

**UNIVERSITY DEPARTMENTS**  
**ANNA UNIVERSITY, CHENNAI 600 025**  
**REGULATIONS - 2013**  
**M.E. BIOMEDICAL ENGINEERING**  
**CURRICULUM AND SYLLABUS I TO IV SEMESTERS (FULL TIME)**  
**SEMESTER I**

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
<b>THEORY</b>						
1.	BO8101	Biomedical Sensors and Instrumentation	3	0	0	3
2.	BO8102	Diagnostic and Therapeutic Equipments	3	0	0	3
3.	BO8103	Medical Imaging Systems	3	0	0	3
4.	MA8163	Advanced Applied Mathematics	3	1	0	4
5.	MD8152	Anatomy and Physiology	3	0	0	3
6.		Elective I	3	0	0	3
<b>PRACTICAL</b>						
7.	BO8111	Clinical Instrumentation Laboratory	0	0	4	2
<b>TOTAL</b>			<b>18</b>	<b>1</b>	<b>4</b>	<b>21</b>

**SEMESTER II**

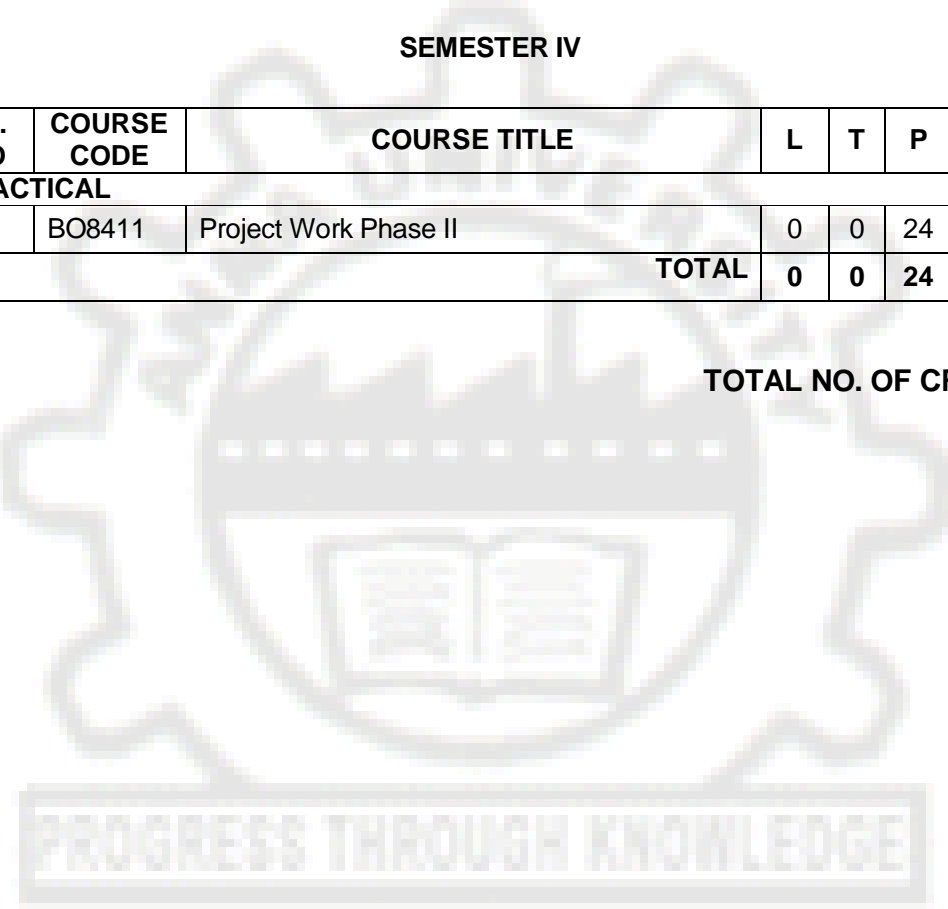
SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
<b>THEORY</b>						
1.	BO8252	Bio Mechanics	3	0	0	3
2.	BO8253	Rehabilitation Engineering	3	0	0	3
3.		Elective II	3	0	0	3
4.		Elective III	3	0	0	3
5.		Elective IV	3	0	0	3
6.		Elective V	3	0	0	3
<b>PRACTICAL</b>						
7.	BO8211	Hospital Information System Laboratory	0	0	4	2
<b>TOTAL</b>			<b>18</b>	<b>0</b>	<b>4</b>	<b>20</b>

**SEMESTER III**

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
<b>THEORY</b>						
1.		Elective VI	3	0	0	3
2.		Elective VII	3	0	0	3
3.		Elective VIII	3	0	0	3
<b>PRACTICAL</b>						
4.	BO8311	Project Work Phase I	0	0	12	6
<b>TOTAL</b>			<b>9</b>	<b>0</b>	<b>12</b>	<b>15</b>

**SEMESTER IV**

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
<b>PRACTICAL</b>						
1.	BO8411	Project Work Phase II	0	0	24	12
<b>TOTAL</b>			<b>0</b>	<b>0</b>	<b>24</b>	<b>12</b>

**TOTAL NO. OF CREDITS:68**


PROGRESS THROUGH KNOWLEDGE

Attested

  
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**M.E. BIOMEDICAL ENGINEERING**  
**CURRICULUM I TO VI SEMESTERS (PART TIME)**

**SEMESTER I**

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
<b>THEORY</b>						
1.	MA8163	Advanced Applied Mathematics	3	1	0	4
2.	BO8101	Biomedical Sensors and Instrumentation	3	0	0	3
3.	MD8152	Anatomy and Physiology	3	0	0	3
<b>TOTAL</b>			<b>9</b>	<b>1</b>	<b>0</b>	<b>10</b>

**SEMESTER II**

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
<b>THEORY</b>						
1.	BO8252	Bio Mechanics	3	0	0	3
2.	BO8253	Rehabilitation Engineering	3	0	0	3
3.		Elective I	3	0	0	3
<b>TOTAL</b>			<b>9</b>	<b>0</b>	<b>0</b>	<b>9</b>

**SEMESTER III**

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
<b>THEORY</b>						
1.	BO8102	Diagnostic and Therapeutic Equipments	3	0	0	3
2.	BO8103	Medical Imaging Systems	3	0	0	3
3.		Elective II	3	0	0	3
<b>PRACTICAL</b>						
4.	BO8111	Clinical Instrumentation Laboratory	0	0	4	2
<b>TOTAL</b>			<b>9</b>	<b>0</b>	<b>4</b>	<b>11</b>

**SEMESTER IV**

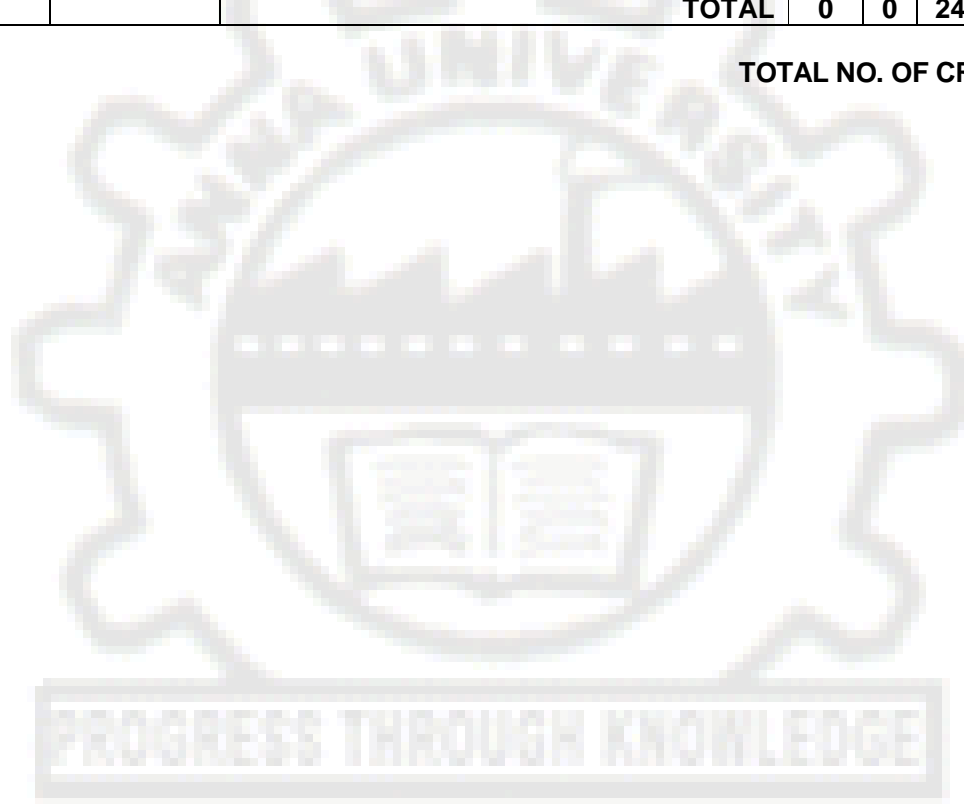
SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
<b>THEORY</b>						
1.		Elective III	3	0	0	3
2.		Elective IV	3	0	0	3
3.		Elective V	3	0	0	3
<b>PRACTICAL</b>						
4.	BO8211	Hospital Information System Laboratory	0	0	4	2
<b>TOTAL</b>			<b>9</b>	<b>0</b>	<b>4</b>	<b>11</b>

**SEMESTER V**

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
<b>THEORY</b>						
1.		Elective VI	3	0	0	3
2.		Elective VII	3	0	0	3
3.		Elective VIII	3	0	0	3
<b>PRACTICAL</b>						
4.	BO8311	Project Work Phase I	0	0	12	6
<b>TOTAL</b>			<b>9</b>	<b>0</b>	<b>12</b>	<b>15</b>

**SEMESTER VI**

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
<b>PRACTICAL</b>						
1.	BO8411	Project Work Phase II	0	0	24	12
<b>TOTAL</b>			<b>0</b>	<b>0</b>	<b>24</b>	<b>12</b>

**TOTAL NO. OF CREDITS : 68**

Attested

  
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## ELECTIVES LIST

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
1.	BO8001	Bio Statistics	3	0	0	3
2.	BO8002	Finance Management in Hospital	3	0	0	3
3.	BO8003	Finite Element Analysis For Biomedical Engineering	3	0	0	3
4.	BO8004	Health Informatics	3	0	0	3
5.	BO8005	Health Policy and Equipment Management	3	0	0	3
6.	BO8006	Hospital Architecture	3	0	0	3
7.	BO8007	Hospital Planning, Organization and Management	3	0	0	3
8.	BO8008	Hospital Waste Management	3	0	0	3
9.	BO8009	Human Resource Management in Hospital	3	0	0	3
10.	BO8010	Physics in Medicine	3	0	0	3
11.	BO8011	Quality Assurance and Safety in Hospitals	3	0	0	3
12.	BO8012	Signal Processing and Image processing Techniques Applied to Biological Systems	3	0	0	3
13.	BO8071	Bio Materials	3	0	0	3
14.	MD8071	Advanced Neural Computing	3	0	0	3
15.	MD8072	Advanced Neural Engineering	3	0	0	3
16.	MD8073	Bio MEMS	3	0	0	3
17.	MD8074	Computer Based Medical Instrumentation	3	0	0	3
18.	MD8075	Medical Ethics and Standards	3	0	0	3
19.	MD8076	Medical Optics	3	0	0	3
20.	MD8077	Nanomedicine Principles and Applications	3	0	0	3
21.	MD8078	Pattern Recognition Techniques and Applications	3	0	0	3
22.	MD8079	Physiological Modeling	3	0	0	3
23.	MD8080	Principles of Genetic Analysis	3	0	0	3
24.	MD8081	Tele Health Technology	3	0	0	3
25.	MD8082	Tissue Engineering	3	0	0	3
26.	MD8083	Ultrasound Principles and Applications in Medicine	3	0	0	3

*Attested*

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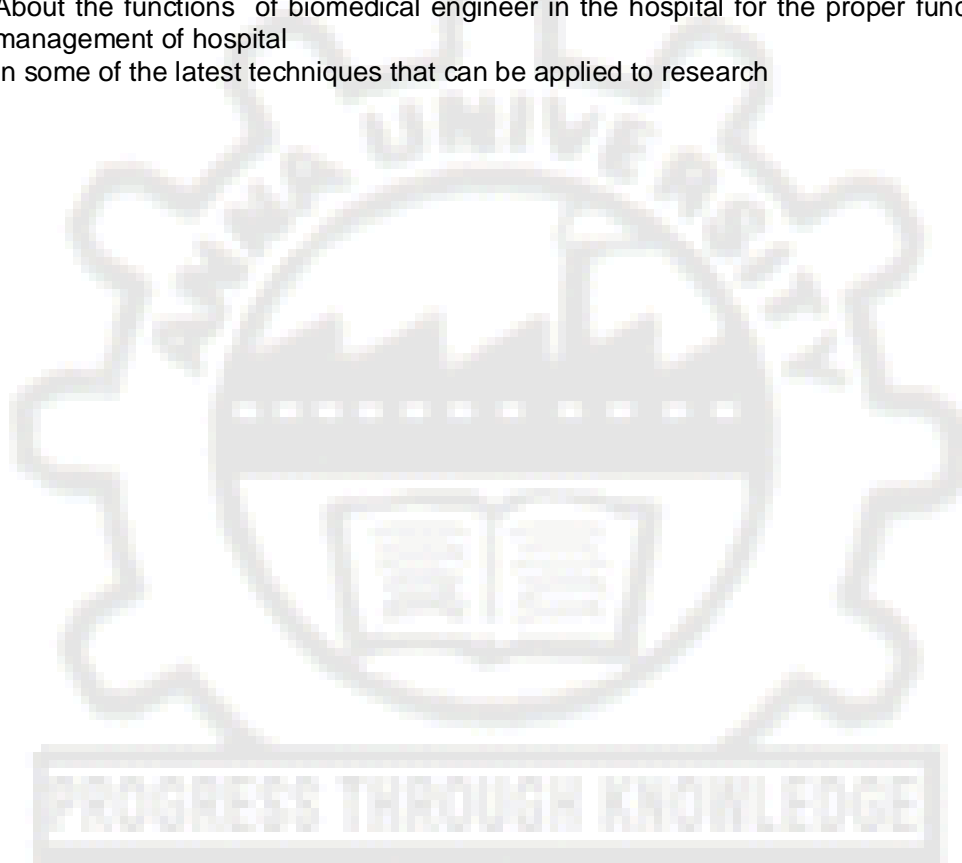
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**SYLLABUS I TO IV SEMESTERS (FULL TIME)**

**M.E. BIOMEDICAL ENGINEERING**

**PROGRAMME OBJECTIVES:**

The students will learn and gain knowledge

- In the use of different types of sensors and measurement of various physiological parameters
- About various imaging modalities used in the hospitals
- In the application of basic processing techniques for the analysis of these signals
- About the functions of biomedical engineer in the hospital for the proper functioning and management of hospital
- In some of the latest techniques that can be applied to research





**OBJECTIVES:**

- To know the various biopotential recordings so as to enable students to record various biosignals.
- To know the various functional blocks present in cardiac care units so that the students can handle these equipments with care and safety.
- To develop an understanding of the physiotherapy and diathermy equipment so that the student can learn to operate.

**UNIT I BIO POTENTIAL RECORDING 9**

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

**UNIT II CARDIAC CARE UNITS 9**

Pace makers - different types, batteries for pace makers. DC defibrillators, asynchronous and synchronous types, patient monitoring system, principles of bio telemetry.

**UNIT III DIATHERMY AND STIMULATOR 9**

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

**UNIT IV ASSIST DEVICES 9**

Heart lung machine-Condition to be satisfied by the H/L System. Different types of Oxygenators, Pumps, Pulsatile and Continuous Types, Monitoring Process. Hemodialyser-Indication and Principle of Hemodialysis, Membrane, Dialysate, Different types of hemodialysers, Monitoring Systems, Wearable Artificial Kidney, Implanting Type. Respiratory aids- Intermittent positive pressure, Breathing Apparatus Operating Sequence, Electronic IPPB unit with monitoring for all respiratory parameters.

**UNIT V RECENT TRENDS 9**

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

**TOTAL: 45 PERIODS****REFERENCES:**

1. Albert M Cook and Webster J G – Therapeutic medical devices Prentice Hall New York 1982
2. Heinz Kresse – Handbook of Electro medicine. John Wiley & Sons – Chichester – 1985
3. Webster J.G Medical Instrumentation application and design – John Wiley and sons New York 3<sup>rd</sup> edition 1999
4. Jacobson B and Webster J G Medical and Clinical Engineering – Prentice Hall of India New Delhi 1999
5. Leslie Cromwell , Fred J.Weibell and Erich A.Pfeiffer - Biomedical Instrumentation Prentice Hall New Delhi 2000
6. Joseph J Carr and John M Brown – Introduction to Biomedical equipment Technology - Pearson Education 4<sup>th</sup> edition New Delhi 2001.
7. Khandpur R.S Hand Book of Biomedical Instrumentation – Tata McGraw Hill publication , New Delhi 2<sup>nd</sup> edition 2003
8. John Denis Enderle, Joseph D. Bronzino, Susan M. Blanchard, 'Introduction to Biomedical Engineering:' Academic Press, 2005 , 2<sup>nd</sup> Edition ISBN 0122386620, 9780122386626



**OUTCOMES:**

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

- Develop measurement systems by selecting different types of, electrodes, signal conditioning circuits for acquiring and recording various biopotential.
- Describe and explain specific parts in Cardiac care units.
- Describe important working mechanisms of assist devices.
- Get clear domain knowledge about various types of Medical stimulators, and recently developed equipments.

**BO8103****MEDICAL IMAGING SYSTEMS****L T P C**  
**3 0 0 3****OBJECTIVES:**

- To study the production of x-rays and its application to different medical Imaging techniques.
- To study the different types of Radio diagnostic techniques.
- To study the special imaging techniques used for visualizing the cross sections of the body.
- To study the imaging of soft tissues using ultrasound technique

**UNIT I PRINCIPLES OF RADIOGRAPHIC EQUIPMENT 8**

X-Ray tubes, cooling systems, removal of scatters, Fluoroscopy- construction of image Intensifier tubes, angiographic setup, mammography, digital radiology, DSA.

**UNITII COMPUTED TOMOGRAPHY 10**

Need for sectional images, Principles of sectional scanning, CT detectors, Methods of reconstruction, Iterative, Back projection, convolution and Back-Projection. Artifacts, Principle of 3D imaging

**UNIT III RADIO ISOTOPIC IMAGING 9**

Alpha, Beta and Gamma radiation, Radiation detectors, Radio isotopic imaging equipments, Radio nuclides for imaging, Gamma ray camera, scanners, Positron Emission tomography, SPECT,PET/CT.

**UNIT IV ULTRASONIC SYSTEMS 9**

Wave propagation and interaction in Biological tissues, Acoustic radiation fields, continuous and pulsed excitation, Transducers and imaging systems, Scanning methods, Imaging Modes, Principles and theory of image generation.

**UNIT V MAGNETIC RESONANCE IMAGING 9**

NMR, Principles of MRI, Relaxation processes and their measurements, Pulse sequencing and MR image acquisition, MRI Instrumentation, Functional MRI.

**TOTAL: 45 PERIODS****REFERENCES:**

1. D.N.Chesney and M.O.Chesney Radio graphic imaging, CBS Publications, New Delhi, 1987.
2. Peggy, W., Roger D.Ferimarch, MRI for Technologists, Mc Graw Hill, New York, 1995.
3. Steve Webb, The Physics of Medical Imaging, Taylor & Francis, New York.1988.
4. Donald W.McRobbice, Elizabeth A.Moore, Martin J.Grave and Martin R.Prince MRI from picture to proton ,Cambridge University press, New York 2006.
5. Jerry L.Prince and Jnathan M.Links," Medical Imaging Signals and Systems"- Pearson Education Inc. 2006

**OUTCOMES:**

- Students will get the clear domain knowledge about the various Medical Imaging techniques.
- Students will be able to understand the various diagnostic applications of the medical imaging techniques.

**OBJECTIVES:**

- To encourage students to develop a working knowledge of the central ideas of linear algebra;
- To study and understand the concepts of probability and random variable of the various functions;
- understand the notion of a Markov chain, and how simple ideas of conditional probability and matrices can be used to give a thorough and effective account of discrete-time Markov chains;
- To formulate and construct a mathematical model for a linear programming problem in real life situation;
- Introduce the Fourier Transform as an extension of Fourier techniques on periodic functions and to solve partial differential equations;

**UNIT I LINEAR ALGEBRA****9+3**

Vector spaces – norms – Inner Products – Eigen values using QR transformations – QR factorization - generalized eigenvectors – Canonical forms – singular value decomposition and applications - pseudo inverse – least square approximations --Toeplitz matrices and some applications.

**UNIT II ONE DIMENSIONAL RANDOM VARIABLES****9+3**

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 III RANDOM PROCESSES****9+3**

Classification – Auto correlation - Cross correlation - Stationary random process – Markov process -- Markov chain - Poisson process – Gaussian process.

**UNIT IV LINEAR PROGRAMMING****9+3**

Formulation – Graphical solution – Simplex method – Two phase method - Transportation and Assignment Models

**UNIT V FOURIER TRANSFORM FOR PARTIAL DIFFERENTIAL EQUATIONS****9+3**

Fourier transforms: Definitions, properties-Transform of elementary functions, Dirac Delta functions – Convolution theorem – Parseval's identity – Solutions to partial differential equations: Heat equations, Wave equations, Laplace and Poisson's equations.

**TOTAL: 45+15=60 PERIODS****TEXT BOOKS:**

1. Bronson, R. Matrix Operation, Schaum's outline series, Mc GrawHill, Newyork (1989).
2. Oliver C. Ibe, "Fundamentals of Applied Probability and Random Processes, Academic Press, (An imprint of Elsevier), 2010.
3. Taha H.A. "Operations Research : An introduction" Ninth Edition, Pearson Education, Asia, New Delhi 2012.
4. Sankara Rao, K. "Introduction to partial differential equations" Prentice Hall of India, pvt, Ltd, New Delhi, 1997.

**REFERENCES:**

1. Andrews, L.C. and Philips. R.L. "Mathematical Techniques for engineering and scientists", Printice Hall of India, 2006.
2. O'Neil P.V. "Advanced Engineering Mathematics", (Thomson Asia Pvt Ltd, Singapore) 2007, cengage learning India private limited.

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**OUTCOME:**

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

**MD8152****ANATOMY AND PHYSIOLOGY****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 OF HUMAN BODY 8**

Organization of human body, tissue 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**

Skeletal System: Bones, types and functions - Axial and Appendicular Skeleton. Joints: Definition, Types and functions. Cartilage: An overview - types and functions. Muscular System: Types of Muscle - Skeletal Muscle structure - Action potential and functions - Skin and Appendages.

**UNIT III RESPIRATION, NUTRITION AND EXCRETORY SYSTEM 10**

GI Tract: Organization of GI tract – Mouth, Pharynx, Esophagus, Stomach, Small Intestine and Large Intestine - Accessory Organs: Salivary glands, Liver, Pancreas, Gall bladder, Teeth and Tongue. Ingestion, Digestion and Absorption – Factors regulating Movements and Digestion in GI tracts. Respiratory System: The Nose, Pharynx, Larynx, Trachea, Primary Bronchi, Lungs – Mechanism of Breathing – Respiratory Volumes, Measurements and Artificial Respiration. Urinary System: Structure of Kidney, Nephron, Ureter and Urinary bladder. Urine formation and Micturition reflex.

**UNIT IV CARDIOVASCULAR AND ENDOCRINE SYSTEM 9**

**Cardiovascular System:** Blood vessel, Types and internal structure - Cardiac Muscle: Structure and Action potential – Structure and Components of Heart - Conducting System of Heart – Heart Sounds – Blood Pressure – Regulation of Blood Pressure and Measurements. Endocrine Hormone – General Action – Second Messenger – Anterior and Posterior Pituitary Gland Hormones.

**UNIT V NERVOUS SYSTEM AND SPECIAL SENSES 10**

Organization of Nervous system: Structure, Types and Properties of Neurons - Action potential of Neuron - Neuroglial Cells – Central Nervous System and Peripheral Nervous System organization – Brain, Lobes and Cortical Areas – Spinal cord arrangement and Plexus formation. Autonomic Nervous System: Divisions and control on each system - Reflex Mechanism. Special Senses: Structure of Eye and Ear - Errors of refraction and Correction. Conduction pathway of vision and Hearing.

**TOTAL: 45 PERIODS****REFERENCES:**

1. Anatomy & Physiology, Gary A.Thibodeau, Kevin T.Patton – 7<sup>th</sup> 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 Jaunders company Philadelphia - 10 edition 2002
4. Ranganathan T S, Text Book of human Anatomy S. Chand and company New Delhi – 1994.

**OUTCOMES:**

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

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

**BO8111****CLINICAL INSTRUMENTATION LABORATORY****L T P C  
0 0 4 2****OBJECTIVES:**

- To study the various aspects of bio signals and amplifiers
- To understand the performance of surgical diathermy.
- To study practically the concepts of audiometer

**LIST OF EXPERIMENTS**

1. Operational Amplifier-various amplifier configurations
2. Study of Timer circuit
3. Study of FSK modulation and demodulation
4. Design and testing of Bio-Amplifiers
5. Recording of Electromyogram.
6. Study of ECG machine.
7. Study of EEG machine
8. Study of Patient monitoring system and biotelemetry
9. Bio-chemical measurements
10. Performance and testing of surgical diathermy unit using diathermy analyzer
11. Plotting of human auditory response using audiometer.
12. Study of Multi parameter simulator.

**TOTAL: 60 PERIODS****OUTCOME:**

Students will get the clear practical knowledge about the various basic amplifiers and their characteristics.

**BO8252****BIO MECHANICS****L T P C  
3 0 0 3****OBJECTIVES :**

- To get the clear understanding of application of mechanics in medicine.
- To study the properties of blood , bone and soft tissues like articular cartilage tendons and ligaments ,
- To gain necessary knowledge about accident and injuries.

**UNIT I INTRODUCTION****9**

Introduction to bio-mechanics, relation between mechanics and Medicine, Newton's laws, stress, strain, shear rate, viscosity, visco elasticity, non Newtonian viscosity, soft tissue mechanics, mechanical properties of soft biological tissues. biofluid mechanics.

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**UNIT II MECHANICS OF CIRCULATION 9**

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

**UNIT III MECHANICS APPLIED TO ORTHOPAEDICS 9**

Orthopedic biomechanics, mechanical properties of bones, stress induced bone growth, kinematics and kinetics of joints, lubrication of joints, and analysis of force in orthopedic implants.

**UNIT IV MECHANISM OF BIOLOGICAL SYSTEMS 9**

Skeletal muscles servo mechanism, Cardio vascular control mechanism, respiratory control mechanism

**UNIT V BIO MECHANICAL ASPECT OF ACCIDENT INVESTIGATION 9**

Experimental and Analytical method of analysis, Clinical evaluation, Head Injury tolerance, rotational injury, spine injury – Accident reconstruction, Analysis of impact, skid analysis – Damage analysis.

**TOTAL: 45 PERIODS**

**REFERENCES:**

1. Y.C.Fung, Biomechanics: Mechanical properties in living tissues, Springer Verlag, New York 1981.
2. Susan J.Hall, Basics Bio Mechanics 5<sup>th</sup> Edition, McGraw-Hill Publishing Co, Newyork, 2007.
3. Subrata pal ,Text book of Biomechanics, Viva education private limited, 2009.
4. C.R Ethier and C.A.Simmons , Biomechanics from cells to organisms, Cambridge university press,2007.
5. D.Dawson and Right, Introduction to Bio-mechanics of joints and joint replacement, Mechanical Engineering publications Ltd. 1989.
6. Jacob clime, Head book of Bio Medical Engineering, Academic Press in, Sandiego, 1988.

**OUTCOME:**

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

**BO8253 REHABILITATION ENGINEERING L T P C  
3 0 0 3**

**OBJECTIVES:**

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

**UNIT I PROSTHETIC AND ORTHOTIC DEVICES 9**

Hand and arm replacement, different types of models for externally powered limb prosthetics, Lower limb, Upper limb orthotics, and material for prosthetic and orthotic devices, mobility aids.

**UNIT II AUDITORY AND SPEECH ASSIST DEVICES 9**

Types of deafness, hearing aids, application of DSP in hearing aids, Cochlear implants, Voice synthesizer, speech trainer.

**UNIT III VISUAL AIDS 9**

Ultra sonic and laser canes, Intra ocular lens, Braille Reader, Tactile devices for visually challenged, Text voice converter, screen readers.

**UNIT IV MEDICAL STIMULATOR****9**

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

**UNIT V REHABILITATION MEDICINE AND ADVOCACY****9**

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

**TOTAL: 45 PERIODS****REFERENCES:**

1. Rory A Cooper, An Introduction to Rehabilitation Engineering, CRC press,2006
2. Joseph D.Bronzino,The Biomedical Engineering Handbook,Third Edition: Three Volume Set,CRC Press,2006
3. Levine.S.N.Editor, Advances in Bio Medical Engineering and Medical Physics, Inter University Publication, New York 1968.
4. Albert M.Cook and Webster J.G, Therapeutic Medical devices, Prentice Hall Inc., New Jersey, 1982.
5. Reswick.J, What is Rehabilitation Engineering, Annual review of Rehabilitation-volume2, Springer-Verlag, New York 1982.

**OUTCOME:**

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

**BO8211 HOSPITAL INFORMATION SYSTEM LABORATORY****L T P C  
0 0 4 2****OBJECTIVES:**

- To study about the basics of Java programming, web designing and to develop a hospital information system.
- To study about signal and image processing applications using MATLAB

**LIST OF EXPERIMENTS**

1. HTML, XHTML, XML programming
2. Java Script programming
3. Development of front end and back end applications for hospital information system
4. Development of Web portal for medical applications
5. Study of medical standards-HL7,DICOM,LOINC,Medical data formats
6. Processing of BioSignals using Mat Lab
7. Image processing techniques using Mat Lab
8. Study of Data acquisition systems

**TOTAL: 60 PERIODS****OUTCOME:**

Students gain the programme based knowledge to design a hospital information system



**BO8001**

**BIO-STATISTICS**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To introduce strengths and limitations of measures of central tendency and measures of variability.
- Classify common statistical tests and tools.
- Distinguish between p-values and confidence intervals as measures of statistical significance.
- Interpret commonly used regression analysis.
- Evaluate commonly used statistical and epidemiologic measures.

**UNIT I INTRODUCTION 9**  
Introduction to probability, likelihood & odds, distribution variability.

**UNIT II STATISTICAL PARAMETERS 6**  
Statistical parameters p-values, computation and level chi square test and distribution.

**UNIT III REGRESSION ANALYSIS 6**  
Regression, correction use of regression, multiple regression.

**UNIT IV INTERPRETING DATA 12**  
Interpreting life tables clinical trails, epidemical reading and interpreting of epidemical studies, application in community health.

**UNIT V META ANALYSIS 12**  
META analysis for research activities, purpose and reading of META analysis, kind of data used for META analysis

**TOTAL: 45 PERIODS**

**REFERENCE:**

1. Joseph A. Ingelfinger, Frederick Mosteller, Lawrence A. Thibodeau, James H. Ware Biostatistics in Clinical Medicine (third edition), Singapore, 1994.

**OUTCOME:**

The student is able to understand the techniques used in statistical & regression analysis. Also the student is able to compare the various parameters used in statistical significance.

**BO8002**

**FINANCE MANAGEMENT IN HOSPITALS**

**L T P C**  
**3 0 0 3**

**OBJECTIVES :**

- The objective of this subject is to expose the students to decision making by corporate board in the areas of finance function.
- To provide an understanding of the basic principles and processes involved in the accounting system of a hospital.

**UNIT I INTRODUCTION 4**  
Finance Function – Meaning – Definition - scope of finance function- Executive functions & Incidental functions - Scope and goal of Financial Management in Hospitals – Profit maximization & Wealth maximization.

**UNIT II ACCOUNTING TECHNIQUES 10**  
Types of Accounting, Hospital accounting - Financial book Keeping, Book keeping obligations. Accounting Concepts & Conventions – Final Accounts :Trading – Profit & Loss Accounts - Balance Sheet.

<b>UNIT III</b>	<b>COSTING IN HOSPITALS</b>	<b>10</b>
Nature & Scope of Cost Accounting – Cost analysis & Classification - Cost Calculation, significance of internal billing in Hospital -Necessary for internal & external controlling cost, cost unit calculation.		
<b>UNIT IV</b>	<b>MANAGEMENT ACCOUNTING</b>	<b>11</b>
Budgeting & Budgetary control – Cost – Volume – Profit analysis.		
<b>UNIT V</b>	<b>FINANCING DECISIONS</b>	<b>10</b>
Cost of capital & Capital Structure – Sources of Short term finance: Management of Working Capital –Sources of Long term finance: share capital, debentures - corporate debit capacity.		
		<b>TOTAL: 45 PERIODS</b>

**REFERENCES:**

1. James C. Vanhorne, Fundamentals of Financial Management, Prentice Hall of India Pvt. Ltd., New Delhi, 8<sup>th</sup> Edition, 1993.
2. James C. Vanhorne, Financial Management and Policy, Prentice Hall of India Pvt. Ltd., New Delhi, 9<sup>th</sup> Edition, 1995.
3. Prasannachandra, Financial Management, Tata McGraw Hill Publishing Co. Ltd., New Delhi, First Revised edition
4. Financial Management IM Pandey Vikas Publishing Co. 1999.

**OUTCOME:**

- The students is equipped with concepts, technical and analytical tools for optimal management of financial resources.
- Also the course helps to develop skills in analyzing accounting statements for decision-making in a hospital setting and practice the preparation of final accounts

<b>BO8003</b>	<b>FINITE ELEMENT ANALYSIS FOR BIOMEDICAL ENGINEERING</b>	<b>L T P C</b> <b>3 0 0 3</b>
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**OBJECTIVES:**

- To introduce the basic concepts of finite element analysis
- To study about the application to Field Problems in Bio mechanics
- To gain ideas about the materials used in the field of biomedical engineering

<b>UNIT I</b>	<b>GENERAL INTRODUCTION</b>	<b>10</b>
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 artificial implants,		
<b>UNIT II</b>	<b>BEAM ELEMENTS AND SCALAR PROBLEM IN 2D</b>	<b>9</b>
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		
<b>UNIT III</b>	<b>APPLICATIONS TO FIELD PROBLEMS</b>	<b>9</b>
Higher Order Elements. Natural co-ordinate systems – Isoparametric elements – Shape functions for isoparametric elements – One, two and three dimensions – Serendipity elements – Numerical integration and application to plane stress problems transformation in $\xi, \eta$ and $\zeta$ – coordinates- Jacobian of transformation-order of convergence- numerical integration –example problems- shape functions in natural coordinates- rectangular elements- Lagrange family- Serendipity family- rectangular prisms- tetrahedral elements		



**UNIT IV ISOPARAMETRIC FORMULATION AND MISCELLANEOUS TOPICS 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.

**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.

**OUTCOME:**

At the end of this course the students would have developed a thorough understanding of the basic principles of the finite element analysis techniques with an ability to effectively use the tools of the analysis for solving problems in Bio-mechanical Engineering

**BO8004**

**HEALTH INFORMATICS**

**L T P C  
3 0 0 3**

**OBJECTIVE:**

To enable the students to gain knowledge in various aspects of informatics related to health and the techniques to apply these in proper health care delivery

**UNIT I HEALTH INFORMATICS 9**

Historical highlights and Evolution, Hospital Information System – its characteristics and functional online and offline modules, Health Informatics, Bioinformatics, Medical Informatics, Clinical Informatics, Nursing Informatics, Public Health Informatics, e – health services, Evidence Based Medicine, Bioethics, Virtual Hospital

**UNIT II ELECTRONICS PATIENT RECORDS AND STANDARDS 9**

Electronic Patient Record, Medical data formats, – Medical Standards – HL7 – DICOM - IRMA - LOINC - PACS - Medical Standards for Vocabulary - ICD 10, DRGs, MeSH, UMLS, SNOMED - Healthcare Standards - JCAHO, HIPAA

**UNIT III BIOINFORMATICS AND TECHNOLOGIES 9**

Bio-information technologies, Semantic web and Bioinformatics, Genome projects - Education and Training - Nano technology in Healthcare - Nanomedicine, Nanopharma, CNT based Nano sensor, BioCom chip, Medical Nanorobo - Virtual Reality and Multimedia Applications in Medicine

**UNIT IV JAVA PROGRAMMING 9**

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

**UNIT V INTERNET AND WEB 9**

Medical Networks - Java script programming - Web Design and programming - Design of Web portal services in medicine.

**TOTAL: 45 PERIODS**

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## 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. Yi-Ping Phoebe, Bioinformatics Technologies, Springer International, New Delhi, 2007.
5. Orpita Bosu, Bioinformatics – Databases, Tools and Algorithms, Oxford University Press, 2007.
6. John P Woodward, Biometrics – The Ultimate Reference, Dreamtech Publishers, New Delhi, 2003
7. Ranjan Parekh, Principles of Multimedia, Tata McGraw Hill Publishing Company, New Delhi, 2006
8. H M Dietel, Internet and World Wide Web, AB Goldberg publishers, New Delhi, 2007
9. Atul Khate, Cryptography and network security, Tata McGraw Hill Publishing Company, New Delhi, 2008
10. Lukas K Baehler, Bioinformatics – Basics, Applications in Biological Sciences and Medicine, Taylor & Francis, London, 2005. Deitel, “Java How to Program”, Pearson Education / PHI, 2006

## OUTCOME:

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

**BO8005 HEALTH POLICY AND EQUIPMENT MANAGEMENT L T P C**  
**3 0 0 3**

## OBJECTIVES:

- To expose the students for planning and operation of hospitals in a detailed manner which will include all facts of hospital planning activities covering every department that is involved both in clinical care as well as supportive services.
- To introduce the equipment maintenance management skills and how to protect equipment from electromagnetic interferences.

**UNIT I HEALTH SYSTEM 9**

Health organization of the country, the state and cities, health financial system, teaching cum research hospitals, General Hospital, PHC reference system.

**UNIT II NATIONAL HEALTH POLICY 9**

Need for evaluating a health policy, need for providing primary health care, Health education, health insurance, health legislation, inter sectoral cooperation.

**UNIT III EQUIPMENT MAINTENANCE MANAGEMENT 9**

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

**UNIT IV LOGISTIC SUPPORT & RELIABILITY 9**

Maintenance equipment and Tools, failure analysis, spare parts and maintenance materials. Reliability fundamentals.

**UNIT V EMI TO HOSPITAL EQUIPMENTS 9**

Principles of EMI, computation of EMI, Method of suppressing and isolating the unit from interference.

**TOTAL: 45 PERIODS**

**REFERENCES:**

1. Antony Kelly, 'Maintenance Planning & control' Butterworth, London 1984.
2. Hans Pleiff veradamann (ed) 'Hospital Engineering in developing countries, GTZ report Eschborn, 1986.
3. R.C.Goyal 'Human Resource Management in Hospitals' Prentice Hall of India, New Delhi, 2000.

**OUTCOMES:**

The student becomes an expert in

- Understanding the various health policies
- Planning activities at health care centres.
- Equipment installation ,service & calibration needs

**BO8006****HOSPITAL ARCHITECTURE****L T P C  
3 0 0 3****OBJECTIVES:**

To expose the students to planning and operation of hospitals in a detailed manner which will include all facets of hospital planning activities covering every department that is involved both in clinical care as well as supportive services.

**UNIT I INTRODUCTION TO HEALTH CARE SYSTEM 9**

International and National level policy framework for healthcare facilities – Types of healthcare facilities based on public and private ownership, bed size and type of health care services based on outpatient ,inpatient and diagnostic care - Organizational, function and structure of the hospital.

**UNIT II HOSPITAL PLANNING 9**

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

**UNIT III PLANNING & DESIGNING OF DIFFERENT SERVICES IN HOSPITALS 9**

Planning and designing of administrative services, medical and ancillary services, nursing services, supportive services, public areas and staff services, hospital services

**UNIT IV STANDARDS AND NORMS FOR HOSPITALS 9**

Design and construction standards for the hospitals namely BIS –India and JCAHO, AIA and NHS – general guidelines and standard for out-patient area, in-patient area and diagnostic area in the hospitals. Voluntary & Mandatory standards, General standards, Mechanical standards, Electrical Standards, Standard for centralized medical gas system, Standards for biomedical waste.

**UNIT V FACILITIES FOR SUPPORTIVE SERVICES 9**

Transport, Information system, Communication, Food services, Mortuary, Heating Ventilation and Air Conditioning, Medical gases, House Keeping, Laundry.

**TOTAL : 45 PERIODS****REFERENCES:**

1. G.Kunders."Hospitals- Facilities Planning & Management", Tata Mcgraw - Hill education-2004.
2. S.K.Gupta, S.kant, R.Chandrashekhar, S.Satpathy. "Modern trends in planning and designing of hospitals: Principles and practice", Jaypee Brothers-Medical publishers, New Delhi, 2007.
3. Sa Tabish." Hospital and Nursing Homes planning, Organisation and Management", ", Jaypee Brothers-Medical publishers, New Delhi, 2003
4. Purnima Sharma, Sangeet Sharma, Nerendra Malhotra, Jaideep Malhotra. "Step by Step Hospital Designing and Planning", 2<sup>nd</sup> Edition, Jaypee Brothers-Medical publishers, New Delhi, 2010.

**OUTCOMES:**

The student will be able to follow the newest findings in the area of hospital planning, health consultancy, hospital waste and implement the perspectives in constructing hospital standards.

**OBJECTIVES:**

- With an objective of imbibing a professional approach amongst students towards hospital management.
- The subject encompasses management principles, staffing and marketing processes, discussing their significance and role in effective and efficient management of health care organizations.

**UNIT I FORMS OF ORGANISATION 8**

Sole proprietorship, Partnership, Company-public and private sector enterprises, Principles of management, Evolution of management.

**UNIT II PRINCIPLE OF HOSPITAL MANAGEMENT: 10**

Importance of management and Hospital, Management control systems. Forecasting techniques decision-making process

**UNIT III STAFFING 6**

Staffing pattern in hospitals, Selection, Recruiting process, Training of staff, Organizational structures, Career development

**UNIT IV MARKETING AND MANAGEMENT 10**

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

**UNIT V COMPUTER IN HOSPITAL 11**

System Development life cycle, Reasons to use computers in hospital, main categories of information systems in hospitals

**TOTAL :45 PERIODS****REFERENCES:**

1. Goyal R.C., Human Resource Management in Hospital, Prentice Hall of India Pvt. Ltd., New Delhi, 2000.
2. Nauhria R.N. and Rajnish Prakash, Management & systems, New Delhi Wheeler publishing, 1995.
3. Koontz, Essentials of Management, McGraw Hill, 1995.

**OUTCOME:**

The student acquires knowledge of the principles and practices essential for managing a hospital organization.

**OBJECTIVES :**

- To understand the significance of infections, biomedical waste and its proper disposal.
- To teach the students about the controls applied to waste management.

**UNIT I INTRODUCTION 9**

The Medical Waste Stream, Types of waste - Waste management elements – Categories of Bio-medical waste- Regulatory Requirements.

**UNIT II PRINCIPLES OF STERILIZATION 9**

Disease Transmission - Disinfection methods – Sterilization - steam sterilizing (Auto claving) - Microwave (Non-burn treatment technology).

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<b>UNIT III</b>	<b>DISPOSAL OF WASTE</b>	<b>9</b>
Disposal methods - Incinerator - Hazardous waste, radioactive waste, liquid waste destruction - landfill.		
<b>UNIT IV</b>	<b>CONTROLS APPLIED TO WASTE MANAGEMENT</b>	<b>9</b>
Air pollution and Emission control, Instrumentation and monitoring, Crematories		
<b>UNIT V</b>	<b>ENVIRONMENTAL SAFETY, RISKS &amp; PUBLIC ISSUES.</b>	<b>9</b>
Risk management in hospitals - Environment issues in hospitals - Risk analysis		
		<b>TOTAL : 45 PERIODS</b>

**REFERENCES:**

1. C.R.BRUNNER, Medical Waste Disposable Handbook, Incentrated, Consultant in Corporated, Virginia, 2000.
2. C.R.BRUNNER, Incentrated Consultant in Corporated Incentration System Hand Book, Virginia.

**OUTCOMES:**

- Awareness of environmental hazards
- Challenges against the infectious diseases
- To create litter free zone around hospitals
- New & efficient methods in disposing the hospital waste

<b>BO8009</b>	<b>HUMAN RESOURCES MANAGEMENT IN HOSPITAL</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES:**

- This subject acquaints the students with major functions of HRM aligned with the business strategy.
- The subject encompasses the concept of best fit employee, training & executive development, sustaining employee interest and performance appraisal.

<b>UNIT I</b>	<b>PERSPECTIVES OF HUMAN RESOURCE MANAGEMENT</b>	<b>9</b>
Evolution of Human Resource Management - Importance of Human factor, Objectives of Human resource Management - Human Resource Policies - Need for HRD/HRM in Healthcare Organisation - Computer Applications In Human Resource Management.		
<b>UNIT II</b>	<b>THE CONCEPT OF BEST FIT EMPLOYEE</b>	<b>9</b>
Organisational Job Design - job description - job analysis - job rotation-job evaluation- Man-power planning- Importance of Human Resource Planning, Forecasting of Human Resource Requirements - Selection procedures - test, Validation, Interviews, Recruitment, Medical Examination.		
<b>UNIT III</b>	<b>TRAINING &amp; EXECUTIVE DEVELOPMENT</b>	<b>9</b>
Types of Training methods and their benefits - Executive development Programme - common practices - Benefits, self-development - knowledge Management.		
<b>UNIT IV</b>	<b>SUSTAINING EMPLOYEE INTEREST</b>	<b>9</b>
Wage and Salary Administration – concept of incentives and its operational implications – Participative decision making – Concept of Collective Bargaining – Compensation plans – Rewards – Motivation – Theories of motivation - Grievances and redressal methods.		
<b>UNIT V</b>	<b>PERFORMANCE APPRAISAL</b>	<b>9</b>
Importance of Performance Appraisal - Methods of Performance Evaluation, - Traditional methods – Modern methods – Feedback – Promotion – Demotion – transfer. Implications of jobs change. The control process, Methods and Requirements of Effective control system.		
		<b>TOTAL : 45 PERIODS</b>



## REFERENCES:

1. R.C.Goyal, Human Resource Management in Hospitals, Prentice Hall of India, 2000.
2. Mamoria C.B. and Mamoria S. Personnel Management, Himalaya Publishing Company, 1997.
3. Decenzo and Robbins, Human Resource Management, Wiley & Sons, Singapore, 1999.

## OUTCOME:

Upon the completion of this course, the student is well acquainted with the knowledge about the significance and role in effective and efficient management of human resources in health care organizations

**BO8010**

**PHYSICS IN MEDICINE**

**L T P C**  
**3 0 0 3**

## OBJECTIVE:

To develop an understanding of physics involved in various imaging modalities and the effect of radiation on human body.

### **UNIT I PRINCIPLES OF NUCLEAR PHYSICS 9**

Traditional definition of atom, periodic system of elements, mechanical properties of atom, emission of light and its frequencies . Electromagnetic spectra, Laws of equilibrium - Theory of decay - electron capture - internal conversion - nuclear isomerism- Natural radioactivity, Decay series, type of radiation and their applications, , accelerator principles; reactor and cyclotron produced isotopes - fission products- artificially produced isotopes and its application - Radionuclides used in Medicine and technology.

### **UNIT II PHYSICS OF INFRARED , MICROWAVE AND RADIO FREQUENCY 9**

Production and properties - interaction mechanism of RF and microwaves with biological systems: Thermal and non-thermal effects on whole body, lens and cardiovascular systems - tissue characterization and Hyperthermia and other applications. Biomagnetism - Effects – applications- Infrared detectors—thermographic equipments—quantitative medical thermography— pyroelectric video camera—applications of thermography.

### **UNIT III LASER PHYSICS AND PHOTOMEDICINE 9**

Characteristics of laser radiation , Laser speckle, biological effects, laser safety management Synthesis of vitamin D in early and late cutaneous effects, Phototherapy, photo hemotherapy, exposure level, hazards and maximum permissible exposures. Optical characteristics of biomolecules from the point of spectroscopy – principles of UV – Visible absorption – IR and FTIR absorption – Raman and Fluorescence spectroscopy – application with regard to characterization of biomolecules – blood oxygen, glucose measurements, monitoring drug concentration, cancer

### **UNIT IV DIAGNOSTIC ULTRASOUND 9**

Ultrasonic waves – generation and detection of ultrasound –Beam characteristics—attenuation of ultrasound –specific acoustic impedance—reflection at body interfaces---Coupling medium --- interaction ultrasound with tissues—deleterious effects of Ultrasound- Safety levels of Ultrasound- real time scanners image clarity---Resolution ---axial and lateral resolution ---- Artifacts---Pulse echo imaging ----Obsterics abdominal investigations- Echo cardiograph (UCG) – The Doppler Effect-Doppler Shift---continuous wave Doppler system ---Pulsed wave Doppler systems---duplex scanning-display devices for ultrasonic imaging

### **UNIT V RADIOBIOLOGICAL EFFECT OF RADIATION 9**

Target theory, single hit and multi target theory, cellular effects of radiation, DNA damage, chromosomal damage, Somatic effect : Radio sensitivity protocol of different tissues in human ,LD 50/30 effect, Genetic effect: Threshold of linear dose effect, relationship factors affecting frequency of radiation induced mutation, biological effect of microwave, Rf wave and UV radiation.

**TOTAL: 45 PERIODS**

**REFERENCES:**

1. Moselley 'Non ionizing Radiation' Adam Hilgar Brustol 1998
2. Branski.S and Cherski.P 'Biological effects of microwave ' Hutchinson & ROSS Inc.Stondsburg 1980
3. Glasserr .O.Medical Physics Vol.1, 2,3 year Book Publisher Inc Chicago, 1980
4. Eric .J.Hall, and Amato .J.Giaccia , 'Radiobiology for radiologist' , Lippincott Williams and Wilkins.,2006
5. Sorenson James A, 'Physics in Nuclear Medicine', W.B. Saunder's Company, 1987.
6. Diagnostic Ultrasound applied to OBG-Sabbahaga-Maryland -1980
7. Basic Ultrasound-Hylton B Meire and Pat Farrant-John Wiley & Sons -NY-1994.
8. MRI in Practice-Catherine Westbrok
9. The essential Physics for Medical Imaging – Jerrold T Bushberg

**OUTCOME:**

The students understands the physics behind radiation used in medical techniques and acquires in-depth knowledge about optics & ultrasound along with their effects of radiation

**BO8011                      QUALITY ASSURANCE AND SAFETY IN HOSPITALS                      L T P C**  
**3 0 0 3**

**OBJECTIVES:**

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

**UNIT I                      STANDARDIZATION OF QUALITY MEDICAL CARE IN HOSPITALS                      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**

**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, Prentice Hall Inc., Engle wood Cliffs, New Jersey, 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, 2nd 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

**OUTCOMES:**

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

<b>BO8012</b>	<b>SIGNAL PROCESSING AND IMAGE PROCESSING TECHNIQUES APPLIED TO BIOLOGICAL SYSTEMS</b>	<b>L T P C 3 0 0 3</b>
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**OBJECTIVES:**

- To introduce the basics of signal processing and its application to biological systems.
- To make the students to understand the fundamentals of image processing and its applications.

**UNIT I DISCRETE – TIME SIGNALS AND SYSTEMS 9**

Review of discrete – time signals and systems, DTFT, Frequency response, Analysis of LTI systems using Z transform, DFT and its properties, FFT algorithms and its applications to convolution.

**UNIT II DESIGN OF INFINITE AND FINITE IMPULSE RESPONSE FILTERS 9**

Analog filters – Butterworth and Chebyshev type 1. Analog transformation of prototype LPF to BPF / BSF / HPF .Transformation of analog filters into equivalent digital filters- Impulse invariant and bilinear transformation technique, Design of FIR filter using window method.

**UNIT III ADAPTIVE FILTERING AND WAVELET DETECTION 9**

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

**UNIT IV IMAGE FUNDAMENTALS AND PREPROCESSING 9**

Image perception, Image model, Image sampling and quantization, 2D DFT and DCT, Image enhancement- Histogram modeling, spatial operations, Image restoration- Image degradation model, Wiener filtering, Image compression.

**UNIT V IMAGE ANALYSIS AND OTHER APPLICATIONS 9**

Image segmentation, Image representation and analysis, feature extraction, Statistical feature based image classification, Neural Network approaches, Image Registration, Medical image fusion, Image visualization.

**TOTAL: 45 PERIODS**

**REFERENCES:**

1. A.V.Oppenheim, R.W. Schafer and J.R. Buck, Discrete-Time Signal Processing, 8<sup>th</sup> Indian Reprint, Pearson, 2004.
2. John G Proakis and Manolakis, “ Digital Signal Processing Principles, Algorithms and Applications”, Pearson, Fourth Edition, 2007
3. Arnon Cohen, Bio-Medical Signal Processing Vol I and Vol II, CRC Press Inc., Boca Rato, Florida 1999.

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- Raghuveer M. Rao and Ajith S. Bopardikar, Wavelets transform – Introduction to theory and its applications, Pearson Education, India 2000.
- Anil. K. Jain, 'Fundamentals of Digital Image Processing', Pearson education, Indian Reprint 2003.
- R.C.Gonzalez and R.E.Woods, 'Digital Image Processing', Second Edition, Pearson Education, 2002.
- Kayvan Najarian and Robert Splerstor," Biomedical signals and Image processing",CRC – Taylor and Francis,New York,2006.

#### OUTCOME :

The student acquire thorough knowledge about the various image & signal processing techniques that can be applied to biomedical engineering principles.

**BO8071**

**BIO MATERIALS**

**L T P C**  
**3 0 0 3**

#### OBJECTIVES

- To introduce concepts of materials, surface and tissue placement in biomaterial functions
- To understand diverse elements controlling biological responses to materials
- To provide contemporary biomaterial principles

#### UNIT I INTRODUCTION 10

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

#### UNIT II MATERIALS IN MEDICAL DEVICES 10

Metals, Ceramics, Polymers and Composites. Material preparation, chemical composition, Properties, uses in medicine and biosciences and failure mechanisms.

#### UNIT III STERILIZATION OF BIOMATERIALS 7

Sterilization techniques: – process and mechanism of action of steam sterilization, radiation sterilization, electron beam sterilization, ethylene oxide, chlorine dioxide and plasma gas sterilization.

#### UNIT IV TESTING OF MATERIALS 8

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

#### UNIT V HARD AND SOFT REPLACEMENT 10

Cardiac Implants, Orthopedic Implants, Neuro Muscular Implants, Transcutaneous Implants, Intraocular lenses.

**TOTAL: 45 PERIODS**

#### REFERENCES:

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

#### OUTCOMES:

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

**OBJECTIVES:**

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

**UNIT I INTRODUCTION TO ARTIFICIAL NEURAL SYSTEMS 8**

Biological Neurons and their Artificial models, Models of Artificial Neural Networks, Learning and Adaptation, Neural Network Learning Rules, Single Layer Perceptron Classifiers.

**UNIT II BPN AND BAM 9**

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

**UNIT III OTHER NETWORKS 10**

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

**UNIT IV GENETIC ALGORITHMS & IMPLEMENTATION TECHNIQUES 8**

The Appeal of Evolution, Search Spaces and Fitness Landscapes, Elements of Genetic Algorithms, Data Structures, Adaptive Encoding. Selective Methods, Genetic Operators, Fitness Scaling, GA applications

**UNIT V ADVANCES AND APPLICATIONS 10**

Support Vector Machines, R B F Network, Neocognitron. Evolving neural networks using GA, Applications of ANN in biomedical signal analysis and Medical image analysis

**TOTAL: 45 PERIODS****REFERENCES:**

1. Philip D.Wasermann, Advanced Methods in neural Computing, Van Nostrand Reinhold, New York 1993.
2. David Goldberg, Genetic Algorithms in Search, Optimization and Machine Learning, Addison - Wesley USA, 1997.
3. Melanie Mitchell, An Introduction to Genetic Algorithms: Prentice Hall of India, New Delhi 1998..
4. Simon Haykins, Neural Networks, Prentice Hall international Inc, 1999.
5. James A Freeman and David M. Skapura, Neural Networks, Addison - Wesley, India 1999.

**OUTCOME:**

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



**OBJECTIVES:**

To understand

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

**UNIT I MEMS MATERIALS AND FABRICATION 9**

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

**UNIT II MECHANICAL AND THERMAL SENSORS AND ACTUATORS 9**

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

**UNIT III ELECTROSTATIC AND PIEZOELECTRIC SENSORS AND ACTUATORS 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. Case study: Design of electrostatic actuator

**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 , Case study: Design of electrophoretic microcapillary network system.

**UNIT V APPLICATIONS OF MEMS IN MEDICINE 9**

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

**TOTAL: 45 PERIODS****REFERENCES:**

1. Chang Liu, 'Foundations of MEMS', Pearson Education International, New Jersey, USA, 2006
2. Nitaigour Premchand Mahalik, "MEMS", Tata McGraw Hill Publishing Company, New Delhi, 2007
3. Tai Ran Hsu , "MEMS and Microsystems design and manufacture", Tata McGraw Hill Publishing Company, New Delhi, 2002
4. Wanjun Wang, Stephen A.Soper, "BioMEMs: Technologies and applications", CRC Press, New York, 2007
5. Marc J. Madou ' Fundamentals of Microfabrication: the science of miniaturization', CRC Press, 2002
6. Nadim Maluf, Kirt Williams. "An introduction to Microelectro mechanical Systems Engineering", Second Edition, Artech House Inc, MA, 2004
7. Ellis Meng , "Biomedical Microsystems", CRC Press,Boca Raton, FL, 2011.
8. Victor.C.Yang,That.T.Ngo."Biosensors and their applications", Springer, 2006.

**OUTCOMES:**

Students will be able to

- Understand the operation of different types of sensors and actuators at microscale level
- Understand the design issues at microscale level
- Choose the material for any application
- Apply the concepts to the design of different types of micro systems
- Apply the knowledge of CAD tools for MEMS design.

**MD8074****COMPUTER BASED MEDICAL INSTRUMENTATION****L T P C****3 0 0 3****OBJECTIVES:**

- To teach PC hardware and its related interfacing
- To give a complete overview of 80186, 80286, 80386 and 80486 microprocessors.
- To understand the basics of computerized data acquisition and programming.
- To enrich the students knowledge with biometrics and network security.

**UNIT I PC HARDWARE AND OVERVIEW****9**

System Unit - Overview of Mother Boards - Processors, Memory, Adapter cards, Ports, Power supply - BIOS – DOS interaction, POST, Functional and Architecture Block diagram of a PC, Mother Board logics - Memory and I/O map

**UNIT II PROCESSORS AND MEMORY****9**

80X86 Processors - Architectures and Memory management - Overview of 80X86 based Mother boards

**UNIT III PERIPHERAL INTERFACING AND CONTROLLERS****9**

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

**UNIT IV COMPUTERISED DATA ACQUISITION AND PROGRAMMING****9**

Plug-in-data acquisition and Control Boards, - Data acquisition using GPIB and Serial Interfaces and Programming in C - DSP in Medical applications

**UNIT V CAD IN MEDICAL INSTRUMENTATION****9**

FPGA Design Logics - Virtual Bio- Instrumentation in LABview - Multisim Simulation with bio-amplifiers - Mixed signal SoC applications in biomedical applications

**TOTAL: 45 PERIODS****REFERENCES:**

1. Ramachandra Lele, Computers in Medicine Progress in Medical Informatics, Tata McGraw Hill Publishing Company, New Delhi, 2005
2. N.Mathivanan, PC Based Instrumentation: Concepts and Practice, Prentice Hall of India, New Delhi 2007.
3. B.Govindarajalu, IBM PC and Clones: Hardware, Trouble shooting and Maintenance, Tata McGraw Hill Publishing Company, New Delhi, 2005
4. Herbert Schildt, The Complete Reference – JAVA, Tata McGraw Hill Publishing Company, New Delhi, 2005
5. John P Woodward, Biometrics – The Ultimate Reference, Dreamtech Publishers, New Delhi, 2003
6. Ranjan Parekh, Principles of Multimedia, Tata McGraw Hill Publishing Company, New Delhi, 2006
7. Stephen J Bigelow, Trouble shooting, Maintaining and Repairing of PCs, Tata McGraw Hill Publishing Company, New Delhi, 2005

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8. H M Dietel, Internet and World Wide Web, AB Goldberg publishers, New Delhi, 2007
9. Atul Khate, Cryptography and network security, Tata McGraw Hill Publishing Company, New Delhi, 2008

**OUTCOME:**

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

**MD8075**

**MEDICAL ETHICS AND STANDARDS**

**L T P C  
3 0 0 3**

**OBJECTIVES:**

- Achieve familiarity with some basic ethical framework & understand how these ethical frameworks can help us to think through contemporary questions in medical ethics.
- Students will be able to know about the legal and ethical principles and application of these principles in health care settings & gain knowledge about the medical standards that to be followed in hospitals.

**UNIT I INTRODUCTION TO MEDICAL ETHICS 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 STANDARDS 9**

Accreditation- 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**

**REFERENCES:**

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, 2nd edition 2003
6. Bioethics-"An Introduction for the biosciences", 2<sup>nd</sup> edition 2008, Ben Mepham, Oxford.

**OUTCOMES:**

Upon completion of this course the student should be able to demonstrate a measurable increase in their knowledge, skills and abilities related to:

- Legal and professional guidelines for the health professions
- Public duties and consent
- Guidelines to obtain medical standards in hospitals.

**MD8076****MEDICAL OPTICS****L T P C  
3 0 0 3****OBJECTIVE:**

The objectives of this course are to: (i) provide a possibility for the student to acquire knowledge about the physical properties of light and its impact and interaction with biological tissue in terms of optical properties, instrumentation in photonics, through the use and design of appropriate optical components; (ii) understand the engineering and practical applications of optics related to diagnostics, sensing and therapeutics of the human body

**UNIT I OPTICAL PROPERTIES OF THE TISSUES 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 APPLICATIONS 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.

**OUTCOME:**

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

**OBJECTIVES:**

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

**UNIT I INTRODUCTION OF NANOPARTICLES 9**

Overview of nanotechnology from medical perspective, different types of nanobiomaterials and nanostructure interactions. Synthesis, characterization, and properties smart nanomaterials, Surface modification, biofunctionalization of nanomaterials. Nanocarriers (e.g. liposomes, polymer capsules, polymer nanoparticles, porous materials, nanogels, dendrimers, microemulsions, inorganic nanoparticles, carbon nanotubes, lipoproteins, solid lipid nanoparticles).

**UNIT II PROTEIN AS NANOSTRUCTURES 9**

Protein based nanostructures building blocks and templates – Proteins as transducers and amplifiers – nanobioelectronic devices and polymer nanocontainers – microbial production of inorganic nanoparticles – magnetosomes.

**UNIT III DNA AS NANOSTRUCTURES 9**

DNA based nanostructures – Topographic and Electrostatic properties of DNA – Hybrid conjugates of gold nanoparticles – DNA oligomers – use of DNA molecules in nanomechanics.

**UNIT IV NANOPARTICLES IN DIAGNOSIS 9**

Introduction to nanoparticles in diagnostics— nuclear imaging, optical imaging, PET, Micro PET, cardio vascular disease studies, imaging and therapy of thrombosis, emerging Ethical issues and toxicology of nanomaterials

**UNIT V NANOTHERAPEUTICS 9**

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

**TOTAL : 45 PERIODS****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.

**OUTCOME:**

- The student will be able to follow the newest findings in the area of Nano medicine and implement the perspectives in own research.

**OBJECTIVES:**

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



- UNIT I OVERVIEW OF PATTERN RECOGNITION 9**  
 Discriminant functions- Supervised learning - Parametric estimation-Maximum Likelihood estimation - Bayesian parameter estimation – Problems with Bayes Approach. Non Parametric techniques, Perceptron Algorithm-LMSE Algorithm- -Pattern classification by distance functions - minimum distance Pattern classifier.
- UNIT II UNSUPERVISED CLASSIFICATION 9**  
 Clustering for unsupervised learning and classification, clustering concepts hierarchical clustering, Partitional clustering, k- means algorithm - Validity of clustering solutions.
- UNIT III FEATURE EXTRACTION AND STRUCTURAL PATTERN RECOGNITION 9**  
 KL Transforms - feature selection through functional approximation - Binary selection Elements of formal grammars, syntactic description, stochastic grammars, Structural representation.
- UNIT IV FUZZY SYSTEMS 9**  
 Fuzzy sets and fuzzy reasoning- fuzzy matrices-fuzzy functions-decomposition – Fuzzy inference systems Mamdani and Sugeno model, Fuzzy clustering- fuzzy c- means algorithm- fuzzy control method- fuzzy decision making.
- UNIT V RECENT ADVANCES AND APPLICATIONS 9**  
 Principle of neuro fuzzy techniques, Application of PR in image segmentation – CAD system in Breast cancer detection, ECG signal analysis, Fingerprint identification - Cell cytology classification

**TOTAL : 45 PERIODS**

**REFERENCES:**

1. Duda R.O., and Hart P.G., Pattern Classification and scene analysis, JohnWiley, New York, 1973.
2. Earl Gose, Richard Johnsonbaugh, Steve Jost, Pattern Recognition and Image analysis, Prentice Hall of India, New Delhi - 2007.
3. Robert J. Schalkoff , Pattern recognition: Statistical, Structural and Neural approaches, John Wiley and SonsInc, New York, 1992.
4. Morton Nadier and Eric Smith P., Pattern Recognition Engineering, John Wiley and sons, New York, 1993.
5. Andrew Webb, Statistical Pattern Recognition, Arnold publishers, London, 1999.
6. Donna L. Hudson, Maunee E. Cohan, Neural Networks & Artificial Intelligence for Biomedical Engineering, Prentice Hall of India, New Delhi - 2001.
7. Timothy Ross, Fuzzy Logic with Engineering applications, 2<sup>nd</sup> Edition John Wiley and sons, West Sussex, 2004.

**OUTCOMES:**

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

**MD8079**

**PHYSIOLOGICAL MODELLING**

**L T P C**  
**3 0 0 3**

**OBJECTIVES :**

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

**UNIT I INTRODUCTION TO SYSTEM CONCEPTS 9**

The Model and Analog, System Properties – Resistance and Storage, Concept of Energy Storage and Dissipation in physiological systems, Thermal System with Combined System properties, Step response of a Resistance/Compliant Systems, pulse response of a first order system.

**UNIT II TRANSFER FUNCTION 9**

System as an Operator, Transfer Function of First and Second Order system, Transfer Function and Concept of Impedance – Circuits into transfer function, Circuit Analog from transfer function.

**UNIT III SYSTEM RESPONSE CHARACTERISTICS 9**

Characteristics of Physiological System, Sinusoidal Analysis of Instrumentation System, Frequency Response Characteristics – Semicircular Canals, Visual Tracking System, Evaluation of Transfer Function from Frequency Response, Transient Response Characteristics – Transient input functions, Under-damped Response of physiological system – example - post synaptic aortic arch.

**UNIT IV FEEDBACK 9**

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

**UNIT V SIMULATION OF BIOLOGICAL SYSTEMS 9**

Introduction to Simulation, Simulation of Respiratory mechanics, Cardiovascular Control System, Skeletal muscle servo mechanism, Oculomotor System, Hodgkin Huxley Model.

**TOTAL : 45 PERIODS**

**REFERENCES**

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

**OUTCOME :**

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

PROGRESS THROUGH KNOWLEDGE

**MD8080**

**PRINCIPLES OF GENETIC ANALYSIS**

**L T P C**  
**3 0 0 3**

**OBJECTIVE:**

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

**UNIT I GENETIC INHERITANCE 9**

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

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**UNIT II DNA AND PHENOTYPE 9**

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

**UNIT III ENGINEERING OF GENES 9**

Gene isolation and manipulation, mutations, repair and recombination, site directed mutagenesis, in vivo techniques of genetic manipulation, tools for analysing gene expression and genetically modified organisms.

**UNIT IV HUMAN GENOME PROJECT 9**

Human Genome Project (HGP) – an overview of the project, goals of the project, major scientific strategies & approaches used in HGP, physical mapping, gene ontology, gene annotation, techniques in HGP – microsatellite markers, STS, EST, DNA sequencing and DNA microarray, scientific & medical benefits of this project.

**UNIT V IMPACT OF GENETIC VARIATION 9**

Population Genetics, Quantitative Genetics, Evolution Genetics.

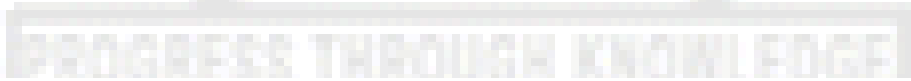
**TOTAL: 45 PERIODS**

**REFERENCES:**

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

**OUTCOMES:**

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



**MD8081**

**TELEHEALTH TECHNOLOGY**

**L T P C  
3 0 0 3**

**OBJECTIVES:**

- To teach the key principles for telemedicine and health.
- 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.

*Attested*

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**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 confidentiality 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.

**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. Bommel, J.H. van, Musen, M.A. (Eds.) (1997). Handbook of Medical Informatics. Heidelberg, Germany: Springer. (ISBN 3-540-63351-0)

**OUTCOMES:**

The student is exposed to the

- Technologies applied in multimedia using telemedicine
- Protocols behind encryption techniques for secure transmission of data.
- Applications of telehealth in healthcare

**OBJECTIVES**

- To understand basics of Tissue Engineering
- To understand fundamentals of cell mechanisms
- To teach the Physical & biological principles that serve as the scientific basis for understanding the interactions of biological molecules and cells with biomaterials employed for the fabrication of permanent implantable prostheses and as matrices for tissue engineering.
- To understand application of Tissue Engineering

**UNIT I BASICS OF TISSUE ENGINEERING 9**

Introduction to Tissue Engineering - Objectives of Tissue Engineering - Basic definitions - Structure and organization of Tissues – Development of Tissue – Tissue exchange and diffusion of simple metabolites – Tissue Equivalent - Wound Healing Process - Biocompatibility and toxicity assessment.

**UNIT II FUNDAMENTALS OF CELL MECHANISMS 9**

Cell adhesion, Cell migration and Cell aggregation – Cell growth and Cell cycle. Cellular Interactions: Cell – Cell and Cell – Matrix. Control of Cell migration in Tissue Engineering –Cell delivery and Recirculation – Cell Culture in vitro – 3D culture in Tissue Engineering - In vitro Organogenesis - Cell transplantation.

**UNIT III BIOMATERIALS IN TISSUE ENGINEERING 9**

Definition – Biological vs Nonbiological materials – Extra Cellular Matrix – Collagen, Chitin & Degradable and Nondegradable materials – Polymer, Ceramics and Metals – Cell interaction with different materials – Scaffolds - Control releaser agents in Tissue Engineering – Cell interaction with suspension and gels – Tissue response to implants.

**UNIT IV STEM CELLS IN TISSUE ENGINEERING 9**

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

**UNIT V TISSUE ENGINEERING APPLICATIONS 9**

Synthetic components – Artificial organs – Joints and dental prostheses - Connective Tissue Engineering – Cardiovascular Tissue Engineering – Neural Tissue Engineering - Cell and Drug Delivery systems.

**TOTAL : 45 PERIODS****REFERENCES:**

1. W. Mark Saltzman Tissue Engineering – Engineering principles for design of replacement organs and tissue – Oxford University Press inc New York, 2004.
2. Gray E Wnek, Gray L Browlin – Encyclopaedia of Biomaterials and Biomedical Engineering – Marcel Dekker Inc New York, 2004.
3. R.Lanza, J.Gearhart et.al,(Eds), Essential of Stem cell Biology, Elsevier Academic Press, 2006.
4. Sujata V.Bhatt, Biomaterials (2<sup>nd</sup> Edition), Narosa Publishing House, 2005.

**OUTCOMES:**

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

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



**OBJECTIVE:**

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

**UNIT I      PRINCIPLES OF ULTRASONICS      9**

Introduction, Piezo Electric Devices, The Fields of 'simple', CW excited sources, The Pulsed Acoustic field, Effects of human body on Beam Propagation, Beam formation by transducer arrays, Magnitudes of Acoustic Field variables, Displacement detectors Thermal mechanisms, Cavitation, Radiation Pressure.

**UNIT II      TISSUE-ULTRASOUND INTERACTION      9**

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

**UNIT III      SCANNING TECHNIQUES      9**

Ultrasound transducers, Construction of ultrasonic probe, Measurement of ultrasonic energy, pulse echo imaging, Pulse echo equation, Transducer motion, Transmit steering and focusing, Beam forming and Dynamic focusing, Transmitter, Receiver, Positional information, Scan converter-Analog, Digital. Image display, Image position, Transducer output, signal processing, adjustment of controls. Scanning Techniques- Acoustic windows, Scanning motion, Transducer Selection, Scan Indexing. Basic Image Interpretation-Contour, Internal Echo pattern, Attenuation, Classification, Artifacts.

**UNIT IV      REAL TIME ULTRASONIC SCANNERS      9**

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

**UNIT V      ULTRASONIC APPLICATIONS      9**

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

**TOTAL: 45 PERIODS****REFERENCES:**

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**OUTCOMES:**

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

