**UNIVERSITY DEPARTMENTS**

**ANNA UNIVERSITY, CHENNAI 600 025**

**M.E. MEDICAL ELECTRONICS**

**REGULATIONS - 2015**

**CHOICE BASED CREDIT SYSTEM**

## PROGRAMME EDUCATIONAL OBJECTIVES (PEOs) :

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

## PROGRAMME OUTCOMES (POs):

On successful completion of the programme, graduates will demonstrate an ability to

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

**MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES WITH PROGRAMME OUTCOMES**

A broad relation between the programme objective and the outcomes is given in the following table

| PROGRAMME EDUCATIONAL OBJECTIVES | PROGRAMME OUTCOMES | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
| I | ✓ | | ✓ | | ✓ | ✓ | | | |
| II | | ✓ | ✓ | ✓ | | | | ✓ | ✓ |
| III | | | | ✓ | | | ✓ | ✓ | ✓ |
| IV | | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| V | | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

| | | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| YEAR 1 | SEM 1 | Advanced Applied Mathematics | ✓ | | | | | | | | |
| | | Human Anatomy and Physiology | ✓ | | | | | | | | |
| | | Bio Medical Instrumentation | | | ✓ | ✓ | | | ✓ | ✓ | ✓ |
| | | Biosignal Processing | | ✓ | | ✓ | | | | | ✓ |
| | | Medical Equipments | | | | ✓ | | | ✓ | | |
| | | Professional Elective I | | | | | | | | | |
| | | Biomedical Instrumentation Lab | | ✓ | | | | | | ✓ | ✓ |
| | | | | | | | | | | | |
| | SEM 2 | Medical Image Processing | | ✓ | | ✓ | | | | | ✓ |
| | | Medical Imaging Systems and Radio Therapy | | | ✓ | | ✓ | | | | |
| | | Professional Elective II | | | | | | | | | |
| | | Professional Elective III | | | | | | | | | |
| | | Professional Elective IV | | | | | | | | | |
| | | Professional Elective V | | | | | | | | | |
| | | Data Acquisition and Processing Lab | | ✓ | | | | | | ✓ | ✓ |
| | | | | | | | | | | | |
| YEAR 2 | SEM 3 | Professional Elective VI | | | | | | | | | |
| | | Professional Elective VII | | | | | | | | | |
| | | Professional Elective VIII | | | | | | | | | |
| | | Hospital Training | | | | ✓ | | | ✓ | | |
| | | Project Work (Phase I) | | | | | ✓ | ✓ | ✓ | ✓ | ✓ |
| | | | | | | | | | | | |
| | SEM 4 | Project Work (Phase II) | | | | | ✓ | ✓ | ✓ | ✓ | ✓ |
| | | | | | | | | | | | |





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**M.E. MEDICAL ELECTRONICS**

**REGULATIONS – 2015**

**CHOICE BASED CREDIT SYSTEM**

**CURRICULA AND SYLLABI**

**I SEMESTER**

| SL. NO. | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | MA7152 | Advanced Applied Mathematics | FC | 4 | 4 | 0 | 0 | 4 |
| 2. | MD7151 | Human Anatomy and Physiology | PC | 3 | 3 | 0 | 0 | 3 |
| 3. | MD7101 | Bio Medical Instrumentation | PC | 3 | 3 | 0 | 0 | 3 |
| 4. | MD7102 | Bio Signal Processing | PC | 3 | 3 | 0 | 0 | 3 |
| 5. | MD7103 | Medical Equipments | PC | 3 | 3 | 0 | 0 | 3 |
| | | Elective I | PE | 3 | 3 | 0 | 0 | 3 |
| **PRACTICALS** | | | | | | | | |
| 6. | MD7111 | Biomedical Instrumentation Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| | | | **TOTAL** | **23** | **19** | **0** | **4** | **21** |

**II SEMESTER**

| SL. NO | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | MM7251 | Medical Image Processing | PC | 3 | 3 | 0 | 0 | 3 |
| 2. | MD7201 | Medical Imaging Systems and Radio Therapy | PC | 3 | 3 | 0 | 0 | 3 |
| 3. | | Elective II | PE | 3 | 3 | 0 | 0 | 3 |
| 4. | | Elective III | PE | 3 | 3 | 0 | 0 | 3 |
| 5. | | Elective IV | PE | 3 | 3 | 0 | 0 | 3 |
| 6. | | Elective V | PE | 3 | 3 | 0 | 0 | 3 |
| **PRACTICALS** | | | | | | | | |
| 7. | MD7211 | Data Acquisition and Processing Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| 8. | MD7212 | Technical Seminar and Report Writing | EEC | 2 | 0 | 0 | 2 | 1 |
| | | | **TOTAL** | **24** | **18** | **0** | **6** | **21** |

**III SEMESTER**

| SL. NO | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | | Elective VI | PE | 3 | 3 | 0 | 0 | 3 |
| 2. | | Elective VII | PE | 3 | 3 | 0 | 0 | 3 |
| 3. | | Elective VIII | PE | 3 | 3 | 0 | 0 | 3 |
| **PRACTICALS** | | | | | | | | |
| 4. | MD7311 | Hospital Training | EEC | 4 | 0 | 0 | 4 | 2 |
| 5. | MD7312 | Project Work Phase I | EEC | 12 | 0 | 0 | 12 | 6 |
| | | | **TOTAL** | **25** | **9** | **0** | **16** | **17** |

**IV SEMESTER**

| SL. NO | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **PRACTICALS** | | | | | | | | |
| 1. | MD7411 | Project Work Phase II | EEC | 24 | 0 | 0 | 24 | 12 |
| | | | **TOTAL** | **24** | **0** | **0** | **24** | **12** |

**TOTAL NO. OF CREDITS: 71**

**ANNA UNIVERSITY, CHENNAI**

**UNIVERSITY DEPARTMENTS**

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**CHOICE BASED CREDIT SYSTEM**

**CURRICULA AND SYLLABI**

**I SEMESTER**

| SL. NO | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | MA7152 | Advanced Applied Mathematics | FC | 4 | 4 | 0 | 0 | 4 |
| 2. | MD7102 | Bio Signal Processing | PC | 3 | 3 | 0 | 0 | 3 |
| 3. | MD7151 | Human Anatomy and Physiology | PC | 3 | 3 | 0 | 0 | 3 |
| | | | **TOTAL** | **10** | **10** | **1** | **0** | **10** |

**II SEMESTER**

| SL. NO | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | MM7251 | Medical Image Processing | PC | 3 | 3 | 0 | 0 | 3 |
| 2. | MD7201 | Medical Imaging Systems and Radio Therapy | PC | 3 | 3 | 0 | 0 | 3 |
| 3. | | Elective I | PE | 3 | 3 | 0 | 0 | 3 |
| | | | **TOTAL** | **9** | **9** | **0** | **0** | **9** |

**III SEMESTER**

| SL. NO | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | MD7101 | Bio Medical Instrumentation | PC | 3 | 3 | 0 | 0 | 3 |
| 2. | MD7103 | Medical Equipments | PC | 3 | 3 | 0 | 0 | 3 |
| 3. | | Elective II | PE | 3 | 3 | 0 | 0 | 3 |
| **PRACTICALS** | | | | | | | | |
| 4. | MD7111 | Biomedical Instrumentation Lab | PC | 4 | 0 | 0 | 4 | 2 |
| | | | **TOTAL** | **13** | **9** | **0** | **4** | **11** |



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**IV SEMESTER**

| SL. NO. | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | | Elective III | PE | 3 | 3 | 0 | 0 | 3 |
| 2. | | Elective IV | PE | 3 | 3 | 0 | 0 | 3 |
| 3. | | Elective V | PE | 3 | 3 | 0 | 0 | 3 |
| **PRACTICALS** | | | | | | | | |
| 4. | MD7211 | Data Acquisition and Processing Lab | PC | 4 | 0 | 0 | 4 | 2 |
| 5. | MD7212 | Technical Seminar and Report Writing | EEC | 2 | 0 | 0 | 2 | 1 |
| | | | **TOTAL** | **15** | **9** | **0** | **6** | **12** |

**V SEMESTER**

| SL. NO. | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | | Elective VI | PE | 3 | 3 | 0 | 0 | 3 |
| 2. | | Elective VII | PE | 3 | 3 | 0 | 0 | 3 |
| 3. | | Elective VIII | PE | 3 | 3 | 0 | 0 | 3 |
| **PRACTICALS** | | | | | | | | |
| 4. | MD7312 | Project Work Phase I | EEC | 12 | 0 | 0 | 12 | 6 |
| | | | **TOTAL** | **21** | **9** | **0** | **12** | **15** |

**VI SEMESTER**

| SL.NO | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **PRACTICALS** | | | | | | | | |
| 1. | MD7311 | Hospital Training | EEC | 4 | 0 | 0 | 4 | 2 |
| 2. | MD7411 | Project Work Phase II | EEC | 24 | 0 | 0 | 24 | 12 |
| | | | **TOTAL** | **24** | **0** | **0** | **28** | **14** |

**TOTAL NO. OF CREDITS: 71**

**FOUNDATION COURSES (FC)**

| SL. NO | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| 1. | | Advanced Applied Mathematics | FC | 4 | 3 | 1 | 0 | 4 |



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## PROFESSIONAL CORE (PC)

| SL. NO | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| 1. | | Bio Medical Instrumentation | PC | 3 | 3 | 0 | 0 | 3 |
| 2. | | Biosignal Processing | PC | 3 | 3 | 0 | 0 | 3 |
| 3. | | Medical Equipments | PC | 3 | 3 | 0 | 0 | 3 |
| 4. | | Human Anatomy and Physiology | PC | 3 | 3 | 0 | 0 | 3 |
| 5. | | Medical Image Processing | PC | 3 | 3 | 0 | 0 | 3 |
| 6. | | Medical Imaging Systems and Radio Therapy | PC | 3 | 3 | 0 | 0 | 3 |
| 7. | | Biomedical Instrumentation Lab | PC | 4 | 0 | 0 | 4 | 2 |
| 8. | | Data Acquisition and Processing Laboratory | PC | 4 | 0 | 0 | 4 | 2 |

## PROFESSIONAL ELECTIVES (PE)

| SL. NO | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| 1. | MD7001 | Advances in Electronics Applied to Hospital Engineering | PE | 3 | 3 | 0 | 0 | 3 |
| 2. | MD7002 | Brain Computer Interface | PE | 3 | 3 | 0 | 0 | 3 |
| 3. | MD7003 | Health Care, Hospital and Equipment Management. | PE | 3 | 3 | 0 | 0 | 3 |
| 4. | MD7004 | Human Assist Devices | PE | 3 | 3 | 0 | 0 | 3 |
| 5. | MD7005 | Medical Informatics | PE | 3 | 3 | 0 | 0 | 3 |
| 6. | MD7006 | Wavelet Transforms and its Application | PE | 3 | 3 | 0 | 0 | 3 |
| 7. | AP7074 | DSP Integrated Circuits | PE | 3 | 3 | 0 | 0 | 3 |
| 8. | BO7071 | Bio Materials | PE | 3 | 3 | 0 | 0 | 3 |
| 9. | BO7251 | Bio Mechanics | PE | 3 | 3 | 0 | 0 | 3 |
| 10. | BO7202 | Rehabilitation Engineering | PE | 3 | 3 | 0 | 0 | 3 |
| 11. | MD7071 | Advanced Neural Computing | PE | 3 | 3 | 0 | 0 | 3 |
| 12. | MD7072 | Advanced Neural Engineering | PE | 3 | 3 | 0 | 0 | 3 |
| 13. | MD7073 | Bio MEMS | PE | 3 | 3 | 0 | 0 | 3 |
| 14. | | Computer Based | PE | 3 | 3 | 0 | 0 | 3 |



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| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | MD7074 | Medical Instrumentation | | | | | | |
| 15. | MD7075 | Medical Ethics and Standards | PE | 3 | 3 | 0 | 0 | 3 |
| 16. | MD7076 | Medical Optics | PE | 3 | 3 | 0 | 0 | 3 |
| 17. | MD7077 | Nanomedicine Principles and Applications | PE | 3 | 3 | 0 | 0 | 3 |
| 18. | MD7078 | Pattern Recognition Techniques and Applications | PE | 3 | 3 | 0 | 0 | 3 |
| 19. | MD7079 | Physiological Systems Modeling and Simulation | PE | 3 | 3 | 0 | 0 | 3 |
| 20. | MD7080 | Principles of Genetic Analysis | PE | 3 | 3 | 0 | 0 | 3 |
| 21. | MD7081 | Tele Health Technology | PE | 3 | 3 | 0 | 0 | 3 |
| 22. | MD7082 | Tissue Engineering. | PE | 3 | 3 | 0 | 0 | 3 |
| 23. | MD7083 | Ultrasound Principles and Applications in Medicine | PE | 3 | 3 | 0 | 0 | 3 |
| 24. | MD7007 | Wireless Body Area Networks | PE | 3 | 3 | 0 | 0 | 3 |

**EMPLOYABILITY ENHANCEMENT COURSES (EEC)**

| SL. NO | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| 1. | | Hospital Training | EEC | 4 | 0 | 0 | 4 | 2 |
| 2. | | Technical Seminar and Report Writing | EEC | 2 | 0 | 0 | 2 | 1 |
| 3. | | Project Work Phase I | EEC | 12 | 0 | 0 | 12 | 6 |
| 4. | | Project Work Phase II | EEC | 24 | 0 | 0 | 24 | 12 |

**MA7152** **ADVANCED APPLIED MATHEMATICS** **L T P C**
**4 0 0 4**

**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 Poison's equations.

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

**OUTCOMES:**

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

**TEXT BOOKS:**


1. Bronson, R.Matrix Operation, Schaum's outline series, McGraw Hill, New York (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.

**MD7151 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 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 MUSCULOSKELETAL SYSTEM 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 glands - 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**

**OUTCOMES:**

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

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

**REFERENCES:**


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 - 10 edition 2002
4. Ranganathan T S, Text Book of human Anatomy S. Chand and company New Delhi – 1994.


**MD7101 BIO MEDICAL INSTRUMENTATION L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To know the various functional blocks present is biosignal acquisition system so that the students capable to design the data acquisition system.
- To understand the different biopotential characteristics and recording methods so as to enable to record various biosignals.
- To develop an understanding of the nonelectrical parameters measurements so as to enable to record various non electrical parameters.
- To study the biochemical measurements so as to create confidence in students to do biochemical measurement.

**UNIT I BIOMEDICAL TRANSDUCERS AND AMPLIFIERS 9**

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

**UNIT II BIOPOTENTIAL RECORDING 9**

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

**UNIT III NON ELECTRICAL PARAMETER MEASUREMENTS 9**

Respiration rate, Pulse rate, Temperature, Blood Pressure, $O_2$ , $CO_2$ 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, auto analyser, Biosensors.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

**By the completion of this course the student will to**

- Describe various functional blocks present is biosignal acquisition system and to design the data acquisition system.
- Analyze different biopotential characteristics and recording methods of biosignals.
- Develop measurement systems by selecting different types of sensors, signal conditioning circuits for acquiring and recording various physiological parameters.
- Perform biochemical measurement with Confidence.

**REFERENCES:**


1. Geddes LA and Baker L.E Principals of Applied Biomedical Instrumentation, 3rd Edition, John Wiley and sons, New york 1989
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.
5. Richard S.Cobbold Transducers for Biomedical Measurements; Principle and applications- John Wiley and sons, 1992.


**MD7102 BIO SIGNAL PROCESSING L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To introduce the characteristics of different biosignals
- To discuss linear and non-linear filtering techniques to extract desired information
- To introduce techniques for automated classification and decision making to aid diagnosis

**UNIT I SIGNAL, SYSTEM AND SPECTRUM 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, non stationary process, fixed segmentation, adaptive segmentation, application in EEG, PCG and HRV signals, model based ECG simulator. Spectral estimation – Blackman Tukey method, periodogram, and model based estimation. Application in Heart rate variability, PCG signals,

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

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

**UNIT IV BIOSIGNAL CLASSIFICATION AND RECOGNITION 9**

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

**UNIT V TIME FREQUENCY AND MULTIVARIATE ANALYSIS 9**

Time frequency representation, spectrogram, Time-scale representation, scalogram, wavelet analysis – Data reduction techniques, ECG data compression, ECG characterization, Feature extraction- Wavelet packets, Multivariate component analysis-PCA, ICA

**TOTAL: 45 PERIODS**

**OUTCOMES**:

**Upon the completion of this course, the students are able**

- To analyse the different types of signals & systems
- To analyse signals in time series domain & estimate the spectrum
- To demonstrate the significance of wavelet detection applied in biosignal processing.
- To extract the features using multivariate component analysis.

**REFERENCES:**


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.


**MD7103 MEDICAL EQUIPMENTS L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To know the various functional blocks present is cardiac care units so that the students can handle these equipments with care and safety.
- To understand the different types of neurology equipments so the students learn to use this equipment.
- To develop an understanding of the physiotherapy and diathermy equipment so that the student can learn to operate.

**UNIT I CARDIAC CARE UNIT 9**

Pacemakers – Need, different types, electrode types and placement, batteries for pacemakers, Design. AC defibrillators, DC defibrillators - asynchronous and synchronous, Types of waveforms, electrode types and placement, precautions, Patient monitoring system

**UNIT II NEUROLOGY EQUIPMENT 9**

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

**UNIT III PHYSIOTHERAPY AND DIATHERMY EQUIPMENT 9**

Physiological effects of HF radiation, Depth of Penetration, short wave, Ultrasonic and microwave diathermy, Surgical diathermy, Galvanic, Faradic Stimulators, Interferential therapy, Electrical safety-IEC-60601 standard, Physiological effects of current, Leakage current, Micro and macro electric shock, GFI units, Earthing Scheme, Electrical safety Analyzer.

**UNIT IV FIBER OPTICS AND LASER APPLICATIONS 9**

Fibre optic cables- Principles, Types. Principles of Laser action, Different types- $CO_2$, Nd-YAG, Argon, Helium-Neon, Clinical applications of laser. Endoscopy, Laparoscopy

**UNIT V RECENT TRENDS 9**

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

**TOTAL: 45 PERIODS**

**OUTCOMES :**

**On completion of this course the student will be able to:**

- Describe the working of pacemakers and defibrillator and related circuits.
- Obtain the domain knowledge of Neurological equipment, Physiotheraphy equipment and Laser and ultrasound equipment.
- Identify the electrical hazards in the hospital environment and make it shock free zone.
- Discuss the recent trends in field of diagnostic and therapeutic equipments.

**REFERENCES:**


1. Albert M Cook and Webster J G – Therapeutic medical devices Prentice Hall New York 1982
2. Khandpur R.S Hand Book of Biomedical Instrumentation – Tata Mc Graw Hill publication, New Delhi 2nd edition 2003
3. Leslie Cromwell , Fred J.Weibell and Erich A.Pfeiffer - Biomedical Instrumentation Prentice Hall New Delhi 2000
4. Jacobson B and Webster J G Medical and Clinical Engineering – Prentice Hall of India New Delhi 1999.
5. Wolbasrsht . M. L, Laser Application in Medicine and Biology plenum press NewYork 1989.
6. Heinz Kresse – Handbook of Electro medicine. John Wiely & Sons – Chrchester - 1985


**MD7111 BIO MEDICAL INSTRUMENTATION LABORATORY L T P C**
**0 0 4 2**

**OBJECTIVES :**

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

**LIST OF EXPERIMENTS**

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

**TOTAL: 60 PERIODS**

**OUTCOME:**

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

**MM7251 MEDICAL IMAGE PROCESSING L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To provide information about various medical imaging modalities
- To understand the basic concepts of image enhancement, image restoration, morphological image processing, image segmentation, feature recognition in medical images
- To provide information about classification and image visualization in medical image processing projects
- To familiarize the student with the image processing facilities in Matlab and its equivalent open source tools

**UNIT I FUNDAMENTALS OF IMAGE PROCESSING 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.

**UNIT II BIO-MEDICAL IMAGE PREPROCESSING 9**

Image Enhancement operations – Image noise and modeling, Image restoration – Image degradation model, Inverse and Weiner filtering, Geometric transformations and correction.

**UNIT III MEDICAL IMAGE RECONSTRUCTION 9**

Mathematical preliminaries and basic reconstruction methods, Image reconstruction in CT scanners, MRI, fMRI, Ultra sound imaging., 3D Ultra sound imaging Nuclear, Medical Imaging modalities – SPECT,PET, Molecular Imaging.

**UNIT IV IMAGE ANALYSIS AND CLASSIFICATION 9**

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

**UNIT V IMAGE REGISTRATIONS AND VISUALIZATION 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:**

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

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

**REFERENCES:**


1. Atam P.Dhawan, “Medical Image Analysis’, Wiley Interscience Publication, NJ S.Sridhar, “Digital Image Processing”, Oxford University Press, 2011, New Delhi.
2. Rafael C.Gonzalez and Richard E.Woods, “Digital Image Processing”, Third Edition, Pearson Education, 2008, New Delhi
3. Geoff Dougherty, “Digital Image Processing for Medical Applications”, Cambridge University Press, 2010.
4. Alasdair McAndrew, “Introduction to Digital Image Processing with Matlab”, Cengage Learning 2011, India.
5. Anil J Jain, “Fundamentals of Digital Image Processing”, PHI, 2006.
6. Alfred Horowitz, ‘MRI Physics for Radiologists – A Visual Approach’, Second
7. edition Springer Verlag Network, 1991.
8. Kavyan Najarian and Robert Splerstor,” Biomedical signals and Image processing”,CRC – Taylor and Francis, New York, 2006
9. John L.Semmlow, ”Biosignal and Biomedical Image Processing Matlab Based applications” Marcel Dekker Inc., New York,2004




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**MD7201 MEDICAL IMAGING SYSTEMS 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 AND COMPUTED TOMOGRAPHY 9**

Principle and production of X – Rays, Selection of anodes, heel pattern, Scattered Radiation, Porter-Bucky systems, Digital Radiography, principles of Angiography and Fluoroscopic Techniques, Image Intensifiers, digital subtraction angiography, mammography, dental X- ray units. Computerised Axial Tomography, Principle, Detectors, image reconstruction, Spiral CT, 3D Imaging.

**UNIT II EMISSION IMAGING 9**

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

**UNIT III MAGNETIC RESONANCE IMAGING 9**

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

**UNIT IV ULTRASOUND IMAGING AND THERMOGRAPHY 9**

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

**UNIT V THERAPY USING X – RAYS AND ISOTOPES 9**

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

**TOTAL: 45 PERIODS**

**OUTCOME:**

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

**REFERENCES:**


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


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**MD7211 DATA ACQUISITION AND PROCESSING LABORATORY L T P C**
**0 0 4 2**

**OBJECTIVE:**

To study the various aspects of acquisition and analysis of bio signals and medical images
To understand the importance of electrical safety of medical equipments
To study practically the concepts of physiological modeling

**LIST OF EXPERIMENTS**

1. Acquisition and analysis of bio signals using workstation.
2. Study of auditory and visual evoked responses.
3. Development of software for basic telemedicine.
4. Development of neural network for signal classification.
5. Acquisition and analysis of medical images.
6. Development of software for medical image compression.
7. Development of algorithm for medical data security.
8. Study of IDL as a tool for medical image analysis.
9. Study of DICOM standards.
10. Study of lung and cardiovascular models.
11. Electrical safety testing of medical equipment.
12. Mini project (Should include hardware and software).

**TOTAL: 60 PERIODS**

**OUTCOMES:**

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

**MD7001 ADVANCES IN ELECTRONICS APPLIED TO HOSPITAL ENGINEERING 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, PACS.

**UNIT III 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, sources of EMI, effects of EMI on medical devices, computation of EMI, measuring techniques to quantify the level of interference, method of suppressing and isolating the unit from interference.

**UNIT VI VIRTUAL REALITY APPLICATION 9**

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

**TOTAL : 45 PERIODS**

**OUTCOMES:**

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

**REFERENCES:**


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, Wiley Interscience Publication, New Delhi, 1991.
5. SK Basandia, Local Area Network, Golgotia Publishing Pvt. Ltd., New Delhi, 1995
6. R.C.Goyal,'Hospital administration and human resource management', 4th edition, Prentice Hall of India, New Delhi, 2006.


**MD7002 BRAIN COMPUTER INTERFACE L T P C**
**3 0 0 3**

**OBJECTIVES:**

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

**UNIT I INTRODUCTION TO BCI 9**

Fundamentals of BCI – Structure of BCI system – Classification of BCI: Invasive, Non-invasive and Partially invasive BCI- Brain signal acquisition, Signal Preprocessing, Artifacts removal

**UNIT II ELECTROPHYSIOLOGICAL SOURCES 9**

Sensorimotor activity –Neuronal activity in motor cortex and related areas- Electric and magnetic fields produced by the brain- signals reflecting brain metabolic activity- Mu rhythm, Movement Related Potentials – Slow Cortical Potentials - P300 Event related potential - Visual Evoked Potential - Activity of Neural Cells - Multiple Neuromechanisms

**UNIT III FEATURE EXTRACTION METHODS 9**

Time/Space Methods – Fourier Transform, Wavelets, AR, MA, ARMA models, Bandpass filtering, Template matching, Kalman filter, PCA, Laplacian filter – Linear and Non-Linear Features

**UNIT IV FEATURE TRANSLATION METHODS 9**

Linear Discriminant Analysis –Nearest neighbours, Support Vector Machines - Regression – Learning Vector Quantization – Gaussian Mixture Modeling – Hidden Markov Modeling – Neural Networks

**UNIT V APPLICATIONS OF BCI** **9**

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

**TOTAL: 45 PERIODS**

**OUTCOMES:**

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

**REFERENCES:**


1. Jonathan Wolpaw,Elizabeth Winter Wolpaw,'Brain Computer Interfaces: Principles and practice", Edition 1, Oxford University Press, USA, January 2012
2. Special Issue on Brain Control Interfaces, IEEE Transactions on Neural Systems and Rehabilitation Engineering, Vol 14, June 2006.
3. R. Spehlmann, "EEG Primer", Elsevier Biomedical Press, 1981.
4. Bernhard Graimann, Brendan Allison, Gert Pfurtscheller, "Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction", Springer, 2010
5. Ali Bashashati, Mehrdad Fatourechi, Rabab K Ward, Gary E Birch," A survey of signal Processing algorithms in brain–computer interfaces based on electrical brain signals" JOURNAL OF NEURAL ENGINEERING, VOL.4, 2007, PP.32-57
6. Arnon Kohen, "Biomedical Signal Processing", Vol I and II, CRC Press Inc, Boca Rato, Florida.
7. Bishop C.M., "Neural networks for Pattern Recognition", Oxford, Clarendon Press, 1995.
8. Andrew Webb, "Statistical Pattern Recognition", Wiley International, Second Edition, 2002.
9. Torsten Felzer, "On the possibility of Developing a Brain Computer Interface",Technical Report, Technical University of Darmstadt, Germany,2001.
10. Wolpaw J.R, N.Birbaumer et al, "Brain control interface for Communication and control", Clinical Neurophysiology, 113, 2002.
11. Jose del R.Millan et al, "Non-invasive brain actuated control of a mobile robot by human
12. EEG", IEEE Transactions on biomedical Engineering, Vol 51, No.6, 2004 June.
13. S.Coyle, T.Ward et al, "On the suitability of near infra red systems for next generation Brain Computer interfaces", Physiological Measurement, 25, 2004.
14. Carlo Tomasi, "Estimating Gaussian Mixture Densities with EM – A Tutorial", Duke University, 2000.
15. R.Dugad, U.B Desai, "A Tutorial on Hidden Markov Modeling", Signal Processing and Artificial Neural Networks Laboratory, IIT Bombay, 1996.
16. http:://ida.first.fhg.de/projects/bci/competition_iii




**MD7003 HEALTH CARE, HOSPITAL AND EQUIPMENT MANAGEMENT** **L T P C**
**3 0 0 3**

**OBJECTIVE:**

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

**UNIT I HEALTH SYSTEM** **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, Ambulatory care.

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

**REFERENCES:**


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. San Deigo 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


**MD7004 HUMAN ASSIST DEVICES L T P C**
**3 0 0 3**

**OBJECTIVE:**

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

**UNIT I HEART LUNG MACHINE AND ARTIFICIAL HEART 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 ORTHOTIC DEVICES 9**

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

**UNIT V RESPIRATORY AND HEARING AIDS 9**

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

**TOTAL: 45 PERIODS**

**OUTCOMES:**

**At the end of this course the students will be able to**

- Explain the role and importance of Heart lung machine and artificial Heart.
- Explain the importance of different types of assist devices and related issues.
- Ability to specify the type of assistive devices for rehabilitation.

**REFERENCES:**


1 Kolff W.J., Artificial Organs, John Wiley and Sons, New York, 1979.
2 Andreas.F.Von racum, 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.


**MD7005 MEDICAL INFORMATICS L T P C**
**3 0 0 3**

**OBJECTIVE**

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

**UNIT I MEDICAL INFORMATICS 9**

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

**UNIT II MEDICAL DATA AND STANDARDS 9**

Electronic Patient Record (EPR) - Integrated clinical data - Biosignal and Medical image formats - Medical data storage and retrieval techniques – Steganography, - Medical Standards – HL7 – DICOM - IEEE 1073 - IRMA - LOINC - ICD10 - Medical standard organizations

**UNIT III DECISION MAKING 9**

Fuzzy logic – its applications in Medicine, Physiological System Modeling and Simulation, Virtual Reality and Multimedia Applications in Medicine, Biometrics - Biometric Devices - Physiological Characteristic Devices - Behavioral Characteristic Devices - Feature extraction and Decision making- Social issues

**UNIT IV JAVA PROGRAMMING 9**

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

**UNIT V INTERNET AND WEB 9**

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

**TOTAL: 45 PERIODS**

**OUTCOME:**

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

**REFERENCES:**


1. Ramachandra Lele, Computers in Medicine Progress in Medical Informatics, Tata McGraw Hill Publishing Company, New Delhi, 2005
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


**MD7006 WAVELET TRANSFORMS AND ITS APPLICATIONS L T P C**

**3 0 0 3**

**OBJECTIVE:**

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

**UNIT I INTRODUCTION TO WAVELETS 9**

Introduction to Multirate signal processing- Decimation and Interpolation, Quadrature Mirror Filters, Subband coding, Limitations of Fourier transform, Short time Fourier transform and its drawbacks, Continuous Wavelet transform, Time frequency representation, Wavelet System and its characteristics, Orthogonal and Orthonormal functions and function space

**UNIT II MULTIRESOLUTION CONCEPT AND DISCRETE WAVELET TRANSFORM 9**

Multiresolution formulation of wavelet systems- signal spaces, scaling function, wavelet function and its properties, Multiresolution analysis, Haar scaling and wavelet function, Filter banks-Analysis and Synthesis, 1D and 2D Discrete wavelet transform, Wavelet Packets, Tree structured filter bank, Multichannel filter bank, Undecimated wavelet transform.

**UNIT III WAVELET SYSTEM DESIGN 9**

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

**UNIT IV WAVELET FAMILIES 9**

Continuous Wavelets- Properties of Mexican hat wavelet, Morlet, Gaussian and Meyer wavelets. Orthogonal wavelets- Properties of Haar wavelets, Daubechies wavelets, Symlets, Coiflets and Discrete Meyer wavelets. Properties of Biorthogonal wavelets, Applications of wavelet families.

**UNIT V WAVELET APPLICATIONS 9**

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

**TOTAL: 45 PERIODS**

**OUTCOME:**

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

**REFERENCES:**


1. M.Vetterli and J. Kovacevic, 'Wavelets and sub band coding', Prentice Hall, 1995.
2. C.Sidney Burrus, Ramesh Gopinath & Haito Guo, 'Introduction to wavelets and wavelet transform', Prentice Hall, 1998.
3. Metin Akay, 'Time frequency and wavelets in biomedical signal processing', Wiley-IEEE Press, October 1997.
4. Raguveer m Rao & Ajith S. Bopardikar, 'Wavelet transforms – Introduction to theory and applications', Addison Wesley, 1998
5. S.Mallet, 'A Wavelet tour of signal processing', Academic Press 1998
6. G.Strang and T.Nguyen, 'Wavelet and filter banks', Wesley and Cambridge Press.
7. P.P.Vaidyanathan, 'Multi rate systems and filter banks', Prentice Hall 1993.




**AP7074 DSP INTEGRATED CIRCUITS L T P C**
**3 0 0 3**

**OBJECTIVES:**

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

**UNIT I INTRODUCTION TO DSP INTEGRATED CIRCUITS 9**

Introduction to 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, Standard digital signal processors, Application specific IC's for DSP, DSP systems, DSP system design, Integrated circuit design.

**UNIT II 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 III DSP ARCHITECTURES 9**

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

**UNIT IV SYNTHESIS OF DSP ARCHITECTURES AND ARITHMETIC UNIT 9**

**Synthesis:** Mapping of DSP algorithms onto hardware, Implementation based on complex PEs, Shared memory architecture with Bit – serial PEs.

**Arithmetic Unit :** Conventional number system, Redundant Number system, Residue Number System, Bit-parallel and Bit-Serial arithmetic, Digit Serial arithmetic, CORDIC Algorithm, Basic shift accumulator, Reducing the memory size, Complex multipliers, Improved shift-accumulator.

**UNIT V CASE STUDY-INTEGRATED CIRCUIT DESIGN 9**

Layout of VLSI circuits, Layout Styles, **Case Study:** FFT processor, DCT processor and Interpolator.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Get to know about the Digital Signal Processing concepts and it's algorithms
- Get an idea about finite wordlength effects in digital filters
- Concept behind multirate systems is understood.
- Get familiar with the DSP processor architectures and how to perform synthesis of processing elements
- Acquire an general idea about VLSI circuit layout design aspects

**REFERENCES:**


1. Lars Wanhammer, "DSP Integrated Circuits", Academic press, New York, 1999.
2. John J. Proakis, Dimitris G. Manolakis, "Digital Signal Processing", Pearson Education, 2002.
3. B.Venkatramani, M.Bhaskar, "Digital Signal Processors", Tata McGraw-Hill, 2002.
4. Emmanuel C. Ifeachor, Barrie W. Jervis, " Digital signal processing – A practical approach", Tata McGraw-Hill, 2002.
5. Keshab K.Parhi, "VLSI Digital Signal Processing Systems design and Implementation", John Wiley & Sons, 1999.


**BO7071 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 Biomimetic Materials, Composites. Material preparation, chemical composition, Properties, uses in medicine and biosciences and failure mechanisms.

**UNIT III STERLIZATION 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 – biood compatibility and thromobogenicity, ISO 10993- standard for assessment of biocompatibility.

**UNIT V HARD AND SOFT REPLACEMENT 10**

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

**TOTAL: 45 PERIODS**

**OUTCOMES:**

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

**REFERENCES:**


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.




**BO7251 BIO MECHANICS L T P C**

**3 0 0 3**

**OBJECTIVES :**

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

**UNIT I INTRODUCTION 9**

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

**UNIT II MECHANICS OF CIRCULATION 9**

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

**UNIT III MECHANICS APPLIED TO ORTHOPAEDICS 9**

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

**UNIT IV MECHANISM OF BIOLOGICAL SYSTEMS 9**

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

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

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

**TOTAL:45 PERIODS**

**OUTCOMES:**

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

**REFERENCES:**


1. Y.C.Fung, Biomechanics: Mechanical properties in living tissues, Springer Verlag, New York 1981.
2. Susan J.Hall, Basics Bio Mechanics 4th Edition, McGraw-Hill Publishing Co, 2002.
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 Engineerin, publications Ltd. 1989.

6 Jacob Kline, Head book of Bio Medical Engineering, Academic Press

**BO7202** **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, materials for prosthetic and orthotic devices, mobility aids, wheel chair.

**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**

**OUTCOME:**

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

**REFERENCES:**


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
4. Publication, New York 1968.
5. Albert M.Cook and Webster J.G, Therapeutic Medical devices, Prentice Hall Inc., New Jersy,
6. 1982.
7. Reswick.J, What is Rehabilitation Engineering, Annual review of Rehabilitation-volume2, Springer- Verlag, New York 1982

**MD7071** **ADVANCED NEURAL COMPUTING** **L T P C**
**3 0 0 3**

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

**UNIT I INTRODUCTION TO ARTIFICIAL NEURAL SYSTEMS 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**

**OUTCOME:**

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

**REFERENCES:**


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 lnc, 1999.
5. James A Freeman and David M. Skapura, Neural Networks, Addison - Wesley, India 1999.


**MD7072 ADVANCED NEURAL ENGINEERING L T P C**

**3 0 0 3**

**OBJECTIVES :**

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

**UNIT I BASICS OF NERVE 9**

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

**UNIT II BRAIN, BRAIN STEM AND SPINAL CORD 9**

Brain: Lobes - Cortical Areas – Brain Circuits – Memory – Sleep - Brains Stem: Structure and Control areas – Cerebellum - dyslexia. Spinal cord: Structure and Functions. Concepts of Nuclei, Ganglia and tracts - Reticular formation – Plexus formation – Visual, Auditory & Olfactory Pathway. Neurophysiology and neural control of genitourinary function.

**UNIT III NEURON TRACING 9**

Physiology of Nerve conduction - Visualization of nervous system – Synaptic transmission and cellular signaling of Neurons - Electrical activity of the brain and recording of brain waves - Cortical mapping - Voltage sensitive dyes - Fluorescent tracing of neural tissue. Synchronization and control of neural activity in-vivo and in-vitro - Spinal neural circuits – Neural cell markers.

**UNIT IV NERVE INJURY AND DISORDERS 9**

Blood Brain Barrier - Neurological dysfunctions - Neuro degeneration – Demyelination – Neuronal injury - Neural plasticity- Wallerian degeneration – Drugs acting on CNS and their Pharmacokinetics. Alzheimer's, Parkinson's and Prion diseases. Sleep Disorder – Schizophrenia

**UNIT V NEURAL ENGINEERING 9**

Regeneration of the Nervous system - Axon guidance - Retinal regeneration - Neuron & Neuroglial culture - Nerve graft: Neural Tissue Engineering –Peripheral Nerve Reconstruction - Drug Delivery system in CNS. Cognitive & neurobehavioral rehabilitation.

**TOTAL: 45 PERIODS**

**OUTCOME:**

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

**REFERENCES:**


1. Mathews G.G.' Neurobiology', 2nd Edition, Blackwell Science, UK, 2000.
2. Malcom Carpenter , 'Textbook of Neuroanatomy', Mc.Graw hill Edition.
3. Park J.B."Biomaterials Science and Engineering", Plenum Press, 1984.
4. W. Mark Saltzman 'Tissue Engineering – Engineering principles for design of replacement organs and tissue' - Oxford University Press inc New York, 2004.


**MD7073 BIO MEMS L T P C**
**3 0 0 3**

**OBJECTIVES:**

**To understand**

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

**UNIT I MEMS MATERIALS AND FABRICATION 9**

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

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

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

**UNIT III ELECTROSTATIC AND PIEZOELECTRIC SENSORS AND ACTUATORS 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 elecrophoretic 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**

**OUTCOMES:**

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

**REFERENCES:**


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, "Bio MEMs: Technologies and applications", CRC Press, New York, 2007
5. Marc J. Madou ' Fundamentals of micro fabrication: the science of miniaturization', CRC Press,2002
6. Nadim Maluf, Kirt Williams. "An introduction to Microelectro mechancial 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.


**MD7074 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 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 III PROCESSORS AND MEMORY 9**

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

**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 MEDCAL INSTRUMENTATION 9**

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

**TOTAL: 45 PERIODS**

**OUTCOMES:**

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

**REFERENCES:**


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
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


**MD7075 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 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
- Guidelines to obtain medical standards in hospitals

**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”, 2nd edition 2008, Ben Mepham, Oxford.


**MD7076 MEDICAL OPTICS L T P C**

**3 0 0 3**

**OBJECTIVE:**

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

**UNIT I OPTICAL PROPERTIES OF THE TISSUES 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**

**OUTCOME:**

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

**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.


**MD7077 NANOMEDICINE PRINCIPLES AND APPLICATIONS L T P C**

**3 0 0 3**

**OBJECTIVE**:

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

**UNIT I INTRODUCTION OF NANOPARTICLES 9**

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

**UNIT II PROTEIN AS NANOSTRUCTURES 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**

**OUTCOMES:**

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

**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


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

**OBJECTIVES:**

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

**UNIT I OVERVIEW OF PATTERN RECOGNITION 9**

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**

Attested



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**OUTCOMES:**

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

**REFERENCES:**


1. Duda R.O., and Hart P.G.,Pattern Classification and scene analysis, John Wiley, 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 Sonslnc, 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, 2nd Edition John Wiley and sons, West Sussex,2004.


**MD7079 PHYSIOLOGICAL SYSTEMS MODELING AND SIMULATION L T P C**
**3 0 0 3**

**OBJECTIVES :**

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

**UNIT I INTRODUCTION TO SYSTEM CONCEPTS 9**

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**

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

**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. 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.


**MD7080 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 – reptitive and non repetitive sequence, Genetic mapping - restriction cleavage ,RFLP and SNPs.

**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 sequencingand DNA microarray, scientific & medical benefits of this project.

**UNIT V IMPACT OF GENETIC VARIATION 9**
Population Genetics, Quantitative Genetics, Evolution Genetics

**TOTAL: 45 PERIODS**

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

**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.


**MD7081 TELEHEALTH TECHNOLOGY L T P C**

**3 0 0 3**

**OBJECTIVES:**

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

**UNIT I TELEMEDICINE AND HEALTH 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.

**TOTAL: 45 PERIODS**

**OUTCOME**:

The student is exposed to the

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

**REFERENCES:**


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)


**MD7082 TISSUE ENGINEERING L T P C**
**3 0 0 3**

**OBJECTIVES:**

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

**UNIT I BASICS OF TISSUE ENGINEERING 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 – Hem poetic Stem cells - Embryonic Stem cells - Adult stem cells – Cancer Stem cells – Cord Blood cells – Induced Pluripotent Stem cells - Stem cell identification - Surface markers & FACS analysis – Differentiation, Dedifferentiation and Immortalization – Application of stem cells in tissue Engineering.

**UNIT V TISSUE ENGINEERING APPLICATIONS 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**

**OUTCOMES:**

By successfully completing this course, students will have the ability to:

- Identify the importance of tissue engineering in the field of biomedical engineering
- Explain the mechanisms involved in interaction of different materials with cells and tissues
- Explain different methods involved in characterization and preparation of biomaterials in tissue engineering.
- Apply the knowledge in creating new models in drug delivery systems using synthetic and natural scaffolds
- Analyse different types of stem cells and its application in tissue engineering

**REFERENCES:**


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 (2nd Edition), Narosa Publishing House, 2005.
5. Develop new approaches to build new tissues using tissue engineering techniques


**MD7083 ULTRASOUND PRINCIPLES AND APPLICATIONS IN MEDICINE L T P C**
**3 0 0 3**

**OBJECTIVES:**

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

**UNIT I PRINCIPLES OF ULTRASONICS 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**

**OUTCOMES:**

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

**REFERENCES:**


1. Shirley Blackwell Cusick, Farman and Vicary, A User's Guide to Diagnostic Ultrasound; Pitman Medical Publishing Co Ltd; Kent, England. (1978).
2. C.R.Hill, Jeff C.Bamber, Gail Haa, Physical Principles of medical Ultrasonics; John Wiley & Sons Ltd; 2nd Edition, 2004.
3. W.N.McDicken, Churchill Livingstone, Diagnostic Ultrasonics – Principles and use instruments – New York, 3rd Edition, 1991.
4. Timothy J.Hall, AAPM/RSNA, "Physics Tutorial For Residents: Elasticity Imaging With Ultrasound", Radio Graphics, Vol.23, No.6, Nov-Dec 2003. (RSNA 2003)
5. T.Rago, F.Santini, M.Scutari, A. Pinchera and P.Vitti, "Elastography: New developments in Ultrasound for Predicting Malignancy in Thyroid Nodules", Journal of Clinical Endocrinology and Metabolism, August 2007, 92(8) : 2917 – 2922.
6. James Revell, Majid Mirmehdi and Donal McNally, "Computer Vision Elastography: Speckle Adaptive Motion Estimation for Elastography using Ultrasound Sequences", IEEE Transactions on Medical Imaging, Vol.24, No.6, June 2005.
7. Hassan Rivaz, Emad Boctor, Pezhman Foroughi, Richard Zellars, Gabor and Gregory Hager, "Ultrasound Elastography: A Dynamic Programming Approach", IEEE Transactions on Medical Imaging, 2008

8. Khandpur R.S Hand Book of Biomedical Instrumentation – Tata Mc Graw Hill publication , New Delhi 2nd edition 2003
9. M.A.Flower, "Webb's Physics of Medical Imaging", 2nd Edition, CRC Press ,Boca Raton, FL,201210. Thomas L.Szabo, "Diagnostic ultrasound imaging Inside out", Elsevier Academic Press, London, 2004

**MD7007 WIRELESS BODY AREA NETWORKS L T P C**
**3 0 0 3**

**OBJECTIVES:**

**The student should be made to:**

- Learn about wireless body area networks" and different hardware related to it
- Study about sensors and its application in wearable systems

**UNIT I INTRODUCTION 9**

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

**UNIT II HARDWARE FOR BAN 9**

Processor-Low Power MCUs, Mobile Computing MCUs ,Integrated processor with radio transceiver, Memory ,Antenna-PCB antenna, Wire antenna, Ceramic antenna, External antenna, Sensor Interface, Power sources- Batteries and fuel cells for sensor nodes.

**UNIT III WEARABLE SENSORS 9**

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

**UNIT IV SIGNAL PROCESSING 9**

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

**UNIT V APPLICATIONS 9**

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

**TOTAL: 45 PERIODS**

**OUTCOMES:**

**At the end of the course, the student should be able to:**

- Explain about working of wireless Body Area Network
- Discuss the applications of WBAN
- Explain need of wireless health systems and the application of wearable systems

**TEXT BOOK:**

1. Annalisa Bonfiglio, Danilo De Rossi ,"Wearable Monitoring Systems", Springer, 2011.(Unit I, II, III & V).
2. Sandeep K.S. Gupta,Tridib Mukherjee,Krishna Kumar Venkata Subramanian, "Body Area Networks Safety, Security, and Sustainability," Cambridge University Press, 2013. (Unit IV).

**REFERENCES:**

1. Zhang, Yuan-Ting, “Wearable Medical Sensors and Systems”,Springer, 2013.
2. Guang-Zhong Yang(Ed.), “Body Sensor Networks, “Springer, 2006.
3. Mehmet R. Yuce, Jamil Y.Khan, “Wireless Body Area Networks Technology, Implementation, and Applications”, Pan Stanford Publishin