – RDBMS, Macromedia Dream Weaver, Web Servers, Databases – SQL, MYSQL, DBI and ADO.NET, Web based Medical Information Systems.

TOTAL : 45 PERIODS

REFERENCES:

1. Ramachandra Lele, Computers in Medicine Progress in Medical Informatics, Tata McGraw Hill Publishing Company, New Delhi, 2005
2. Herbert Schildt, The Complete Reference – JAVA, Tata McGraw Hill Publishing Company, New Delhi, 2005
3. Mohan Bansal M S, Medical Informatics, Tata McGraw Hill Publishing Company, New Delhi, 2005
4. H M Dietel, Internet and World Wide Web, AB Goldberg publishers, New Delhi, 2007
5. Ranjan Parekh, Principles of Multimedia, Tata McGraw Hill Publishing Company, New Delhi, 2006
6. Tay Vaughan, Multimedia – Making it Work, Tata McGraw Hill Publishing Company, New Delhi, 2006
7. Raif Steinmetz, Multimedia – Computing, Communications and Applications, Pearson Education, New Delhi, 2007
8. Deitel, “Java How to Program”, Pearson Education / PHI, 2006.
9. A S Godbole A Kahate, “Web Technologies, TCP/IP to Internet Application Architectures”, TMH 2007

MX7211 DATA ACQUISITION AND PROCESSING LABORATORY L T P C
0 0 4 2

OBJECTIVES :

- To acquire and analyse biosignals
- To test the electrical safety aspect of medical devices
- To analyse medical images and to compress them

LIST OF EXPERIMENTS

1. Acquisition and analysis of bio signals using workstation.
2. Study of auditory and visual evoked responses.
3. Electrical safety testing of medical equipment.
4. Development of software for basic telemedicine.
5. Development of neural network for signal classification.
6. Processing and analysis of medical images: Preprocessing, basic filtering techniques and basic segmentation techniques and computation of performance measures .
7. Development of software for medical image compression.
8. Development of algorithm for medical data security.
9. Study of DICOM standards.
10. Physiological modeling of cardiac output and analysis under various conditions of heart.
11. Mini project (Should include hardware and software).

OUTCOMES:

The student will be in a position to analyse any medical image and to compress them without affecting the quality. The mini project will help the students to apply various concepts of Medical Electronics to develop devices

TOTAL:60 PERIODS

MX7301 HUMAN ASSIST DEVICES L T P C
3 0 0 3

OBJECTIVE;

- 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.
- A brief introduction to design aspects of prosthetic and orthodic devices for the disability will be given.

UNIT I HEART LUNG MACHINE AND ARTIFICIAL HEART 9

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 ORTHODIC DEVICES 9

Hand and Arm Replacement - Different Types of Models Externally Powered Limb Prosthesis Feedback in Orthodic System, Functional Electrical Stimulation, Sensory Assist Devices, Materials for Prosthetic and orthodic devices, Haptic Devices

UNIT V RESPIRATORY AND HEARING AIDS. 9

Intermittent positive pressure, Breathing Apparatus Operating Sequence, Electronic IPPB unit with monitoring for all respiratory parameters.Types of Deafness, Hearing Aids, Construction and Functional Characteristics.

L = 45 TOTAL : 45 PERIODS

OUTCOMES:
The student can understand various assist devices and will be in a position to understand various issues related to the use of these device

REFERENCES:

1. Kolff W.J., Artificial Organs, John Wiley and Sons, New York, 1979.
2. Andreas.F.Vonracum, Hand book of bio material evalution, Mc-Millan publishers, 1980.
3. Albert M.Cook and Webster J.G., Therapeutic Medical Devices, Prentice Hall Inc., New Jersey, 1982
4. Gray E Wnek, Gray L Browlin – Encyclopedia of Biomaterials and Biomedical Engineering – Marcel Dekker Inc New York 2004.
5. John. G . Webster – Bioinstrumentation - John Wiley & Sons (Asia) Pvt Ltd - 2004.

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 9
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 9
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 9
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 9
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 9
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

1. W. Mark Saltzman Tissue Engineering – Engineering principles for design of replacement organs and tissue –- Oxford University Press inc New York, 2004.
2. Robert. P.Lanza, Robert Langer & William L. Chick, Principles of tissue engineering Academic press.
3. Joseph D. Bronzino, The Biomedical Engineering –Handbook, CRC press.
4. Enderle, Blanchard & Bronzino Introduction to Biomedical Engg. , , Academic press.
5. B. Palsson, J.A. Hubbell, R.Plonsey & J.D. Bronzino Tissue Engineering, , CRC-Taylor & Francis

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/inherited 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

TOTAL: 45 PERIODS

REFERENCES:

1. Watson. J. etal, " Molecular Biology of the Gene ", 5th Edition, Pearson Publication, 2004.
2. Griffiths, Wesslers, Lewontin, Bart Gel, Suzuki, Miller "Introduction to Genetics Analysis", – W.H Freeman & company, New York 8th Edition - 2005.
3. Glick, B.R and J.J Pasternak "Molecular Biotechnology", Principles and application of Recombinant DNA" 3rd Edition ASM Press, 2003
4. Karp, Gerald." Cell and Molecular Biology". Concepts and Experiments, 4th Edition, John Wiley Sons, 2005.
5. Weaver. R.F. " Molecular Biology " 3rd Edition, McGraw – Hill, 2005.
6. Tom Strachan, Andrew P Read "Human molecular Genetics" 3rd Edition, Garland Publishing – 2004.

BM7003 BIOMATERIALS L T P C
3 0 0 3

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 9

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 9

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 II POLYMERIC AND COMPOSITE BIOMATERIALS 9

Introduction, polymerization and basic structure, polymers used as biomaterials, sterilization, surface modifications to for improving 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 9

Phase behavior, nonfreezing storage-hypothermic, freeze-thaw technology, freeze-drying, vitrification.

UNIT V TESTING AND IMPLANTS OF MATERIALS 9

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:

1. J.H.U.Brown (Ed), Advances in Bio Medical Engineering, Academic Press 1975.
2. Andrew F.Von Racum, Hand Book of Bio Medical Evaluation, Mc-Millan Publishers, 1980.
3. Jacob Cline, Hand Book of Bio Medical Engineering, Academic Press in Sandiego, 1988.
4. Jonathan Black, Biological Performance of Materials- Fundamentals of bio compatibility, 4th Edition, CRC Press 2005.
5. Larry L. Hench and Julian R.Jones, Biomaterials, Artificial organs and Tissue Engineering, 2005.
6. Buddy D.Ratner,Allan S .Hoffman, Frederick J. Schoen, Jack E. Lemons, Biomaterial Science; An Introduction to Materials in Medicine,2nd Edition, Elsevier Academic Press,San Diego,2004

MX7002 MEDICAL ETHICS AND STANDARDS L T P C
3 0 0 3

OBJECTIVE:

- To achieve familiarity with some basic ethical framework & understand how these ethical frameworks can helpus think through contemporary questions in medical ethics.
- 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 8

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 9

Theories-Deontology & Utilitarianism ,Casuist theory, Virtue theory, The Right Theory. Principles-Non-Maleficence, Beneficence, Autonomy, Veracity, Justice. Autonomy & Confidentiality issues in medical practice, Ethical Issues in biomedical research ,Bioethical issues in Human Genetics & Reproductive Medicine

UNIT III HOSPITAL ACCREDITATION STANDRADS 9

Accrediation- JCI Accreditation & its Policies. Patient centered standards, Healthcare Organization management standards.

UNIT IV HOSPITAL SAFETY STANDARDS 10

Life Safety Standards- Protecting Occupants, Protecting the Hospital From Fire, Smoke, and Heat, Protecting Individuals From Fire and Smoke, Providing and Maintaining Fire Alarm Systems, Systems for Extinguishing Fires Environment of Care Standards-Minimizing EC Risks, Smoking Prohibitions, Managing Hazardous Material and Waste, Maintaining Fire Safety Equipment, Features, Testing, Maintaining, and Inspecting Medical Equipment.

UNIT V MEDICAL EQUIPMENT SAFETY STANDARDS 9

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

TOTAL :45 PERIODS

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

REFRENCES:

1. Domiel A Vallero “Biomedical Ethics for Engineers”, Elsevier Pub.1st edition, 2007
2. Biomedical Ethics: A Canadian Focus. Johnna Fisher (ed.), Oxford University Press Canada (2009)
3. Robert M Veatch” Basics of Bio Ethics”, Second Edition. Prentice- Hall,Inc 2003
4. Physical Environment Online: A Guide to The Joint Commission’s Safety Standards is published by HCPro, Inc.2010
5. Joint Commission Accreditation Standards for Hospitals ,2 nd edition 2003
6. Bioethics-“An Introduction for the biosciences”, 2nd edition 2008, Ben Mepham, Oxford.

BM7011 BIOMEDICAL OPTICS L T P C
3 0 0 3

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 9

Refraction, Scattering, absorption, light transport inside the tissue, tissue properties, Light interaction with tissues, opto-thermal interaction, fluorescence.

UNIT II INSTRUMENTATION IN PHOTONICS 9

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 9

Laser in tissue welding, lasers in dermatology, lasers in ophthalmology, otolaryngology, urology.

UNIT IV DIAGNOSTIC APPLICATIONS 9

Optical coherence tomography, Elastography, Fluorescence Imaging, Raman Imaging, FLIM.

UNIT V THERAPEUTIC APLLICATIONS 9

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

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Markolf H.Niemz, “Laser-Tissue Interaction Fundamentals and Applications”, Springer, 2007.
2. Paras N. Prasad, “Introduction to Biophotonics”, A. John Wiley and sons, Inc. Publications, 2003.

REFERENCES:

1. Tuan Vo Dinh, “Biomedical photonics – Handbook”, CRC Press LLC, 2003.
2. Mark E. Brezinski, “Optical Coherence Tomography: Principles and Applications”, Academic Press, 2006.
3. R. Splinter and B.A. Hooper, “An Introduction to Biomedical Optics”, Taylor and Francis, 2007.

MX7003 BIO MEMS L T P C
3 0 0 3

(Only qualitative analysis)

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 9

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

UNIT II MECHANICAL AND THERMAL SENSORS AND ACTUATORS 9

Mechanics for MEMs design- static bending of thin plates, mechanical vibration, thermomechanics, fracture and thin film mechanics. Mechanical sensors and actuators – beam and cantilever – microplates, strain, pressure and flow measurements, Thermal sensors and actuators- actuator based on thermal expansion, thermal couples, thermal resistor, Shape memory alloys- Inertia sensor, flow sensor

UNIT III ELECTROSTATIC AND PIEZOELECTRIC SENSORS AND ACTUATORS 9

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 9

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 **9**

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

TOTAL: 45 PERIODS

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
3. Apply the concepts to the design of different types of micro systems
4. Apply the knowledge of CAD tools for MEMS design

REFERENCES

1. Tai Ran Hsu, "MEMS and Microsystems design and manufacture", Tata McGraw Hill Publishing Company, New Delhi, 2002
2. Nitaigour Premchand Mahalik, " MEMS", Tata McGraw Hill Publishing Company, New Delhi, 2007
3. Wanjun Wang, Steven A.Soper " BioMEMS- Technologies and applications", CRC Press,Boca Raton,2007
4. Chang Liu,' Foundations of MEMS', Pearson Education International, New Jersey, USA, 2006

BM7005 NANOTECHNOLOGY AND APPLICATIONS **L T P C**
3 0 0 3

UNIT I INTRODUCTION **6**

Definition of nanotechnology, Objective and goal of Nanotechnology, Importance of Nanoscale, revolution of Nanotechnology, Silicon based Technology.

UNIT II NANOMATERIALS **12**

Different forms of Nanomaterials – nanocomposite, carbon nanotubes, nanowires, nanoplates and nanorods. Preparation of nanomaterials-Plasma arcing, Chemical Vapor Deposition, Sol-gels techniques, Electrodeposition, Ball milling and Laser method, Natural nanomaterials, Applications of nanomaterials-Insulation materials, Machine tools, Phosphors, Batteries, High power magnets Medical implants.

UNITIII EXPERIMENTAL TECHNIQUES **10**

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 **10**

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

UNIT V R & D IN NANOTECHNOLOGY **7**

Nanotechnology current and future perspectives, research areas in nanotechnology, development of nanotechnology in India, Ehical issues and socioeconomic challenges
In nanotechnology

L =45 TOTAL: 45 PERIODS

REFERENCES:

1. Nanobiotechnology – Concepts, Applications and Perspectives – 2004. Edited by CM, Niemeyer, C.A. Mirkin. Wiley – VCH.
2. Nanoparticle Assemblies and Superstructures. By Nicholas A. Kotov.2006 -CRC.
3. Nano: The Essentials: T. Pradeep. McGraw – Hill education – 2007.
4. Nanofabrication Towards Biomedical Applications, Techniques, Tools, Applications and Impact. 2005 - By Challa, S.S.R. Kumar, Josef Hormes, Carola Leuschaer. Wiley – VCH.

BM7010 FINITE ELEMENT METHODS FOR BIO MECHANICAL ANALYSIS L T P C
3 0 0 3

UNIT I GENERAL INTRODUCTION 10

Historical Background – Mathematical Modeling of field problems in Engineering – Governing Equations – Discrete and continuous models – Boundary, Initial and Eigen Value problems – Variational Formulation of Boundary Value Problems – Ritz Technique –Natural and Essential Boundary conditions - Basic concepts of the Finite Element Method. One Dimensional Second Order Equations – Discretization – element types- Linear and Higher order Elements – Derivation of Shape functions and Stiffness matrices and force vectors - Assembly of Matrices - solution of problems from solid and bio mechanics- Structural, stress, and strain analysis of the human body and/or artifical implants.

UNIT II BEAM ELEMENTS AND SCALAR PROBLEM IN 2D: 9

Fourth Order Beam Equation –Transverse deflections - Natural frequencies of beams and Longitudinal vibration. Second Order 2D Equations involving Scalar Variable – Variational formulation –Finite Element formulation – Triangular elements – Shape functions and element matrices and vectors. Application to Field Problems in Bio mechanics - Quadrilateral elements

UNIT III APPLICATIONS TO FIELD PROBLEMS 9

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 ¶,¦ *and* ¸ – 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 8

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 9

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.

L = 45 TOTAL : 45 PERIODS

TEXT BOOKS:

1. Seshu. P. “Textbook of Finite Element Analysis” Prentice Hall of India, 2003.
2. J.N. Reddy, “ Finite Element Method” Tata McGraw Hill, 2003.
3. S.S. Rao, “The Finite Element Method in Engineering “Butter worth heinemann, 2001.
4. Reddy, J.N, “An Introduction to the Finite element Method”, McGraw – Hill, 1985.

VL7102 VLSI DESIGN TECHNIQUES L T P C
3 0 0 3

OBJECTIVES:

- To understand the concepts of MOS transistors operations and their AC , DC characteristics.
- To know the fabrication process of cmos technology and its layout design rules
- To understand the latch up problem in cmos circuits.
- To study the concepts of cmos invertors and their sizing methods
- To know the concepts of power estimation and delay calculations in cmos circuits.

UNIT I MOS TRANSISTOR THEORY 9

NMOS and PMOS transistors, CMOS logic, MOS transistor theory – Introduction, Enhancement mode transistor action, Ideal I-V characteristics, DC transfer characteristics, Threshold voltage- Body effect- Design equations- Second order effects. MOS models and small signal AC characteristics, Simple MOS capacitance Models, Detailed MOS gate capacitance model, Detailed MOS Diffusion capacitance model

UNIT II CMOS TECHNOLOGY AND DESIGN RULE 9

CMOS fabrication and Layout, CMOS technologies, P -Well process, N -Well process, twin -tub process, MOS layers stick diagrams and Layout diagram, Layout design rules, Latch up in CMOS circuits, CMOS process enhancements, Technology – related CAD issues, Fabrication and packaging.

UNIT III INVERTERS AND LOGIC GATES 9

NMOS and CMOS Inverters, Inverter ratio, DC and transient characteristics , switching times, Super buffers, Driving large capacitance loads, CMOS logic structures , Transmission gates, Static CMOS design, dynamic CMOS design.

UNIT IV CIRCUIT CHARACTERISATION AND PERFORMANCE ESTIMATION 9

Resistance estimation, Capacitance estimation, Inductance, switching characteristics, transistor sizing, power dissipation and design margining. Charge sharing Scaling.

UNIT V VLSI SYSTEM COMPONENTS CIRCUITS AND SYSTEM LEVEL PHYSICAL DESIGN 9

Multiplexers, Decoders, comparators, priority encoders, Shift registers. Arithmetic circuits – Ripple carry adders, Carry look ahead adders, High-speed adders, Multipliers. Physical design – Delay modelling ,cross talk, floor planning, power distribution. Clock distribution. Basics of CMOS testing.

TOTAL: 45 PERIODS

REFERENCES:

1. Neil H.E. Weste and Kamran Eshraghian, Principles of CMOS VLSI Design, Pearson Education ASIA, 2nd edition, 2000.
2. John P.Uyemura “Introduction to VLSI Circuits and Systems”, John Wiley & Sons, Inc., 2002.
3. Eugene D.Fabricius, Introduction to VLSI Design McGraw Hill International Editions, 1990.
4. Pucknell, “Basic VLSI Design”, Prentice Hall of India Publication, 1995.
5. Wayne Wolf “Modern VLSI Design System on chip. Pearson Education. 2002.

MX7004 COMPUTER BASED MEDICAL INSTRUMENTATION L T P C
3 0 0 3

UNIT I PC HARDWARE AND OVERVIEW 9

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 9

Pentium Microprocessor Architecture – Special Pentium Registers – Pentium Memory Management – New Pentium Instructions – Pentium Pro Microprocessor Architecture – Special features – Pentium II Microprocessor Architecture – Pentium III Microprocessor Architecture – Pentium III Architecture – Pentium IV Architecture – Comparison of Pentium Processors.

UNIT III COMPUTER ASSISTED MEDICAL IMAGING AND DECISION MAKING 9

Computers in Nuclear Medicine – Ultrasound Imaging: Ultrasonography – Computed X-ray Tomography – General Model of CMD – Various Approaches to Decision–making – Computer-assisted Decision Support Systems – Algorithmic Methods – Multivariate Analysis – Database Comparisons and Case-based Reasoning (CBR) – Production Rule Systems – Cognitive Models – Semantic Networks – Decision Analysis in Clinical Medicine.

UNIT IV COMPUTERISED DATA ACQUISITION AND PROGRAMMING 9

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 9

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

L = 45 TOTAL :45 PERIODS

REFERENCES:

1. N.Mathivanan, PC Based Instrumentation: Concepts and Practice, Prentice Hall of India, New Delhi 2007.
2. Herbert Schildt, The Complete Reference – JAVA, Tata McGraw Hill Publishing Company, New Delhi, 2005
3. John P Woodward, Biometrics – The Ultimate Reference, Dreamtech Publishers, New Delhi, 2003
4. Ranjan Parekh, Principles of Multimedia, Tata McGraw Hill Publishing Company, New Delhi, 2006
5. Stephen J Bigelow, Trouble shooting, Maintaining and Repairing of PCs, Tata McGraw Hill Publishing Company, New Delhi, 2005
6. H M Dietel, Internet and World Wide Web, AB Goldberg publishers, New Delhi, 2007
7. Atul Khate, Cryptography and network security, Tata McGraw Hill Publishing Company, New Delhi, 2008

BM7203 BIO MECHANICS L T P C
3 0 0 3

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 9

Use of statics, kinetics – rigid and non rigid bodies – Forces and motion – Newtons laws – Moment of force – Static equillibrum – 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 9

Bone structure & composition mechanical properties of bone, cortical and cancellous bones - Electrical properties of bone, fracture mechanism and crack propagation in bones, fracture fixators, repairing of bones. Pseudo elasticity, nonlinear stress-strain relationship, viscoelasticity, structure, function and mechanical properties of skin, ligaments and tendons. Head Injury tolerance, rotational injury, spine injury – Accident reconstruction, Analysis of impact, skid analysis – Damage analysis

UNIT III MECHANICS OF THE 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.

L = 45 TOTAL = 45 PERIODS

OUTCOMES:

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 (UNIT I, V)
2. Donald R. Peterson and Joseph D. Bronzino, Biomechanics Principles and applications, CRC press, Taylor & Francis Group, LLC, 2008 (UNIT II, III)
3. Duane Knudson, Fundamentals of Biomechanics, Second Edition, Springer publication , 2007 (UNIT IV)

CU7001 REAL TIME EMBEDDED SYSTEM L T P C
3 0 0 3

UNIT I INTRODUCTION TO EMBEDDED COMPUTING 9

Complex systems and microprocessors – Design example: Model train controller – Embedded system design process – Formalism for system design – Instruction sets Preliminaries – ARM Processor – CPU: Programming input and output – Supervisor mode, exception and traps – Coprocessor – Memory system mechanism – CPU performance – CPU power consumption.

UNIT II COMPUTING PLATFORM AND DESIGN ANALYSIS 9

CPU buses – Memory devices – I/O devices – Component interfacing – Design with microprocessors – Development and Debugging – Program design – Model of programs – Assembly and Linking – Basic compilation techniques – Analysis and optimization of execution time, power, energy, program size – Program validation and testing.

UNIT III PROCESS AND OPERATING SYSTEMS 9

Multiple tasks and multi processes – Processes – Context Switching – Operating Systems – Scheduling policies - Multiprocessor – Inter Process Communication mechanisms – Evaluating operating system performance – Power optimization strategies for processes.

UNIT IV HARDWARE ACCELERATES & NETWORKS 9

Accelerators – Accelerated system design – Distributed Embedded Architecture – Networks for Embedded Systems – Network based design – Internet enabled systems.

UNIT V CASE STUDY 9

Hardware and software co-design - Data Compressor - Software Modem – Personal Digital Assistants – Set–Top–Box. – System-on-Silicon – FOSS Tools for embedded system development.

TOTAL: 45 PERIODS

REFERENCES:

1. Wayne Wolf, “Computers as Components - Principles of Embedded Computer System Design”, Morgan Kaufmann Publisher, 2006.
2. David E-Simon, “An Embedded Software Primer”, Pearson Education, 2007.
3. K.V.K.K.Prasad, “Embedded Real-Time Systems: Concepts, Design & Programming”, dreamtech press, 2005.
4. Tim Wilmshurst, “An Introduction to the Design of Small Scale Embedded Systems”, Pal grave Publisher, 2004.
5. Sriram V Iyer, Pankaj Gupta, “Embedded Real Time Systems Programming”, Tata Mc-Graw Hill, 2004.
6. Tammy Noergaard, “Embedded Systems Architecture”, Elsevier, 2006.

BM7301 REHABILITATION ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

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 9

Definition, Concept of Rehabilitation: Types of Physical Impairments, Principles of Assistive Technology Assessment, Principles of Rehabilitation Engineering- Key Engineering Principles, Key Ergonomic Principles**,** Engineering Concepts in Sensory & Motor rehabilitation.

UNIT II ORTHOTICS & PROSTHETICS IN REHABILITATION: 9

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: 9

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: 9

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

TOTAL:45 PERIODS

OUTCOME

The student will have the knowledge about various rehabilitation aids available and the issues associated with the use of these aids

REFERENCES:

1. Rory A Cooper, An Introduction to Rehabilitation Engineering, Taylor & Francics ,CRC press,2006
2. Joseph D.Bronzino,The Biomedical Engineering Handbook,Third Edition: Three Volume Set,CRC Press,2006
3. MacLachlan M. and Gallagher P. Enabling Technologies – Body Image and Body Function, Churchill Livingstone, 2004.
4. Mann W.C. (ed). Smart Technology for Aging, Disability, and Independence – The State of The Science, Wiley, New Jersey, 2005.
5. Muzumdar A. Powered Upper Limb Prostheses – Control, Implementation and Clinical Application. Springer, 2004.

MX7005 ADVANCED NEURAL COMPUTING L T P C
3 0 0 3

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 9

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

Back Propagation Network, Generalised Delta Rule, BPN Application, Associative Memory definition, BAM, Hopfield Memory, Simulated Annealing – Boltzmann Machine.

UNIT III OTHER NEURAL NETWORKS 9

Counter Propagation Network, Feature Mapping, Self Organising Feature Maps, Adaptive Resonance Theory(ART) Network Descriptions.

UNIT IV GENETIC ALGORITHMS & IMPLEMENTATION TECHNIQUES 9

Genetic Algorithm: Fundamentals of genetic algorithm-Mathematical foundations-Genetic modeling-Survival of the fittest - crossover- Inversion and Deletion-mutation-reproduction Generational cycle-rank method-rank space method- Other derivative free optimization simulated annealing- Random search- Downhill simplex search- Applications.

UNIT V ADVANCES AND APPLICATIONS 9

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

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:

1. Philip D.Wasermann, Advanced Methods in neural Computing, Van Nostrand Reinhold, Newyork 1993.
2. Jang J.S.R., Sun C.T and Mizutani E, “Neuro Fuzzy and Soft Computing: A Computational Approach to Learning Machine Intelligence”, Prentice Hall, 1997.

REFERENCES:

1. David Goldberg, Genetic Algorithms in Search, Optimization and Machine Learning, Addison – Wesley USA, 1997.
2. Melanie Mitchell, An Introduction to Genetic Algorithms: Prentice Hall of India, New Delhi 1998.
3. Simon Haykins, Neural Networks, Prentice HallinternationalInc, 1999.
4. James A Freeman and David M.Skapra, Neural Networks, Addison – Wesley, India 1999.

CU7006 WAVELET TRANSFORMS AND APPLICATIONS L T P C
3 0 0 3

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 9

Vector Spaces – Properties– Dot Product – Basis – Dimension, Orthogonality and Orthonormality – Relationship Between Vectors and Signals – Signal Spaces – Concept of Convergence – Hilbert Spaces for Energy Signals- Fourier Theory: Fourier series expansion, Fourier transform, Short time Fourier transform, Time-frequency analysis.

UNIT II MULTI RESOLUTION ANALYSIS 9

Definition of Multi Resolution Analysis (MRA) – Haar Basis – Construction of General Orthonormal 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 9

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 9

Filter Bank and Sub Band Coding Principles – Wavelet Filters – Inverse DWT Computation by Filter Banks – Basic Properties of Filter Coefficients – Choice of Wavelet Function Coefficients – Derivations of Daubechies Wavelets – Mallat's Algorithm for DWT – Multi Band Wavelet Transforms Lifting Scheme- Wavelet Transform Using Polyphase Matrix Factorization – Geometrical Foundations of Lifting Scheme – Lifting Scheme in Z –Domain.

UNIT V APPLICATIONS 9

Wavelet methods for signal processing- Image Compression Techniques: EZW–SPHIT Coding – Image Denoising Techniques: Noise Estimation – Shrinkage Rules – Shrinkage Functions – Edge Detection and Object Isolation, Image Fusion, and Object Detection.

TOTAL: 45 PERIODS

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:

1. Rao R M and A S Bopardikar, —Wavelet Transforms Introduction to theory and Applications, Pearson Education, Asia, 2000.
2. L.Prasad & S.S.Iyengar, Wavelet Analysis with Applications to Image Processing, CRC Press, 1997.

REFERENCES

1. J. C. Goswami and A. K. Chan, "Fundamentals of wavelets: Theory, Algorithms and Applications" WileyInterscience Publication,John Wiley & Sons Inc., 1999.
2. M. Vetterli, J. Kovacevic, "Wavelets and subband coding" Prentice Hall Inc, 1995.
3. Stephen G. Mallat, "A wavelet tour of signal processing" 2 nd Edition Academic Press, 2000.
4. Soman K P and Ramachandran K I, —Insight into Wavelets From Theory to practicell, Prentice Hall, 2004.

MX7006 PHYSIOLOGICAL MODELING L T P C

3 0 0 3

OBJECTIVE:

To understand and appreciate the value and application of

1. Physiological models, 2.vital organs .3. Modeling dynamically varying physiological system 4. Methods and techniques to analyze and synthesis dynamic models 5. Develop differential equations to describe the dynamic models, simulate and visualize dynamic responses of physiological models using software.

UNIT I INTRODUCTION 9

System Concept, System Properties, Piece-Wise Linear Approximation, Electrical Analog for Compliance, Thermal Storage, Mechanical Systems, Step response of a Resistance/Compliant Systems, Pulse Response of First Order System.

UNIT II TRANSFER FUNCTION 9

System as an Operator use of Transfer Function, Bio Engineering of a Coupled System, Example of Transformed Signals and Circuits for the Transfer Function with Impedance Concept, Prediction of Performance.

UNIT III PERIODIC SIGNALS 9

Sinusoidal Functions, Sinusoidal Analysis of Instrumentation System, Evaluation of Transfer Function s 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 9

Characterization of Physiological Feedback. Systems, Uses and Testing of System Stability.

UNIT V SIMULATION OF BIOLOGICAL SYSTEMS 9

Simulation of Skeletal muscle servomechanism, thermo Regulation, cardiovascular control System, Respiration controls, Occulo Motor System, Endocrine control system and Modeling of receptors.

L = 45 TOTAL :45 PERIODS

OUTCOME:

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

REFERENCES:

1. William B. Blesser, A System Approach to Biomedicine, McGraw Hill Book Co, New York, 1969.
2. Manfreo Clynes and John H. Milsum, Biomedical Engineering System, McGraw Hill and Co, New York, 1970.
3. Douglas S. Rigg, Control Theory and Physiological Feedback Mechanism, The William and Wilkins Co, Baltimore, 1970 .
4. Richard Skalak and Shu Chien, Hand Book of Biomedical Engineering, McGraw Hill and Co, New York, 1987.
5. Michael C.K. Khoo, "Physiological Control System" - Analysis, Simulation and Estimation"- Prentice Hall of India, New Delhi, 2001

BM7004 BIO STATISTICS L T P C
3 0 0 3

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 9

Introduction, Some basic concepts, Measurement and Measurement Scales, Simple random sample, Computers and biostatistical analysis, Introduction to probability, likelihood & odds, distribution variability.

UNIT II STATISTICAL PARAMETERS 9

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 9

Introduction, regression model, sample regression equation, evaluating the regression equation, using the regression equation, correlation model, correlation coefficient

UNIT IV INTERPRETING DATA 9

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

UNIT V META ANALYSIS AND ANALYSIS OF VARIANCE 9

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:

1. Wayne W. Daniel, “Biostatistics-A Foundation for Analysis in the Health Sciences” John Wiley & Sons Publication, 6th Edition.
2. Marcello Pagano and Kimberlee Gauvreu “Principles of Biostatistics”, Thomson Learning Publication, 2006.
3. Ronald N Forthofer and Eun Sul Lee “Introduction to Biostatistics”, Academic Press
4. Animesh K. Dutta “Basic Biostatistics and its Applications” (2006)

MX7007 BRAIN CONTROL INTERFACES L T P C
3 0 0 3

OBJECTIVE :

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

UNIT I INTRODUCTION TO BCI 9

Concept of BCI – Invasive and Non-invasive Types – EEG Standards – Signal Features – Spectral Components – EEG Data Acquisition – Pre-processing – Hardware and Software – Artifacts – Methods to Remove – Near Infrared BCI.

UNIT II BCI APPROACHES 9

Mu Rhythm – Movement Related EEG Potentials – Mental States – Visual Evoked Potential Based – P300 component.

UNIT III EEG FEATURE EXTRACTION METHODS 9

Time/Space Methods – Fourier Transform – Wavelets – AR models – Band pass filtering – PCA – Laplacian Filters – Linear and Non-linear Features.

UNIT IV EEG FEATURE TRANSLATION METHODS 9

LDA – Regression – Memory Based – Vector Quantization – Gaussian Mixture Modeling – Hidden Markov Modeling.

UNIT V CASE STUDY **9**

Case Study of Problems in BCI Competition III(2005) – Dataset I, II, III, IV and V – Solutions. Case Study of Brain Actuated Control of Khepera Mobile Robot.

L = 45 TOTAL : 45 PERIODS

OUTCOMES:

At the end of the course, the student will be able to

1. Acquire the brain signal in the format required for the specific application
2. Preprocess the signal for signal enhancement
3. Extract the dominant and required features
4. Classify the signal for applications

REFERENCES:

1. Special Issue on Brain Control Interfaces, IEEE Transactions on Neural Systems and Rehabilitation Engineering, Vol 14, June 2006.
2. Andrew Webb, "Statistical Pattern Recognition", Wiley International, Second Edition, 2002.
3. R.Spehlmann, "EEG Primer", Elsevier Biomedical Press, 1981. ArnonKohen, "Biomedical Signal Processing", Vol I and II, CRC Press Inc, ocaRato, Florida.
4. Bishop C.M, "Neural Networks for Pattern Recognition", Oxford, Clarendon Press, 1995.
5. TorstenFelzer, "On the possibility of Developing a Brain Computer Interface", Technical Report, Technical University of Darmstadt, Germany, 2001.
6. Wolpaw J.R, N.Birbaumer et al, "Brain control interface for Communication and control", Clinical Neurophysiology, 113, 2002.
7. Jose del R.Millan et al, "Non-invasive brain actuated control of a mobile robot by human EEG", IEEE Transactions on biomedical Engineering, Vol 51, No.6, 2004 June.
8. S.Coyle, T.Ward et al, "On the suitability of near infra red systems for next generation Brain Computer interfaces", Physiological Measurement, 25, 2004.
9. Carlo Tomasi, "Estimating Gaussian Mixture Densities with EM – A Tutorial", Duke University, 2000.
10. R.Dugad, U.B Desai, " A Tutorial on Hidden Markov Modeling", Signal Processing and Artificial Neural Networks Laboratory, IIT Bombay, 1996.
11. http:://ida.first.fhg.de/projects/bci/competition_iii

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**

Overview of Pattern recognition – Discriminant functions – Supervised learning – Parametric estimation – Maximum Likelihood Estimation – Bayesian parameter Estimation – Problems with Bayes approach– Pattern classification by distance functions – Minimum distance pattern classifier.

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.

UINT III FEATURE EXTRACTION AND STRUCTURAL PATTERN RECOGNITION 9

KL Transforms – Feature selection through functional approximation – Binary selection -Elements of formal grammars - Syntactic description - Stochastic grammars - Structural representation. .

UNIT IV HIDDEN MARKOV MODELS AND SUPPORT VECTOR MACHINE 9

State Machines – Hidden Markov Models – Training – Classification – Support vector Machine – Feature Selection.

UNIT V RECENT ADVANCES 9

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:

1. M. Narasimha Murthy and V. Susheela Devi, “Pattern Recognition”, Springer 2011.
2. S.Theodoridis and K.Koutroumbas, “Pattern Recognition”, 4th Ed., Academic Press, 2009.
3. Robert J.Schalkoff, “Pattern Recognition Statistical, Structural and Neural Approaches”, John Wiley & Sons Inc., New York, 1992.
4. C.M.Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006.
5. R.O.Duda, P.E.Hart and D.G.Stork, “Pattern Classification”, John Wiley, 2001.
6. Andrew Webb, “Stastical Pattern Recognition”, Arnold publishers, London, 1999.

MX7008 TELE HEALTH 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 9

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 9

Principles of Multimedia - Text, Audio, Video, data, Data communications and networks, PSTN, POTS, ANT, ISDN, Internet, Air/ wireless communications: GSM satellite, and Micro wave, Modulation techniques, Types of Antenna, Integration and operational issues, Communication infrastructure for telemedicine – LAN and WAN technology. Satellite communication. Mobile hand held devices and mobile communication. Internet technology and telemedicine using world wide web (www). Video and audio conferencing. Clinical data –local and centralized.

UNIT III TELEMEDICAL STANDARDS 9

Data Security and Standards: Encryption, Cryptography, Mechanisms of encryption, phases of Encryption. Protocols: TCP/IP, ISO-OSI, Standards to followed DICOM, HL7, H. 320 series (Video phone based ISBN) T. 120, H.324 (Video phone based PSTN), Video Conferencing, Real-time Telemedicine integrating doctors / Hospitals, Clinical laboratory data, Radiological data, and other clinically significant biomedical data, Administration of centralized medical data, security and confidentially of medical records and access control, Cyber laws related to telemedicine.

UNIT IV MOBILE TELEMEDICINE 9

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 9

Telemedicine access to health care services – health education and self care. · Introduction to robotics surgery, telesurgery. Telecardiology, Teleoncology, Telemedicine in neurosciences, Electronic Documentation, e-health services security and interoperability., Telemedicine access to health care services – health education and self care, Business aspects - Project planning and costing, Usage of telemedicine.

L =45 TOTAL : 45 PERIODS

REFERENCES:

1. Norris, A.C. Essentials of Telemedicine and Telecare. Wiley (ISBN 0-471-53151-0), 2002
2. Wootton R. Craig, J., Patterson, V. (Eds.), Introduction to Telemedicine. Royal Society of Medicine Press Ltd (ISBN 1853156779), 2006
3. O'Carroll, P.W, Yasnoff W.A., Ward E.Ripp, L.H., Martin, E.L. (Eds), Public Health Informatics and Information Systems. Springer (ISBN 0-387-95474-0), 2003
4. Ferrer-Roca, O., Sosa-Iudicissa, M. (editors), Handbook of Telemedicine. IOS Press (Studies in Health Technology and Informatics, Volume 54). (ISBN 90-5199-413-3), 2002.
5. Simpson, W. 2006. Video over IP. A practical guide to technology and applications. Focal Press (Elsevier). ISBN-10: 0-240-80557-7
6. Bemmel, J.H. van, Musen, M.A. (Eds.) (1997). Handbook of Medical Informatics. Heidelberg, Germany: Springer. (ISBN 3-540-63351-0)

AP7008 DSP INTEGRATED CIRCUITS L T P C
3 0 0 3

OBJECTIVES:

- To study the procedural flow of system design in DSP and Integrated circuit.
- To analyse the frequency response and transfer function of DSP systems.
- To compare and study the performance of various transforms for signal processing.
- To design FIR and IIR filters for the given specifications.
- To study the architectures for DSP system.
- To study the design layout for VLSI circuits.

UNIT I DSP INTEGARTED CIRCUITS AND VLSI CIRCUIT TECHNOLOGIES 9

Standard digital signal processors, Application specific IC's for DSP, DSP systems, DSP system design, Integrated circuit design. MOS transistors, MOS logic, VLSI process technologies, Trends in CMOS technologies.

UNIT II DIGITAL SIGNAL PROCESSING 9

Digital signal processing, Sampling of analog signals, Selection of sample frequency, Signal-processing systems, Frequency response, Transfer functions, Signal flow graphs, Filter structures, Adaptive DSP algorithms, DFT-The Discrete Fourier Transform, FFT-The Fast Fourier Transform Algorithm, Image coding, Discrete cosine transforms.

UNIT III DIGITAL FILTERS AND FINITE WORD LENGTH EFFECTS 9

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 IV DSP ARCHITECTURES AND SYNTHESIS OF DSP ARCHITECTURES 9

DSP system architectures, Standard DSP architecture, Ideal DSP architectures, Multiprocessors and multicomputers, Systolic and Wave front arrays, Shared memory architectures. Mapping of DSP algorithms onto hardware, Implementation based on complex PEs, Shared memory architecture with Bit – serial PEs.

UNIT V ARITHMETIC UNITS AND INTEGRATED CIRCUIT DESIGN 9

Conventional number system, Redundant Number system, Residue Number System, Bit-parallel and Bit-Serial arithmetic, Basic shift accumulator, Reducing the memory size, Complex multipliers, Improved shift-accumulator. Layout of VLSI circuits, FFT processor, DCT processor and Interpolator as case studies. Cordic algorithm.

TOTAL: 45 PERIODS

REFERENCES:

1. Lars Wanhammer, "DSP Integrated Circuits", 1999 Academic press, New York
2. A.V.Oppenheim et.al, "Discrete-time Signal Processing", Pearson Education, 2000.
3. Emmanuel C. Ifeachor, Barrie W. Jervis, " Digital signal processing – A practical approach", Second Edition, Pearson Education, Asia.
4. Keshab K.Parhi, "VLSI Digital Signal Processing Systems design and Implementation", John Wiley & Sons, 1999.

MX7009 ADVANCES IN ELECTRONICS APPLIED TO HOSPITAL ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

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

UNIT I CLINICAL ENGINEERING 9

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

UNIT II NETWORKING 9

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.

UNITIII FIBRE OPTIC SENSORS FOR MEASURING PHYSIOLOGICAL PARAMETERS 9

Different optical sources, optical detectors, principle of fiber optic cables, single mode, multi mode, step index and graded index type, sensors based on polarisation, interferometer principle, magnetic sensors, application of the sensors in measuring pressure, temperature, flow, rotation and chemical activities, principles of smart sensors.

UNIT IV EMI AND EMC APPLIED TO HOSPITAL EQUIPMENTS 9

Principles of EMI, computation Of EMI, measuring techniques to quantify the level of interference, method of suppressing and isolating this unit from interference

UNIT VI VIRTUAL REALITY APPLICATION 9

Basic concepts of Virtual Environment , Human Factors and Human Perception, Computer graphics principles used in VR, Modeling of a Virtual Environment ,Existing tools, Avadars, Sensors for Perception, Tracking, Camera, Head mount display used in VR, Applications of Virtual Reality in Medicine

L = 45 TOTAL : 45 PERIODS

OUTCOMES:

- At the end of the course, the student will know about the role and importance of clinical engineer in the management of the hospital, need for calibration of medical devices and will be able to specify the type of networking facility to be provided in the hospital
- The student will have knowledge about the electromagnetic effects and the methods of making the devices electromagnetically compatible
- The student will be able to specify the type of optic sensor for physiological measurement

REFERENCES:

1. Syed Amin Tabish “Hospital and Health services Administration Principles and Practices Oxford Press New Delhi 2001
2. Jacob Kline – Handbook of Biomedical Engineering Academe press INC Sandiego 1981.
3. Bernhard Keiser, Principles of Electromagnetic Compatibility, Artech House 3rd Edition, 1986.
4. Eric Udd, Fibre Optic Sensors and introduction for engineers and scientists,WileyInterscience Publication, New Delhi, 1991.
5. SK Basandra, Local Area Network,Golgotia Publishing Pvt. Ltd., New Delhi, 1995

MX7010 HEALTH, HOSPITAL AND EQUIPMENT MANAGEMENT L T P C
3 0 0 3

OBJECTIVES:

- To develop an understanding of the various setups of hospital, health care codes, equipment management so as to enable the student to work in the hospital environment.

UNIT I HEALTH SYSTEM 9

Health organisation of the country, the State, the Cities and the Region, Health Financing System, Health services, Functions of Hospitals, Types of Hospitals, Primary Health Care –An Introduction.

UNIT II HOSPITAL ORGANISATION AND MANAGEMENT 9

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 9

FDA Regulation, Joint Commission of Accreditation for Hospitals, National Fire Protection Association Standard, IRPQ.

UNIT IV TRAINED TECHNICAL PERSONNEL 9

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 9

Organising Maintenance Operations, Paper Work Control, Maintenance Job Planning, Maintenance Work Measurement and Standards, Preventive Maintenance, Maintenance Budgeting and Forecasting, Maintenance Training, Contract Maintenance.

TOTAL: 45 PERIODS

OUTCOME:

The student will know the need for regulatory bodies and their functions and the role of engineer in the hospital in the management of essential medical device for proper healthcare delivery in the hospital

REFERENCES:

1. Cesar A.Caceres and Albert Zara,The Practice of Clinical Engineering, Academic Press, New York,1977.
2. Webster.J.G. and Albert M.Cook,Clinical Engineering Principles and Practices Prentice Hall Inc. ,Englewood Cliffs, New Jersey, 1979.
3. Hans Pfeiff,Vera Dammann (Ed.),Hospital Engineering in Developing Countries, Z Report, Eschbom,1986
4. Jacob Kline, Handbook of Bio Medical Engineering, Academic Press Inc. SanDeigo 1988
5. R.C.Goyal, Human Resource Management in Hospital, Prentice Hall of India, 3rd edition,2000.
6. Syed Amin Tabish “Hospital and Health services Administration Principles and Practices Oxford Press New Delhi 2001

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

OBJECTIVES:

- To gain information about regulatory requirements in a hospital
- To understand the safety aspects in health care and in hospitals

UNIT I STANDARDIZATION OF QUALITY MEDICAL CARE IN HOSPITALS 9

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 9

FDA regulations, Accreditation for hospitals - JCI, NABH and NABL, Other regulatory Codes.

UNIT III HOSPITAL SAFETY 9

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 9

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 9

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

OUTCOME

The student will know the need for regulatory bodies and their functions for proper and safe healthcare delivery in the hospital

REFERENCES:

1. Cesar A. Cacere & Albert Zana, The Practice of Clinical Engg. Academic press, New York, 1977.
2. Webster J.G and Albert M.Cook, Clinical Engg, Principles & Practices, Prentic Hall Inc.,Engle wood Cliffs, New Jersy, 1979.
3. B.M.Sakharkar, Principles of Hospital administration and Planning, JAYPEE Brothers, Medical Publishers (P) Ltd.
4. K.Shridhara Bhat, Quality Management, Himalaya Publishing House.
5. Karen Parsley, Karen Parsley Philomena Corrigan "Quality improvement in Healthcare, 2 nd edition, Nelson Thrones Pub, 2002
6. Sharon Myers "Patient Safety & Hospital Accreditation - A Model for Ensuring Success" Springer Publishers 2012
7. Joseph F Dyro "Clinical Engineering Handbook " Elsevier Publishers, 2004

AP7301 ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY L T P C
3 0 0 3

OBJECTIVES:

- To understand the basics of EMI
- To study EMI Sources
- To understand EMI problems
- To understand Solution methods in PCB
- To understand Measurement technique for emission
- To understand Measurement technique for immunity

OUTCOMES:

Upon Completion of the course, the students will be able to

- To design a EMI free system
- To reduce system level crosstalk
- To design high speed Printed Circuit board with minimum interference
- To make our world free from unwanted electromagnetic environment

UNIT I EMI/EMC CONCEPTS 9

EMI-EMC definitions and Units of parameters; Sources and victim of EMI; Conducted and Radiated EMI Emission and Susceptibility; Transient EMI, ESD; Radiation Hazards.

UNIT II EMI COUPLING PRINCIPLES 9

Conducted, radiated and transient coupling; Common ground impedance coupling; Common mode and ground loop coupling ; Differential mode coupling ; Near field cable to cable coupling, cross talk ; Field to cable coupling ; Power mains and Power supply coupling.

UNIT III EMI CONTROL TECHNIQUES 9

Shielding- Shielding Material-Shielding integrity at discontinuities, Filtering- Characteristics of Filters-Impedance and Lumped element filters-Telephone line filter, Power line filter design, Filter installation and Evaluation, Grounding- Measurement of Ground resistance-system grounding for EMI/EMC-Cable shielded grounding, Bonding, Isolation transformer, Transient suppressors, Cable routing, Signal control. EMI gaskets

UNIT IV EMC DESIGN OF PCBS 9

EMI Suppression Cables-Absorptive, ribbon cables-Devices-Transient protection hybrid circuits ,Component selection and mounting; PCB trace impedance; Routing; Cross talk control-Electromagnetic Pulse-Noise from relays and switches, Power distribution decoupling; Zoning; Grounding; VIAs connection; Terminations.

UNIT V EMI MEASUREMENTS AND STANDARDS 9

Open area test site; TEM cell; EMI test shielded chamber and shielded ferrite lined anechoic chamber; Tx /Rx Antennas, Sensors, Injectors / Couplers, and coupling factors; EMI Rx and spectrum analyzer; Civilian standards-CISPR, FCC, IEC, EN; Military standards-MIL461E/462. Frequency assignment - spectrum conversation. British VDE standards, Euro norms standards in japan - comparisons. EN Emission and Susceptibility standards and Specifications.

TOTAL: 45PERIODS

REFERENCES:

1. V.P.Kodali, “Engineering EMC Principles, Measurements and Technologies”, IEEE Press, New york, 1996
2. Clayton R.Paul,” Introduction to Electromagnetic Compatibility”, John Wiley Publications, 2008
3. Henry W.Ott.,”Noise Reduction Techniques in Electronic Systems”, A Wiley Inter Science Publications, John Wiley and Sons, New york, 1988.
4. Bemhard Keiser, “Principles of Electromagnetic Compatibility”, 3rd Ed, Artech house, Norwood, 1986.
5. Don R.J. White Consultant Incorporate, “Handbook of EMI/EMC”, Vol I-V, 1988.