VISION

The Department of ECE shall strive continuously to create highly motivated, technologically competent engineers, be a benchmark and a trend setter in Electronics and Communication Engineering by imparting quality education with interwoven input from academic institutions, research organizations and industries, keeping in phase with rapidly changing technologies imbibing ethical values.

MISSION

- Imparting quality technical education through flexible student centric curriculum evolved continuously for students of ECE with diverse backgrounds.
- Providing good academic ambience by adopting best teaching and learning practices.
- Providing congenial ambience in inculcating critical thinking with a quest for creativity, innovation, research and development activities.
- Enhancing collaborative activities with academia, research institutions and industries by nurturing ethical entrepreneurship and leadership qualities.
- Nurturing continuous learning in the state-of-the-art technologies and global outreach programmes resulting in competent world class engineers.
PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

I. Train the students to possess good scientific and engineering knowledge in the field of biomedical engineering.

II. To understand the principles and recent trends in physiological measurements, diagnosis and therapy procedures followed in hospital.

III. To introduce the concepts of hospital architecture, planning and organization.

IV. To impart knowledge on the management of equipment, finance, human resources and waste related to hospital.

V. Ability to practice engineering in biological, medical and health care system related fields and excel as biomedical professionals in hospitals.

PROGRAMME OUTCOMES (POs):

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<tr>
<th>PO#</th>
<th>Graduate Attribute</th>
<th>Programme Outcome</th>
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<tr>
<td>1.</td>
<td>Research aptitude</td>
<td>An ability to independently carry out research/investigation and development work to solve practical problems</td>
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<td>2.</td>
<td>Technical documentation</td>
<td>An ability to write and present a substantial technical report/document</td>
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<td>3.</td>
<td>Technical competence</td>
<td>Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program</td>
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<td>4.</td>
<td>Engineering Design</td>
<td>Apply knowledge of mathematics, science, and engineering to design, experiment, analyze and interpretation of health care devices</td>
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<tr>
<td>5.</td>
<td>Hospital Management</td>
<td>Design of Hospital management system and apply knowledge in procurement, monitoring, quality maintenance and management of equipments in hospital.</td>
</tr>
<tr>
<td>6.</td>
<td>Environment and Society</td>
<td>Demonstrate leadership in their respective careers in biomedical engineering or interrelated areas of industry, government, academia, and clinical practice and understanding of professional and ethical responsibility</td>
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</table>
PROGRAM SPECIFIC OUTCOMES (PSOs)

By the completion of M.E. - Biomedical Engineering program the student will have following Program specific outcomes.

i. Apply advanced technology for measurement and interpretation of data acquired from biological system addressing the problems associated with the interaction between living and non-living materials and systems

ii. Apply software tools for modeling, designing, analyzing and realizing biomedical engineering devices, systems, components, or processes for precise diagnosis and therapeutic applications in compliance with appropriate global standards.

iii. Exhibit the professional communication and team building skills absorbing the socio-ethical values.

iv. Work professionally and continue learning in multidisciplinary areas of Biomedical Engineering through research and innovation

MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES WITH PROGRAMME OUTCOMES

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

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### ANNA UNIVERSITY, CHENNAI
### UNIVERSITY DEPARTMENTS
### M.E. BIOMEDICAL ENGINEERING
### REGULATIONS – 2019
### CHOICE BASED CREDIT SYSTEM
### I - IV SEMESTER CURRICULA AND SYLLABI

#### SEMESTER – I

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TOTAL NO. OF CREDITS: 72
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## OPEN ELECTIVE COURSES (OEC)
*(out of 6 courses one course must be selected)*

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## AUDIT COURSES (AC)
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## EMPLOYABILITY ENHANCEMENT COURSES (EEC)

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OBJECTIVES:

- To encourage students to develop a working knowledge of the central ideas of linear algebra.
- To enable students to understand the concepts of probability and random variables.
- To make students 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 familiarize the students with the formulation and construction of a mathematical model for a linear programming problem in real life situation.
- To introduce the Fourier Transform as an extension of Fourier techniques on periodic functions and to solve partial differential equations.

UNIT I  LINEAR ALGEBRA  12

UNIT II  ONE DIMENSIONAL RANDOM VARIABLES  12

UNIT III  RANDOM PROCESSES  12
Classification – Auto correlation - Cross correlation - Stationary random process – Markov process — Markov chain - Poisson process – Gaussian process.

UNIT IV  LINEAR PROGRAMMING  12
Formulation – Graphical solution – Simplex method – Two phase method - Transportation and Assignment Models

UNIT V  FOURIER TRANSFORM FOR PARTIAL DIFFERENTIAL EQUATIONS  12

OUTCOMES:
At the end of the course, students will be able to

- Apply the concepts of linear algebra to solve practical problems.
- Use the ideas of probability and random variables in solving engineering problems.
- Classify various random processes and solve problems involving stochastic processes.
- Formulate and construct mathematical models for linear programming problems and solve the transportation and assignment problems.
- Apply the Fourier transform methods of solving standard partial differential equations.

REFERENCES:
OBJECTIVES:

- To focus on the underlying concepts and mechanism in basic science.
- To enhance student's knowledge and critical thinking about the development of drugs based on basic biological science and medicine.
- To improve students skills in knowing the strategies of drug development for human diseases from basic to application level.
- To provide an underlying cause of the health issues that pose unique challenges in society.

UNIT I  BASICs OF LIVING CELLS  9

UNIT II  INTRODUCTION TO HUMAN BODY  8

UNIT III  CARDIOVASCULAR, DIGESTIVE, RESPIRATORY AND URINARY SYSTEM  10

UNIT IV  NERVOUS, SPECIAL SENSORY AND IMMUNE SYSTEM  9

UNIT V  REGENERATIVE MEDICINE  9
Introduction to regeneration in different tissues, role of biomolecules in tissue regeneration, stem cells and its types, isolation procedures and applications of stem cells. Biomaterials Tissue Replacements - Types, biocompatibility, characterization, fabrication, modification and applications of biomaterials in different tissues.

TOTAL: 45 PERIODS

OUTCOMES:

COURSE OUTCOMES:

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

- CO1 Acquire knowledge in cell biology and used to elucidate both the function of cells and their organization into tissues.
- CO2 Understand the basic components and architecture of the human system.
- CO3 Understand different systems and its functions in human body.
- CO4 Understand the structural importance and functions of sensory organs.
- CO5 Acquire the underlying knowledge in the molecular mechanism of disease development.

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BO5102 DIAGNOSTIC AND THERAPEUTIC EQUIPMENT L T P C

OBJECTIVES:
- To study the measurement of various biopotential and non-electrical parameters.
- To explore the various functional blocks present in cardiac care units and various assist devices
- To develop an understanding of the physiotherapy and diathermy equipment
- To study the electrical safety in the hospital environment

UNIT I BIO POTENTIAL RECORDING

UNIT II MEASUREMENT OF NON ELECTRICAL PARAMETER

UNIT III CARDIAC CARE UNITS
Pace makers - different types, batteries for pace makers, Design Concept. DC defibrillators, asynchronous and synchronous types, patient monitoring system, principles of bio telemetry.

UNIT IV ASSIST DEVICES
UNIT V    DIATHERMY, STIMULATOR AND PATIENT SAFETY

Diathermy—Physiological effects of HF radiation, Depth of Penetration, short wave, Ultrasonic and microwave diathermy, Surgical diathermy, Hazards and safety procedures. Medical Stimulators – Intensity Duration Curve, Current waveforms - Galvanic, Faradic, surged faradic, exponential, biphasic, TENS, Interferential therapy. Electrical Safety—Leakage current, Micro and macro electric shock, GFI units, Earthing Scheme, Electrical safety Analyser.

COURSE OUTCOMES:

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

CO1    Design and analyze the bioamplifiers.

CO2    Measure vital and non-electrical parameters

CO3    Design and demonstrate the pacemaker and defibrillator.

CO4    Demonstrate the function of assist devices.

CO5    Design stimulators and test the electrical safety of medical equipment in the hospital environment.

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BO5103    MEDICAL IMAGING SYSTEMS

OBJECTIVES:

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

UNIT I     PRINCIPLES OF RADIOGRAPHIC EQUIPMENT

X-Ray tubes, cooling systems, removal of scatters, Fluoroscopy- construction of image Intensifier tubes, angiographic setup, mammography, digital radiography, DSA.
UNIT II  COMPUTED TOMOGRAPHY  10
Need for sectional images, Principles of sectional scanning, Generation in CT, CT detectors,
Methods of Reconstruction-Iterative, Back projection, convolution and Back-Projection and central
slice theorem. Artifacts, Principle of 3D imaging

UNIT III  RADIO ISOTOPIC IMAGING  9
Alpha, Beta and Gamma radiation, Radiation detectors, Radio isotopic imaging equipment, Radio
nuclides for imaging, Gamma camera, scanners, Positron Emission tomography, SPECT,
PET/CT.

UNIT IV  ULTRASOUND IMAGING SYSTEMS  9
Wave propagation and interaction in Biological tissues, Acoustic radiation fields, continuous and
pulsed excitation, Transducers and imaging systems, Scanning methods, Imaging Modes, Principle and theory of image generation, Applications. Doppler Ultrasound, Ultrasound Image
Quality and Artifacts.

UNIT V  MAGNETIC RESONANCE IMAGING  9
NMR, Principle of MRI, Relaxation processes and their measurements, Pulse sequencing and MR
image acquisition, MRI Instrumentation, MR Artifacts, Magnetic Resonance Spectroscopy,
Functional MRI. Case Study.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
By successfully completing this course, students will be able to:
CO1  Discuss the principle and working of various radiography equipment.
CO2  Explain the tomography concept and image reconstruction techniques.
CO3  Explain the concept of nuclear imaging techniques and radiation detectors
CO4  Describe the basic principle involved in Ultrasound Imaging technique.
CO5  Describe the basic principle and working of Magnetic resonance imaging technique

REFERENCES:
5. Donald W.McRobbice, Elizabeth A.Moore, Martin J.Grave and Martin R.Prince, MRI from
6. Jerry L.Prince and Jonathan M.Links, Medical Imaging Signals and Systems- Pearson
Education Inc. 2014.

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OBJECTIVES:
- To introduce the basics of digital signal processing and fundamentals of image processing with its applications to biological systems
- To introduce mathematical foundation for manipulation for signal processing and digital image processing fundamentals.
- To gain practical knowledge using simulation tools in signal and image processing techniques.

UNIT I  INTRODUCTION TO SIGNALS AND SYSTEMS  9
Review of Signals and Systems, sampling theorem, anti-aliasing filter, DFT, FFT, Introduction to biosignals, Noises, FIR and IIR filters, Spectrum, power spectral density function, cross spectral density and coherence function.

UNIT II  PROBABILITY AND RANDOM SIGNALS  9

UNIT III  FILTERING FOR REMOVAL OF ARTIFACTS  9

UNIT IV  DIGITAL IMAGE FUNDAMENTALS  9
Elements of Digital Image Processing, Image sampling and Quantization, color image fundamentals - RGB, HSI model, histogram, Image enhancement - histogram equalization and specification techniques, noise distributions, spatial averaging, and sharpening, non-linear filters, Image Transforms - DFT, DCT, KL and SVD.

UNIT V  IMAGE SEGMENTATION AND COMPRESSION  9
Image Segmentation - edge detection, edge linking via Hough transform, Thresholding, region based segmentation - region growing, region splitting and merging. Feature Extraction and Representation-Statistical, Shape, Texture features. Statistical and Neural Network based image classification. Image compression – need, huffman, run length encoding, arithmetic coding, transform coding, JPEG standard, MPEG.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
By successfully completing this course, students will be able to:
- CO1 Analyse signals in time series domain & estimate the spectrum
- CO2 Design filters for the analysis of random signals
- CO3 Design pre-processing techniques for removal of artifacts and enhancement of images
- CO4 Implement basic medical image processing algorithms
- CO5 Design and implement image processing applications that incorporates different concepts of medical Image Processing

REFERENCES:
OBJECTIVES:
- Extract research problem formulation
- Illustrate research related information
- Follow research ethics
- Summarize that today’s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity
- Infer about IPR for further research work and investment in R & D for economic growth and social benefits.

UNIT I RESEARCH PROBLEM FORMULATION
Meaning of research problem- Sources of research problem, criteria characteristics of a good research problem, errors in selecting a research problem, scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations

UNIT II RESEARCH ANALYSIS
Effective literature studies approaches, analysis, plagiarism, and research ethics.

UNIT III RESEARCH ETHICS
Effective technical writing, how to write report, paper, developing a research proposal, format of research proposal, a presentation and assessment by a review committee.

UNIT IV INFORMATION TECHNOLOGY IN RESEARCH

UNIT V INTELLECTUAL PROPERTY RIGHTS (IPR)

TOTAL: 30 PERIODS
OUTCOMES:

CO1: Able to understand research problem formulation
CO2: Able to analyze research related information
CO3: Able to follow research ethics
CO4: Able to understand that today’s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity
CO5: Able to understand about IPR for further research work and investment in R & D for economic growth and social benefits.

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REFERENCES:

BO5111 CLINICAL INSTRUMENTATION LABORATORY

OBJECTIVES:
- To study the various aspects of bio signals and amplifiers
- To understand the performance of surgical diathermy.
- To study practically the concepts of audiometer
- To gain knowledge about the measurement of the vital and non-electrical parameters.
- To understand the importance of the electrical safety analyzer.

LIST OF EXPERIMENTS
1. Design and analysis of bioamplifier using circuit simulation tools.
2. Design and testing of Bio-Amplifiers
3. Recording and analysis of Electrocardiogram
4. Recording and analysis of Electroencephalogram
5. Recording and analysis of Electromyogram
6. Study of Patient monitoring system and biotelemetry
7. Respiratory analysis using spirometer
8. Bio-chemical measurements
9. Performance and testing of surgical diathermy unit using diathermy analyzer
11. Electrical safety testing of medical equipment.
12. Study of Multi parameter simulator

TOTAL: 60 PERIODS
COURSE OUTCOMES:
By successfully completing this course, students will be able to:
CO1  Design and develop the various bio signal amplifiers.
CO2  Perform the measurement of various bio signals and physiological parameters.
CO3  Test and analyze the various measurements related to the electrical safety of medical equipment.
CO4  Analyze the Surgical diathermy unit.
CO5  Measure and analyze the function of human auditory and respiratory systems.

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BO5112  BIOSIGNAL AND MEDICAL IMAGE PROCESSING LABORATORY  L T P C  0 0 4 2

OBJECTIVES:
- To understand the analysis of biosignals
- To understand the extraction of features in biosignals.
- To develop algorithms for power spectral density and classification of bio signals.
- To enhance the medical images by applying various filters.
- To segment the region of interest using various image processing algorithms

LIST OF EXPERIMENTS
1. Preprocessing of Biosignals
2. Determination of Heart rate using Pan-Tompkins algorithm.
3. Arrhythmia detection in ECG.
5. Feature extraction in EMG signals
7. Denoising of medical images.
8. Image Enhancement using Python
10. Medical Image Compression.
11. Study of DICOM standards.

TOTAL: 60 PERIODS

COURSE OUTCOMES:
By successfully completing this course, students will be able to:
CO1  Develop algorithms for preprocessing of Biosignals.
CO2  Analyze the spectral characteristics of Biosignals.
CO3  Develop algorithm for enhancement of medical images.
CO4  Extract the region of interest from medical images.
CO5  Perform the compression of medical images.
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  INTRODUCTION

UNIT II  PROSTHETIC AND ORTHOTIC DEVICES

UNIT III  AUDITORY AND SPEECH ASSIST DEVICES
Types of deafness, hearing aids, application of DSP in hearing aids, Cochlear implants, Voice synthesizer, speech trainer. Brain plasticity, Sensory Substitution systems for auditory and speech impairment

UNIT IV  VISUAL AIDS
Sensory Substitution systems for visual impairment, Ultra sonic and laser canes, Intra ocular lens, Braille Reader, Tactile devices for visually challenged, Text voice converter, screen readers. Low vision aids.

UNIT V  REHABILITATION MEDICINE AND ADVOCACY
Architectural design features for motor and visual disability for day-to-day life. Physiological aspects of Function recovery, Psychological aspects of Rehabilitation therapy, Legal aspects of rehabilitation – Disability evaluation, provision available in education, job and in day-to-day life.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of this course the student will be able to:
- CO1 Define various terms related to rehabilitation engineering and their importance
- CO2 Understand the need and functioning of prosthetic and orthotic devices
- CO3 Appreciate the need and method of designing sensory substitution systems
- CO4 Understand the stages of functional recovery and the provisions provided by the government for the differently abled people
- CO5 Design rehabilitation aids
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BO5251 HEALTH CARE, HOSPITAL AND EQUIPMENT MANAGEMENT L T P C 3 0 0 3

OBJECTIVES:
To develop an understanding of the various setups of hospital, health care codes and equipment management in the hospital environment.

UNIT I HEALTH SYSTEM
Health organisation of the country, the State, the Cities and the Region, Health Financing System, Health services, Functions of Hospitals, Types of Hospitals, Primary Health Care – An Introduction, Ambulatory care.

UNIT II HOSPITAL ORGANISATION AND MANAGEMENT
Management of Hospital Organisation, Nursing Sector, Medical Sector, Central Services, Technical Department, Definition and Practice of Management by Objective, Transactional Analysis, Human Relation in Hospital, Importance of Team Work, Legal aspect in Hospital Management.

UNIT III REGULATORY REQUIREMENT AND HEALTH CARE CODES
FDA Regulation, Joint Commission of Accreditation for Hospitals, National Fire Protection Association Standard, IRPQ.

UNIT IV TRAINED TECHNICAL PERSONNEL
Function of Clinical Engineer, Role to be performed in Hospital, Manpower requirement for different types of hospitals, Professional Registration, Structure in Hospital.

UNIT V EQUIPMENT MAINTENANCE MANAGEMENT

TOTAL: 45 PERIODS
COURSE OUTCOMES:
On completion of this course the student will be able to:

- **CO1** Basics about Health system and their services
- **CO2** Apprehend the organisation structure in hospitals
- **CO3** Knowledge about the regulation of health care codes
- **CO4** Understand the duties of technical personnel
- **CO5** Analyse the standards and the training required for technical work for equipment management.

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

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BO5201 HEALTH INFORMATICS

OBJECTIVES
- To prepare the students in development, implementation, and use of modern health care information systems.
- To provide knowledge in interdisciplinary and integrated approach to health care IT.
- To study both the fundamental concepts and the cutting-edge IT technologies used in the design, implementation, and management of health care IT applications

UNIT I INTRODUCTION
Historical highlights and Evolution of Health informatics, Hospital Information System – its characteristics and functional online and offline modules, Health Informatics, Bioinformatics, Medical Informatics, Clinical Informatics, imaging Informatics, Nursing Informatics, Public Health Informatics, e – health services, Evidence Based Medicine, Bioethics, Virtual Hospital, Consumer Health Informatics and Healthcare Data Analytics.
UNIT II ELECTRONICS PATIENT RECORDS AND STANDARDS
Electronic Patient Record, Medical data formats, – Medical Standards and Organizations – HL7 – DICOM - IRMA - LOINC - PACS - Medical Standards for Vocabulary - ICD 10, DRGs, MeSH, UMLS, SNOMED – JCAHO – HIPAA.

UNIT III BIOINFORMATICS AND TECHNOLOGIES

UNIT IV JAVA PROGRAMMING
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
Medical Networks - Java script programming - Web Design and programming - Design of Web portal services in medicine

TOTAL: 45 PERIODS

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

CO1 Explore how technology can be used to improve health care delivery in health care organizations and in public health.

CO2 Acquire breadth of knowledge of the principles of health informatics.

CO3 Develop basic skills in using health informatics principles to improve practice.

CO4 Acquire a conceptual and theoretical framework of the design, development, and implementation of health information systems.

CO5 Programming skills in Java and script languages

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

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OBJECTIVES:
- To study about the basics of Java programming, web designing and to develop a hospital information system.

LIST OF EXPERIMENTS
1. HTML, XHTML, XML programming
2. Java script programming
3. PHP Programming
4. Design and Development of interactive HIS
5. Basics of Java programming
6. Server interface programming in SQL and Java environment
7. Storage of bio signal and medical image databases in their approved standard data formats and their handling
8. Study and implementation of medical standards - HL7, DICOM, LOINC, ICD 10 and IRMA
9. Programming and practicing of Evidence based Medicine
10. Mini Project – A case study

TOTAL: 60 PERIODS

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

CO1 Demonstrate the basics of Java programming.
CO2 Design of web page using Java programming
CO3 Design and development of Hospital information system
CO4 Understanding the medical standards concept for image and biosignal storage
CO5 Gain sufficient knowledge to develop a standard data base for biosignals and medical image

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OBJECTIVES:
- To study practically the concepts of physiological modeling.
- To understand the basic experimental tools and techniques used in musculoskeletal biomechanics
- To acquire software programming skills for processing of medical images using OpenCV.

LIST OF EXPERIMENTS
1. Modelling of cardiovascular system
2. Modelling of lung mechanics
3. Simulation and kinematic analysis of musculoskeletal model
4. Design of Hospital Architecture.
5. LabVIEW based biosignal analysis.
6. Development of face recognition system
7. Analysis of thermal images using OpenCV

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

CO1  Model the various physiological system using software tools
CO2  Demonstrate proficiency in developing a musculoskeletal biomechanics.
CO3  Develop algorithms for processing of medical images.
CO4  Design the hospital information system
CO5  Analyse the bio signals using software tools.

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BO5072 BIOMECHANICS
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. Anthropometry.

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

UNIT IV  MECHANISM OF BIOLOGICAL SYSTEMS 9
Skeletal muscles servo mechanism, Cardio vascular control mechanism, respiratory control mechanism, Finite element analysis in Biomechanics - case study.
UNIT V BIO MECHANICAL ASPECT OF ACCIDENT INVESTIGATION

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

TOTAL: 45 PERIODS

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

CO1 To get the clear understanding of application of mechanics in medicine.
CO2 To study the properties of blood, bone and soft tissues like articular cartilage tendons and ligaments
CO3 Acquire knowledge of evaluating the force in implants
CO4 Analysis on different injuries from accident investigation
CO5 Acquired a conceptual and theoretical framework of the design, development, and implementation of orthopedic implants.

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BO5001 BIO STATISTICS

OBJECTIVES:

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

UNIT I INTRODUCTION

Introduction to probability, likelihood & odds, distribution variability.
UNIT II  STATISTICAL PARAMETERS  6
Statistical parameters p-values, computation and level chi square test and distribution.

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

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

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

TOTAL: 45 PERIODS

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

CO1  Demonstrate and understand the central concepts of modern statistical theory and their probabilistic foundation.

CO2  Compare the various parameters used in statistical significance.

CO3  Explain the techniques used in regression analysis.

CO4  Interpret results of the principal methods of statistical inference and design.

CO5  Use a statistical approach to combine the results from multiple studies.

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BO5002  FINANCE MANAGEMENT IN HOSPITALS  L T P C
3 0 0 3

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

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

**UNIT II  ACCOUNTING TECHNIQUES  10**

**UNIT III  COSTING IN HOSPITALS  10**
Nature & Scope of Cost Accounting – Cost analysis & Classification - Cost Calculation, significance of internal billing in Hospital - Necessary for internal & external controlling cost, cost unit calculation.

**UNIT IV  MANAGEMENT ACCOUNTING  11**
Budgeting & Budgetary control – Cost – Volume – Profit analysis.

**UNIT V  FINANCING DECISIONS  10**

**TOTAL: 45 PERIODS**

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

- **CO1** Understand the scope and applications of Financial Management.
- **CO2** Discuss the Accounting principles, Book keeping and Reporting concepts
- **CO3** Understand the techniques used in Costing and costing as a control Tool.
- **CO4** Explain the types and techniques of budgetary control.
- **CO5** Understand the types of Financial decisions.

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

UNIT I  GENERAL INTRODUCTION

UNIT II  BEAM ELEMENTS AND SCALAR PROBLEM IN 2D

UNIT III  APPLICATIONS TO FIELD PROBLEMS

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

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

TOTAL :45 PERIODS

COURSE OUTCOMES:
On completion of this course the student will be able to:
CO1  Understands the concept of Finite Element Method and realize its limitations
CO2  Formulate simple problems into finite elements and develop 2D models
CO3  Identify mathematical model for solution of biomedical engineering problems.
CO4  Use professional-level finite element software to solve problems in biological system.
CO5  Effectively use the tools of the analysis for solving problems in Bio-mechanical Engineering
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BO5004 HEALTH POLICY AND EQUIPMENT MANAGEMENT  L  T  P  C  3  0  0  3

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

UNIT I HEALTH SYSTEM
Health organization of the country, the state and cities, health financial system, teaching cum research hospitals, General Hospital, PHC reference system, Ambulatory Care.

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

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

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

UNIT V EMI IN HOSPITAL EQUIPMENT
Principles of EMI, computation of EMI, Method of suppressing and isolating the unit from interference.

TOTAL: 45 PERIODS
COURSE OUTCOMES:
On completion of this course the student will be able to:

CO1  Discuss the basics of health organization
CO2  Explain the various national health policies
CO3  Perform equipment installation, service & calibration needs and Planning activities at health care centres
CO4  Repair methods for Material handling equipment
CO5  Minimizing equipment failures and to increase patient safety

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BO5005  HOSPITAL ARCHITECTURE  L T P C
3 0 0 3

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

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

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

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

UNIT IV  STANDARDS AND NORMS FOR HOSPITALS
UNIT V        FACILITIES FOR SUPPORTIVE SERVICES
Transport, Information system, Communication, Food services, Mortuary, Heating Ventilation and Air Conditioning, Medical gases, House Keeping, Laundry.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of this course the student will be able to:
 CO1  Understand the overall structure of hospital. 
 CO2  Focus on overall customer safety provisions. 
 CO3  Understand the different services offered by the hospitals. 
 CO4  Discuss the specification fixed by hospitals with guidelines of Medical Council. 
 CO5  Discuss the concepts of supporting services provided by the hospital.

REFERENCES:
3. Sa Tabish, - Hospital and Nursing Homes planning, Organisation and Management, Jaypee Brothers-Medical publishers, New Delhi, 2003

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BO5006        HOSPITAL PLANNING, ORGANIZATION AND MANAGEMENT

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

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

UNIT II        PRINCIPLE OF HOSPITAL MANAGEMENT:
Importance of management and Hospital, Management control systems. Forecasting techniques decision-making process
UNIT III  STAFFING  6
Staffing pattern in hospitals, Selection, Recruiting process, Training of staff, Organizational structures, Career development

UNIT IV  MARKETING AND MANAGEMENT  10
Basic concepts marketing, Principles of social marketing, Social marketing in health sector, Consumer behavior and research health, Advertising in Health Sector, Relevance of e-marketing of Health care services

UNIT V  COMPUTER IN HOSPITAL  11
System Development life cycle, Reasons to use computers in hospital, main categories of information systems in hospitals

TOTAL :45 PERIODS

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

CO1  Understand the Roles and types of establishment.
CO2  Discuss the functions of hospital management.
CO3  Understand the concepts of HR Management practices.
CO4  Discuss the methods and tools of marketing.
CO5  Understand the impacts of Information technology in hospital management.

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BO5007  HOSPITAL WASTE MANAGEMENT  L T P C  3 0 0 3

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

UNIT I  INTRODUCTION  9
Medical waste stream, different types of medical waste, its source of origin. Waste management elements – categories of bio-medical waste, different colour codes and symbols –rules and regulation includes state and national level bodies.
UNIT II PRINCIPLES OF STERILIZATION
Disease and its mode of transmission - Disinfection methods - concept and mechanism – physical sterilization and chemical sterilization – Large scale autoclave - Microwave (Non-burn treatment technology).

UNIT III DISPOSAL OF WASTE

UNIT IV CONTROLS APPLIED TO WASTE MANAGEMENT
Air pollution and emission control, rules governing pollution, instrumentation and monitoring, emission filters and its types, crematories- gas emission control device. Case studies related air pollution.

UNIT V ENVIRONMENTAL SAFETY, RISKS & PUBLIC ISSUES.
Risk management in hospitals - Environment issues in hospitals - Risk analysis

TOTAL : 45 PERIODS

COURSE OUTCOMES:
On completion of this course the student will be able to:
CO1 Get the clear understanding of regulations framed for waste management
CO2 Understand the significance of infections and the transmission of diseases.
CO3 Acquire knowledge on proper disposal of waste
CO4 Acquire a conceptual idea about the controls applied to waste management.
CO5 Gain sufficient knowledge on Risk analysis and management of public issues.

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BO5008 HUMAN RESOURCES MANAGEMENT IN HOSPITAL

OBJECTIVES:
- This subject acquaints the students with major functions of HRM aligned with the business strategy.
- The subject encompasses the concept of best fit employee, training & executive development, sustaining employee interest and performance appraisal.
UNIT I  PERSPECTIVES OF HUMAN RESOURCE MANAGEMENT  9

UNIT II  THE CONCEPT OF BEST FIT EMPLOYEE  9

UNIT III  TRAINING & EXECUTIVE DEVELOPMENT  9
Types of Training methods and their benefits - Executive development Programme - common practices - Benefits, self-development - knowledge Management.

UNIT IV  SUSTAINING EMPLOYEE INTEREST  9

UNIT V  PERFORMANCE APPRAISAL  9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of this course the student will be able to:
CO1 Discuss the scope and significance of HRM.
CO2 Understand the concepts of recruitment and selection process.
CO3 Understand the procedure of training and carrier development.
CO4 Understand the employee conflicts and administrative system.
CO5 Discuss the methods and techniques of appraisal system.

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

UNIT I  PRINCIPLES OF NUCLEAR PHYSICS  9

UNIT II  PHYSICS OF INFRARED, MICROWAVE AND RADIO FREQUENCY  9

UNIT III  LASER PHYSICS AND PHOTOMEDICINE  9
Characteristics of laser radiation, Laser speckle, biological effects, laser safety management Synthesis of vitamin D in early and late cutaneous effects, Phototherapy, photo hemotherapy, exposure level, hazards and maximum permissible exposures. Optical characteristics of biomolecules from the point of spectroscopy – principles of UV – Visible absorption – IR and FTIR absorption – Raman and Fluorescence spectroscopy – application with regard to characterization of biomolecules – blood oxygen, glucose measurements, monitoring drug concentration, cancer

UNIT IV  DIAGNOSTIC ULTRASOUND  9
Ultrasonic waves – generation and detection of ultrasound – Beam characteristics - attenuation of ultrasound – specific acoustic impedance - reflection at body interfaces - Coupling medium - interaction ultrasound with tissues - deleterious effects of Ultrasound - Safety levels of Ultrasound - real time scanners image clarity – Resolution - axial and lateral resolution - Artifacts - Pulse echo imaging - Obstersics abdominal investigations - Echo cardiograph (UCG) - The Doppler Effect-Doppler Shift - continuous wave Doppler system - Pulsed wave Doppler systems - duplex scanning-display devices for ultrasonic imaging

UNIT V  RADIOBIOLOGICAL EFFECT OF RADIATION  9
Target theory, single hit and multi target theory, cellular effects of radiation, DNA damage, chromosomal damage, Somatic effect: Radio sensitivity protocol of different tissues in human, LD 50/30 effect, Genetic effect: Threshold of linear dose effect, relationship factors affecting frequency of radiation induced mutation, biological effect of microwave, Rf wave and UV radiation.

COURSE OUTCOMES:
On completion of this course the student will be able to:
 CO1 Understand and appreciate the phenomena of nuclear physics
 CO2 Discuss about the effects of IR, microwave and RF
 CO3 Understand the effects and medical applications of light
 CO4 Obtain the in-depth knowledge about the use of ultrasound for diagnostic applications
 CO5 Specify the biological effects especially due to ionising radiation

TOTAL: 45 PERIODS
REFERENCES:
1. Moselley, Non ionizing Radiation, Adam Hilgar Brustol 1998
3. Glasserr.O., Medical Physics Vol.1, 2,3-year Book Publisher Inc Chicago, 1980
6. Diagnostic Ultrasound applied to OBG, Sabbahaga-Maryland -1980
8. MRI in Practice, Catherine Westbrrok
9. The essential Physics for Medical Imaging – Jerrold T Bushberg

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BO5010 QUALITY ASSURANCE AND SAFETY IN HOSPITALS

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

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

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

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

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


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

CO1 Understand the scope of Need and significance of quality practices in health care industry.
CO2 Discuss the system of regulatory measures and accreditation.
CO3 Differentiate the level of safety and security measures and significance.
CO4 Understand the concepts of Electrical and Fire Safety Hazards Mitigations.
CO5 Understand the assessing quality practices using tools.

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

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BO5071 BIOMATERIALS

OBJECTIVES:
- To introduce concepts of materials and interaction of surface towards biomaterials.
- To learn about the polymeric materials and composites in tissue replacements.
- To study the various techniques involved in controlling the microbial growth on the surfaces.
- To understand diverse elements controlling biological responses to materials.
- To know the compatibility and functioning of artificial organs inside the living system.

UNIT I INTRODUCTION
Definition of biomaterials, mechanical properties, surface chemistry of materials, surface modification, Tissue Reaction, Wound Kinetics, Bio Compatibility.
UNIT II MATERIALS IN MEDICAL DEVICES 10
Metals, Ceramics, Polymers and Biomimetic Materials, Composites. Material preparation, chemical composition, Properties, uses in medicine and biosciences and failure mechanisms.

UNIT III STERILIZATION OF BIOMATERIALS 7

UNIT IV TESTING OF MATERIALS 8

UNIT V HARD AND SOFT REPLACEMENT 10
Cardiac Implants, Orthopedic Implants, Neuro Muscular Implants, Transcutaneous Implants, Intraocular lenses.

TOTAL: 45 PERIODS

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

- **CO1** Understand the basic principles in material science and their contribution towards Biomedical engineering.
- **CO2** Analyze different types of materials and apply in designing a device.
- **CO3** Select the materials for designing an implants in tissue replacement.
- **CO4** Identify significant gap required to overcome challenges and further developments.
- **CO5** Critically review papers from the scientific journals and identify areas of research opportunities.

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OBJECTIVES:
- To learn and understand social impact and health issues of environmental pollution caused due nanindustries.
- To develop various analytical techniques and to identify and solve the problems.
- To understand the socio-ethical responsibility.

UNIT I INTRODUCTION TO NANOMATERIALS
Sources of nanoparticles, effect of size and surface charges, entry routes into the human body, nanoparticles surface and body distribution, cellular uptake of nanoparticles, blood-brain barrier. Thrombosis and Lung Inflammation.

UNIT II ENVIRONMENTAL TOXICOLOGY
Air Pollution, air borne pollution particles, adverse effects of PM in epidemiological Studies, role of nanoparticles in mediating pulmonary effects, effects of nanoparticles on the nervous system, gastrointestinal system, liver and cardiovascular system. Endothelial dysfunction and endogenous fibrinolysis- coagulation and thrombosis.

UNIT III NANOTOXICITY
Nanoparticles in the Environment, nanoparticles in mammalian systems, health threats. Toxicity of iron oxide, titanium dioxide, dark Studies, UV irradiation studies, other metal oxides. Toxicological studies of manufactured CNTs- case study, occupational exposure risk, toxicity of MWCNTs/SWCNTs and impact on environmental Health.

UNIT IV NANOREMEDIATION
Nanomaterials for water treatment, nanosensor for environmental applications, nanoparticle based remediation materials - acid-base chemistry - redox chemistry - absorption chemistry - hybrid nanostructured remediation materials - self-assembled monolayers on mesoporous supports (SAMMS) -functional CNTs.

UNIT V ETHICAL AND SAFETY ISSUES IN NANOTECHNOLOGY
Health impact, safety and toxicological effects of nanomaterials. Societal impact & ethical issues in nanoscience and nanotechnology. Integrated concept of risk assessment of nanoparticles, dosimetry. Regulation of engineered nanomaterials and Green nanotechnology.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of this course the student will be able to:
- CO1 Know the basic concepts of nanoparticles.
- CO2 Understand the toxicology effects of nanoparticles in living organisms.
- CO3 Acquire the underlying knowledge in developing toxic free nanoscale products.
- CO4 Understand the remedial techniques and their relevance in the constructing risk-free environment.
- CO5 Aware of ethical issues and develop societal responsibilities in handling nanoproducts.

REFERENCES:
4. Drobne, Nanotoxicology for safe and Sustainable Nanotechnology, Dominant publisher 2007
OBJECTIVES:
- To introduce the basic concepts of brain computer interface
- To study the various signal acquisition methods
- To study the signal processing methods used in BCI

UNIT I  INTRODUCTION TO BCI

UNIT II  ELECTROPHYSIOLOGICAL SOURCES

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

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

UNIT V  APPLICATIONS OF BCI

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course, the student will be able to:
- CO1 Acquire the brain signal in the format required for the specific application
- CO2 Well prepared for preprocessing the signal for signal enhancement
- CO3 Extract the dominant and required features
- CO4 Classify and derive the control signals for BCI applications
- CO5 Extend the BCI knowledge for medical applications
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MD5071 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 of Deep learning concept and Optimization techniques using Genetic algorithm and its applications is introduced.
UNIT I  INTRODUCTION TO ARTIFICIAL NEURAL SYSTEMS  
Biological Neurons and their Artificial models, Models of Artificial Neural Networks, Learning and Adaptation, Neural Network Learning Rules, Single Layer Perceptron Classifiers.

UNIT II  BPN AND BAM  

UNIT III  OTHER NETWORKS  

UNIT IV  GENETIC ALGORITHMS & IMPLEMENTATION TECHNIQUES  

UNIT V  ADVANCES AND APPLICATIONS  
Support Vector Machines, RBF Network. Introduction to Deep Learning – Convolutional Neural Network. Case Study – Neural Network based Classification of Biosignal and Medical Images.

TOTAL: 45 PERIODS

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

CO1  Architecture of neural networks and its learning rules

CO2  Design neural networks like BPN and BAM and its applications

CO3  Design competitive neural networks and its applications

CO4  Apprehend the principles of genetic algorithms as well as techniques used in its implementation.

CO5  Deep learning concept that can be used for biomedical signal analysis and Medical image analysis

REFERENCES:
OBJECTIVES:

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

UNIT I  BASICS OF NERVE  9

UNIT II  BRAIN, BRAIN STEM AND SPINAL CORD  9

UNIT III  NEURON TRACING  9

UNIT IV  NERVE INJURY AND DISORDERS  9

UNIT V  NEURAL ENGINEERING  9

TOTAL: 45 PERIODS
COURSE OUTCOMES:
On completion of this course the student will be able to:

CO1 Understand basics of nervous system
CO2 Describe neural mechanisms, circuit formations and plexus.
CO3 Explain cortical areas and recording of cortical lobe.
CO4 Describe pharmacokinetics in neural system.
CO5 Understand the mechanism of neural regeneration

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MD5072 BIO MEMS

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

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

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

UNIT III ELECTROSTATIC AND PIEZOELECTRIC SENSORS AND ACTUATORS
Parallel plate capacitor, pull in effect, Electrostatic sensors and actuators- Inertia sensor, Pressure sensor, flow sensor, tactile sensor, comb drive. Properties of piezoelectric materials, Piezoelectric sensor and actuator – inchworm motor, inertia sensor, flow sensor. Case study: Design of electrostatic actuator
UNIT IV MICROFLUIDIC SYSTEMS
Fluid dynamics, continuity equation, momentum equation, equation of motion, laminar flow in circular conduits, fluid flow in microconduits, in submicrometer and nanoscale. Microscale fluid, expression for liquid flow in a channel, fluid actuation methods, dielectrophoresis, microfluid dispenser, microneedle, micropumps-continuous flow system, micromixers. **Case study:** Design of electrophoretic microcapillary network system.

UNIT V APPLICATIONS OF MEMS IN MEDICINE
CAD for MEMs, Biological MEMS materials, polymer based gas sensor, micro total analysis systems (MicroTAS) detection and measurement methods, microsystem approaches to polymerase chain reaction (PCR), DNA sensor, Drug delivery - Types of reservoirs, CardioMEMS. **Case study:** Design of BP sensor. Intraocular pressure sensor, Intracranial pressure sensor Introduction to 3D printing.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**
On completion of this course the student will be able to:
- **CO1** Understand the MEMS fabrication processes and characteristics of various materials
- **CO2** Specify the design issues related to different types of sensors and actuators at micro scale level
- **CO3** Understand the methods of actuation of fluids at micro level
- **CO4** Capable of applying the concepts to the design of different types of micro systems with the help of CAD tools
- **CO5** Apply these procedures for the design of MEMS devices for healthcare applications

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

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

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

UNIT III PROCESSORS AND MEMORY MANAGEMENT
80X86 Processors - Architectures and Memory management - Overview of 80X86 based Mother boards

UNIT IV COMPUTERISED DATA ACQUISITION AND PROGRAMMING
Plug-in-data acquisition, AGC and Control Boards - Data acquisition using GPIB and Serial Interfaces and Programming in C - DSP in Medical applications

UNIT V CAD IN MEDICAL INSTRUMENTATION
FPGA Design Logics - Virtual Bio-Instrumentation in LABVIEW - Multisim Simulation with bio-amplifiers - Mixed signal SoC applications in biomedical application

COURSE OUTCOMES:
On completion of this course the student will be able to:
- CO1 Understand various PC hardware
- CO2 Discuss the working of peripheral interfacing and controllers.
- CO3 Demonstrate the functions of Intel 80X86 family of microprocessors
- CO4 Develop computerized data acquisition devices.
- CO5 Design the medical instrumentation in CAD

REFERENCES:
MD5077  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.
- To apply 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

UNIT III  HOSPITAL ACCREDITATION STANDARDS  9

UNIT IV  HOSPITAL SAFETY STANDARDS  10

UNIT V  MEDICAL EQUIPMENT SAFETY STANDARDS  9

TOTAL: 45 PERIODS
COURSE OUTCOMES:
On completion of this course the student will be able to:

CO1  Describe the Social responsibility in healthcare systems
CO2  Discuss the Bioethics and engineers role
CO3  Apply Legal and professional guidelines for the hospital accreditation
CO4  Understand hospital safety aspects
CO5  Comprehend the medical equipment safety standards and medical device maintenance.

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

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MD5078 MEDICAL OPTICS L T P C 3 0 0 3

OBJECTIVES:
The objectives of this course are to:
- Provide a possibility for the student to acquire knowledge about the impact and interaction of light with biological tissue
- Gain knowledge about the fiber optic sensors
- Understand the engineering and practical applications of optics related to diagnostics, sensing and therapeutics of the human body

UNIT I INSTRUMENTATION IN PHOTONICS 9

UNIT II OPTICAL PROPERTIES OF THE TISSUES 9
Optical properties of tissue- melanin, bilirubin, tissue and their spectrum, optical characteristics of constituents of blood – RBC, hemoglobin properties, plasma, oxygenated and deoxygenated hemoglobin, Laser tissue Interaction-Chemical, Thermal, Electromechanical. Photo ablative processes. Laser safety procedures
UNIT III  DIAGNOSTIC APPLICATIONS  9
Wood’s lamp, Imaging techniques - Optical coherence tomography, Elastography, Fluorescence Imaging, FLIM, FRAP, FRET, Raman Imaging, NIRS – Applications

UNIT IV  THERAPEUTIC AND SURGICAL APPLICATIONS OF LIGHT  9
Laser in tissue welding, lasers in dermatology, lasers in ophthalmology, otolaryngology, urology, neurology, orthopedics, gastroenterology. Phototherapy, Photodynamic therapy (PDT) - Principle and mechanism - Oncological and non-oncological applications of PDT. Biostimulation effect – applications.

UNIT V  FIBER OPTIC SENSORS AND APPLICATIONS  9
Light transport in the optical fiber - Total internal reflection, Numerical aperture, Angle of acceptance. losses in fiber, Optical sensors based on polarization, magnetic sensors, Medical applications of fiber optic sensors in measuring temperature, pressure, flow and chemical activities

TOTAL: 45 PERIODS

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

CO1  Know the photonics instruments
CO2  Know the various optical properties of tissue
CO3  Know application of diagnostic applications of lasers in medical fields
CO4  Know application of therapeutic and surgical applications of lasers in medical fields
CO5  Types of fiber optic sensors used in medical application.

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OBJECTIVES:
- To understand the essential features of biology and nanotechnology that are converging to create the new areas of bionanotechnology and nanomedicine.
- To understand the principles behind nanomedicine and the applications of nanomaterials in medicine.
- To understand the need, problem and solutions for polymeric, lipidous and solid nanosized drug delivery systems.
- To impart the knowledge to apply the nanomaterials in different medical applications.
- To know the underlying concept in engineering and implement in nanocentric applications.

UNIT I INTRODUCTION OF NANOPARTICLES
Overview of nanotechnology from medical perceptive, different types of nanobiomaterials and nanostructure interactions. Synthesis and characterization of smart nanomaterials, surface modification, biofunctionalization of nanomaterials.

UNIT II NANOMATERIALS AND NANOENGINEERING
Lipid- based (liposomes, micelles, solid lipid nanoparticles) and magnetic based particles and their delivery for biomedical applications. Inorganic nanoparticles, carbon- based (fullerenes,ucky balls and carbon nanotubes), biodistribution and its fate.

UNIT III NANOENGINEERING IN DRUG DELIVERY
Nanoshells, nanopores, Tectodendrimers, active and passive cell targeting, viral based drug delivery system-nanoparticle drug system for oral administration, drug system for nasal administration, drug system for ocular administration, nanotechnology in diagnostic application. Preformulation studies: on various dosage forms such as tablets, capsule, suspension, creams, emulsion, injectables ophthalmic and aerosols etc.

UNIT IV NANOENGINEERING IN IMAGING, DIAGNOSTIC AND DETECTION
Nuclear imaging systems –SPECT and PET, advanced MR imaging, optical imaging and CT. Ultra sound imaging and therapy, nanoimaging systems, micro/nano fluidics, diagnostics and biosensors.

UNIT V APPLICATION IN CANCER THERAPY

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of this course the student will be able to:
- CO1 Understand latest scientific developments and discoveries in the field of Nanomedicine.
- CO2 Understand the toxicological aspects of Nano sized particles.
- CO3 Understand basic stem cell biology and corresponding requirement for tissue engineering
- CO4 Follow the new findings in the area of Nanomedicine and implement the perspectives in own research.
- CO5 Understand new approaches in nanotechnology that can be used in biomedical therapies.
REFERENCES:
2. Nicholas A. Kotov, Nanoparticle Assemblies and Superstructures. 2006 -CRC.

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MD5082 PATTERN RECOGNITION TECHNIQUES AND APPLICATIONS

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

UNIT II UNSUPERVISED CLASSIFICATION
- 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
- KL Transforms, Regression-Linear, Non-linear and Logistic, Prediction, Elements of formal grammars, syntactic description, stochastic grammars, Structural representation.

UNIT IV FUZZY SYSTEMS
UNIT V RECENT ADVANCES AND APPLICATIONS

TOTAL: 45 PERIODS

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

CO1 Perform classification using Baye's approach
CO2 Implement clustering algorithms for classification
CO3 Perform Feature extraction, feature reduction and structural pattern recognition.
CO4 Apply fuzzy models for classification
CO5 Apply pattern recognition techniques for biosignal and medical image applications.

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

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MD5083 PHYSIOLOGICAL SYSTEMS MODELING AND SIMULATION L T P C
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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

UNIT II TRANSFER FUNCTION
System as an Operator, Transfer Function of First and Second Order system, Transfer Function and Concept of Impedance – Circuits into transfer function, Circuit Analog from transfer function.
UNIT III  SYSTEM RESPONSE CHARACTERISTICS 9

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

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

COURSE OUTCOMES:
On completion of this course the student will be able to:
CO1 Perceive knowledge about different types of physiological models for first order system
CO2 Concepts of transfer function for first and second order system
CO3 Various response characteristics of physiological system
CO4 Apprehend in feedback control system
CO5 Analog simulation of different types of physiological models in the field of biological systems.

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OBJECTIVES:

- To understand fundamental principles of cell division, chromosome segregation and Mendelian inheritance.
- To gain better knowledge in both prokaryotes & eukaryotes about the gene mutation and repair mechanisms.
- To know the underlying concept behind the manipulation of genetic material for a diverse beneficial purpose via Recombinant DNA Technology.
- To know the importance of human genome project and various techniques in gene mapping.
- To understand the basic concepts of population genetics leading to important aspects concerning evolution.

UNIT I  GENETIC INHERITANCE  9
Organisation of DNA, Chromosomal inheritance, Eukaryotic genomes – repetitive 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 sequencing and DNA microarray, scientific & medical benefits of this project.

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

COURSE OUTCOMES:

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

CO1 Interpret different forms of inheritance patterns and identify them in genetic data acquire in depth knowledge in evolutionary analysis of genetic sequence.

CO2 Acquire a wide knowledge in gene arrangement, the mechanisms and regulation involved in gene amplification

CO3 Explain the techniques in gene manipulation and to understand genetically modified organisms, its impact on the society.

CO4 Interpret and critically evaluate the outcomes of statistical analysis associated with the research project

CO5 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.
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MD5085 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 introduce the students with the knowledge of telemedical standards
- To design and develop m-Health platforms for telemedical applications.

UNIT I TELEMEDICINE AND TELEHEALTH
- History and Evolution of telemedicine, Purposes and its organization, Medical assistance of remote patients: Problems and Potentials. Lessons from maritime Telemedicine, Teleconsultation, Tele health, Organs of Telemedicine, Global and Indian scenario, Advances in Telemedicine, Benefits and Challenges

UNIT II TELEMEDICAL TECHNOLOGY
- Principles of Multimedia: Text, Audio, Video, data - Data communications and networks, Internet, Body centric wireless communication: Wireless Body Area Networks (WBAN), Wireless Sensor Networks (WSN) and Wireless Personal Area Networks (WPAN) and their design concepts Antenna design considerations for in-body and on-body electronics - Communication infrastructure for Telemedicine - Telemedicine through world wide web (WWW).

UNIT III TELEMEDICAL STANDARDS
- Real-time Telemedicine integrating doctors / Hospitals, Access to health care services – Health education and self-care, Telesurgery, Teleradiology, Telecardiology, Teleoncology, Telemedicine in neurosciences, Telepathology, Business aspects - Project planning and costing, Usage of telemedicine. Telemedicine and in loco assistance of patients, Interactive videoconferencing consults, Store and forward consults, Remote monitoring and home care, Home Telehealth Protocols and Procedure
UNIT IV  m-HEALTH AND TELEMEDICINE

Mobile Devices : Smart phones, Tablet PCs, iPads, PDAs, Wearable computers – m-Health technology and communication infrastructure - Healthcare Apps – m-Health applications: Education and awareness, Remote data collection, Remote monitoring, Communication and training for healthcare workers, Disease and epidemic outbreak tracking, Diagnostic and treatment support – m-Health and the Transformation of Clinical Trials - Harnessing data, advanced analytics, and the Internet of Things to optimize digitized clinical trials

UNIT V  SECURITY AND LEGAL ISSUES


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

CO1  Describe the key principles for telemedicine and health.
CO2  Understand telemedical technology.
CO3  Introduce the students with the knowledge of telemedical standards
CO4  Design and develop m-Health platforms for telemedical applications
CO5  Acquire knowledge of evaluating the force in implants

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MD5086  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

UNIT II  FUNDAMENTALS OF CELL MECHANISMS  9

UNIT III  BIOMATERIALS IN TISSUE ENGINEERING  9

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

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

CO1  Identify the importance of tissue engineering in the field of biomedical engineering
CO2  Explain the mechanisms involved in interaction of different materials with cells and tissues
CO3  Explain different methods involved in characterization and preparation of biomaterials in tissue engineering.
CO4  Analyse different types of stem cells and its application in tissue engineering
CO5  Apply the knowledge in creating new models in drug delivery systems using synthetic and natural scaffolds

REFERENCES:
5. Develop new approaches to build new tissues using tissue engineering techniques
MD5087 ULTRASOUND PRINCIPLES AND APPLICATIONS IN MEDICINE

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
Principle of Piezo Electric transducers and Magnetostrictive transducers, Ultrasound transducers, Construction of ultrasonic probe - Continuous mode and pulsed mode. Measurement of ultrasonic energy, Manipulation of ultrasonic beam – Beam profile and intensity distribution in different axes, single transducer, transducer array, focusing, Beam steering and Dynamic focusing by electronic methods.

UNIT II TISSUE-ULTRASOUND INTERACTION
Interaction of ultrasound and tissue – propagation of ultrasound through tissue, dependence of speed on tissue characteristics, reflection and acoustic impedance, refraction, scattering, absorption in different tissues, compression and rarefaction, thermal effect. Cavitation, biological effects, Definition of Acoustic pressure and intensity and their relation to tissue properties. Structural contribution to bulk and shear acoustic properties of tissues. Relevance to tissue characterization

UNIT III ULTRASOUND SCANNERS
Different modes of display-A mode, B mode, M mode, applications of A mode and M mode in medicine, B-scan System, Real time scanners- types of transducers, transducer motion for scanning, Scan converters, Signal processing, signal controls- TGC, Flares and acoustic shadows, artifacts.

UNIT IV REAL TIME SCANNER APPLICATIONS AND ADVANCEMENTS
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, Tissue Elasticity and Echo Strain Imaging and advantages, Use of Contrast Media, Contrast-enhanced ultrasound (CEUS). Real Time 3-D Scanners, Image guided surgery. Cleaners in hospitals using cavitation effect

UNIT V ULTRASOUND DOPPLER TECHNIQUES

TOTAL: 45 PERIODS
COURSE OUTCOMES:
On completion of this course the student will have:

CO1  An in-depth knowledge about the concepts of ultrasound
CO2  The capability to understand the interaction of ultrasound with matter especially the living systems.
CO3  In-depth knowledge about the Ultrasound imaging systems
CO4  Ability to specify method of ultrasonic scanning method for imaging different organs and the possible artifacts introduced during scanning.
CO5  Proficient knowledge about Real Time Scanners for blood flow studies

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MD5088  WEARABLE 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
Definition, BAN and Healthcare, Technical Challenges- Sensor design, biocompatibility, Energy Supply, optimal node placement, number of nodes, System security and reliability, BSN Architecture – Introduction

UNIT II HARDWARE FOR BAN

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

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

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of this course the student will be able to:
CO1 Define the need for WBAN and the challenges involved in the design
CO2 Explain about the working of wireless Body Area Network and discuss about the hardware required for the implementation
CO3 Describe about the types of wearable sensors and their suitability for BAN
CO4 Discuss and implement the suitable signal processing technique and thus the ways of reducing power consumption
CO5 Explain the need of wireless health systems and the design an application of wearable systems

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OBJECTIVES:
- To understand the global trends and development methodologies of various types of products and services
- To conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems
- To understand requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them in to design specification
- To understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics
- To develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer

UNIT I  PRODUCT DESIGN  9
Definition, History and Modern Practice – Designs; Design and Product Life Cycle; Design Process; What is a medical device, Challenges in medical device, Understanding the innovation cycle, Good Design Practice. Understanding, analyzing and validating user needs, Screening Needs, Technical Requirements, Concept Generation – Innovation Survey Questionnaire, Morphological Matrix, QFD, Concept Analysis and validation, Concept Modelling, Concept Screening & Validation.

UNIT II  PRODUCT DEVELOPMENT AND REGULATORY  9

UNIT III  CALABLE PRODUCT DEVELOPMENT  9
Design for manufacturing, Design for assembly, Design for Serviceability, Design for usability, Medical Device Verification & Validation, Product Testing & Regulatory compliance, Clinical trial & validation, Device Certification

UNIT IV  MANUFACTURING AND BUSINESS STRATEGIES  9

UNIT V  PRODUCT ECONOMICS AND MARKET INFUSIONS  9

TOTAL: 45 PERIODS
COURSE OUTCOMES:
On completion of this course the student will be able to:

CO1 Define, formulate and analyze a problem for the product design.

CO2 Obtain the domain knowledge of product development and regulatory requirements for the design of prototype.

CO3 Explain the process of manufacturing, testing and validation for scalable product development.


CO5 Discuss the economics in product development and business strategies for turnover from commercialization.

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MD5079 MEDICAL ROBOTICS L T P C 3 0 0 3

OBJECTIVES
- To explain the basic concepts of robots and types of robots
- To discuss the designing procedure of manipulators, actuators and grippers.
- To impart knowledge on various types of sensors and power sources.
- Explore various applications of Robots in Medicine.

UNIT I INTRODUCTION TO ROBOTICS 9
Introduction to Robotics, Overview of robot subsystems, Degrees of freedom, configurations and concept of workspace, Dynamic Stabilization
Sensors and Actuators
Sensors and controllers, Internal and external sensors, position, velocity and acceleration sensors, Proximity sensors, force sensors Pneumatic and hydraulic actuators, Stepper motor control circuits, End effectors, Various types of Grippers, PD and PID feedback actuator models

UNIT II MANIPULATORS & BASIC KINEMATICS 9
Construction of Manipulators, Manipulator Dynamic and Force Control, Electronic and pneumatic manipulator, Forward Kinematic Problems, Inverse Kinematic Problems, Solutions of Inverse Kinematic problems

Navigation and Treatment Planning
Variable speed arrangements, Path determination – Machinery vision, Ranging – Laser – Acoustic, Magnetic, fiber optic and Tactile sensor.

UNIT III SURGICAL ROBOTS 9

UNIT IV REHABILITATION AND ASSITIVE ROBOTS 9
Pediatric Rehabilitation, Robotic Therapy for the Upper Extremity and Walking, Clinical-Based Gait Rehabilitation Robots, Motion Correlation and Tracking, Motion Prediction, Motion Replication. Portable Robot for Tele rehabilitation, Robotic Exoskeletons – Design considerations, Hybrid assistive limb. Case Study.

UNIT V WEARABLE ROBOTS 9

COURSE OUTCOMES:
On completion of this course the student will be able to:
CO1 Describe the configuration, applications of robots and the concept of grippers and actuators.
CO2 Explain the functions of manipulators and basic kinematics.
CO3 Describe the application of robots in various surgeries
CO4 Design and analyze the robotic systems for rehabilitation.
CO5 Design the wearable robots.

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**MD5076**

**MEDICAL EMBEDDED SYSTEMS**

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

**UNIT I**

**REVIEW OF DIGITAL ELECTRONICS AND INTRODUCTION TO ARM PROCESSORS**

Number systems and codes, logic gates, Arithmetic circuits: Half and Full adder, substractor; Combinational circuits: Multiplexers, Demultiplexers, Decoders, Encoders; Latches and Flip-flops, Counters, Registers, A/D and D/A converters.

Introduction to ARM Cortex-M Processors, Introduction to Embedded Software Development.

**UNIT II**

**HARDWARE AND SOFTWARE FOR ARM PROCESSOR**

ARM architecture, ARM Instruction Set, Memory System, Exceptions and Interrupts. The C language: The evolution of C, An overview of C programming, C operators, identifiers, keywords and constants; The C preprocessor: commands, definition and replacement, File inclusion, Conditional compilation; storage classes, variable types, expressions and precedence, statements, functions.

**UNIT III**

**DATA ACQUISITION SYSTEMS**

Analog signals: amplitude, bandwidth; Analog multiplexing, Anti-aliasing filters, Analog to Digital converter, Sensor interfacing, sampling theorem, Digital filters, UART to USB converters, Bluetooth, Zigbee and Wi-fi Communication protocols.

**UNIT IV**

**EMBEDDED SYSTEM ARCHITECTURE - ARM CORE**

ARM organization and implementation, The Thumb Instruction Set, Architectural Support for High-Level Languages. Introduction to Arduino Due; Arduino integrated development environment and programming.
UNIT V  PROTOTYPE PRODUCT DEVELOPMENT
Basics of Printed Circuit Boards: Evolution, components, classification, Manufacturing and challenges; Layout planning and design: General PCB Design Considerations, Electrical Design Considerations, Component Placement Rules, Fabrication and Assembly Considerations, Layout Design and Assembly.
Design of single channel and multi-channel ECG and EMG amplifier systems incorporating analog, digital and communication.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of this course the student will be able to:
CO1 Obtain the domain knowledge of digital electronics and ARM processors.
CO2 Develop hardware and software for ARM processor.
CO3 Demonstrate the various subsystems of data acquisition system for acquisition of biosignals.
CO4 Use the ARM core in the design of medical embedded system.
CO5 Design the layout planning for bioamplifiers and prototype product in PCB.

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OE5091  BUSINESS DATA ANALYTICS  L T P C
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OBJECTIVES:
• To understand the basics of business analytics and its life cycle.
• To gain knowledge about fundamental business analytics.
• To learn modeling for uncertainty and statistical inference.
• To understand analytics using Hadoop and Map Reduce frameworks.
• To acquire insight on other analytical frameworks.
UNIT I  OVERVIEW OF BUSINESS ANALYTICS

Suggested Activities:
- Case studies on applications involving business analytics.
- Converting real time decision making problems into hypothesis.
- Group discussion on entrepreneurial opportunities in Business Analytics.

Suggested Evaluation Methods:
- Assignment on business scenario and business analytical life cycle process.
- Group presentation on big data applications with societal need.
- Quiz on case studies.

UNIT II  ESSENTIALS OF BUSINESS ANALYTICS

Suggested Activities:
- Solve numerical problems on basic statistics.
- Explore chart wizard in MS Excel Case using sample real time data for data visualization.
- Use R tool for data visualization.

Suggested Evaluation Methods:
- Assignment on descriptive analytics using benchmark data.
- Quiz on data visualization for univariate, bivariate data.

UNIT III  MODELING UNCERTAINTY AND STATISTICAL INFERENCE

Suggested Activities:
- Solving numerical problems in sampling, probability, probability distributions and hypothesis testing.
- Converting real time decision making problems into hypothesis.

Suggested Evaluation Methods:
- Assignments on hypothesis testing.
- Group presentation on real time applications involving data sampling and hypothesis testing.
- Quizzes on topics like sampling and probability.

UNIT IV  ANALYTICS USING HADOOP AND MAPREDUCE FRAMEWORK
Suggested Activities:

- Practical – Install and configure Hadoop.
- Practical – Use web based tools to monitor Hadoop setup.
- Practical – Design and develop MapReduce tasks for word count, searching involving text corpus etc.

Suggested Evaluation Methods:

- Evaluation of the practical implementations.
- Quizzes on topics like HDFS and extensions to MapReduce.

UNIT V OTHER DATA ANALYTICAL FRAMEWORKS

Overview of Application development Languages for Hadoop – PigLatin – Hive – Hive Query Language (HQL) – Introduction to Pentaho, JAQL – Introduction to Apache: Sqoop, Drill and Spark, Cloudera Impala – Introduction to NoSQL Databases – Hbase and MongoDB.

Suggested Activities:

- Practical – Installation of NoSQL database like MongoDB.
- Practical – Demonstration on Sharding in MongoDB.
- Practical – Install and run Pig
- Practical – Write PigLatin scripts to sort, group, join, project, and filter data.
- Design and develop algorithms to be executed in MapReduce involving numerical methods for analytics.

Suggested Evaluation Methods:

- Mini Project (Group) – Real time data collection, saving in NoSQL, implement analytical techniques using Map-Reduce Tasks and Result Projection.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course, the student will be able to:

- Identify the real world business problems and model with analytical solutions.
- Solve analytical problem with relevant mathematics background knowledge.
- Convert any real world decision making problem to hypothesis and apply suitable statistical testing.
- Write and Demonstrate simple applications involving analytics using Hadoop and MapReduce
- Use open source frameworks for modeling and storing data.
- Apply suitable visualization technique using R for visualizing voluminous data.

REFERENCES:

OBJECTIVES:
- Summarize basics of industrial safety
- Describe fundamentals of maintenance engineering
- Explain wear and corrosion
- Illustrate fault tracing
- Identify preventive and periodic maintenance

UNIT I  INTRODUCTION
Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT II  FUNDAMENTALS OF MAINTENANCE ENGINEERING
Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT III  WEAR AND CORROSION AND THEIR PREVENTION

UNIT IV  FAULT TRACING
Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment’s like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT V  PERIODIC AND PREVENTIVE MAINTENANCE
Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

TOTAL: 45 PERIODS
OUTCOMES:
Students will be able to:
CO1: Ability to summarize basics of industrial safety
CO2: Ability to describe fundamentals of maintenance engineering
CO3: Ability to explain wear and corrosion
CO4: Ability to illustrate fault tracing
CO5: Ability to identify preventive and periodic maintenance

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REFERENCES:

OE5093 OPERATIONS RESEARCH

OBJECTIVES:
• Solve linear programming problem and solve using graphical method.
• Solve LPP using simplex method
• Solve transportation, assignment problems
• Solve project management problems
• Solve scheduling problems

UNIT I LINEAR PROGRAMMING
Introduction to Operations Research – assumptions of linear programming problems - Formulations of linear programming problem – Graphical method

UNIT II ADVANCES IN LINEAR PROGRAMMING
Solutions to LPP using simplex algorithm - Revised simplex method - primal dual relationships – Dual simplex algorithm - Sensitivity analysis

UNIT III NETWORK ANALYSIS – I
Transportation problems -Northwest corner rule, least cost method, Voges’s approximation method - Assignment problem -Hungarian algorithm

UNIT IV NETWORK ANALYSIS – II
Shortest path problem: Dijkstra’s algorithms, Floyds algorithm, systematic method -CPM/PERT
UNIT V NETWORK ANALYSIS – III
Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models

TOTAL: 45 PERIODS

OUTCOMES:
Students will be able to:
CO1: To formulate linear programming problem and solve using graphical method.
CO2: To solve LPP using simplex method
CO3: To formulate and solve transportation, assignment problems
CO4: To solve project management problems
CO5: To solve scheduling problems

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OE5094 COST MANAGEMENT OF ENGINEERING PROJECTS

OBJECTIVES:
- Summarize the costing concepts and their role in decision making
- Infer the project management concepts and their various aspects in selection
- Interpret costing concepts with project execution
- Develop knowledge of costing techniques in service sector and various budgetary control techniques
- Illustrate with quantitative techniques in cost management

UNIT I INTRODUCTION TO COSTING CONCEPTS
Objectives of a Costing System; Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost; Creation of a Database for operational control.

UNIT II INTRODUCTION TO PROJECT MANAGEMENT
Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities, Pre project execution main clearances and documents, Project team: Role of each member, Importance Project site: Data required with significance, Project contracts.
UNIT III  PROJECT EXECUTION AND COSTING CONCEPTS  9
Project execution Project cost control, Bar charts and Network diagram, Project commissioning: mechanical and process, Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing.

UNIT IV  COSTING OF SERVICE SECTOR AND BUDGETARY CONTROL  9
Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis, Budgetary Control: Flexible Budgets; Performance budgets; Zero-based budgets.

UNIT V  QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT  9
Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning Curve Theory.

OUTCOMES:
Students will be able to:
CO1 – Understand the costing concepts and their role in decision making
CO2–Understand the project management concepts and their various aspects in selection
CO3–Interpret costing concepts with project execution
CO4–Gain knowledge of costing techniques in service sector and various budgetary control
techniques
CO5 - Become familiar with quantitative techniques in cost management

REFERENCES:
2. Charles T. Horngren and George Foster, Advanced Management Accounting, 1988

OE5095  COMPOSITE MATERIALS  L T P C
3 0 0 3

OBJECTIVES:
• Summarize the characteristics of composite materials and effect of reinforcement in composite materials.
• Identify the various reinforcements used in composite materials.
• Compare the manufacturing process of metal matrix composites.
• Understand the manufacturing processes of polymer matrix composites.
• Analyze the strength of composite materials.
UNIT I  INTRODUCTION 9
Definition – Classification and characteristics of Composite materials - Advantages and application of composites - Functional requirements of reinforcement and matrix - Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT II  REINFORCEMENTS 9
Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers - Properties and applications of whiskers, particle reinforcements - Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures - Isostrain and Isostress conditions.

UNIT III  MANUFACTURING OF METAL MATRIX COMPOSITES 9

UNIT IV  MANUFACTURING OF POLYMER MATRIX COMPOSITES 9

UNIT V  STRENGTH 9
Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TOTAL: 45 PERIODS

OUTCOMES:
Students will be able to:
- CO1 - Know the characteristics of composite materials and effect of reinforcement in composite materials.
- CO2 – Know the various reinforcements used in composite materials.
- CO3 – Understand the manufacturing processes of metal matrix composites.
- CO4 – Understand the manufacturing processes of polymer matrix composites.
- CO5 – Analyze the strength of composite materials.

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REFERENCES:
OBJECTIVES:
- Interpret the various types of wastes from which energy can be generated
- Develop knowledge on biomass pyrolysis process and its applications
- Develop knowledge on various types of biomass gasifiers and their operations
- Invent knowledge on biomass combustors and its applications on generating energy
- Summarize the principles of bio-energy systems and their features

UNIT I INTRODUCTION TO EXTRACTION OF ENERGY FROM WASTE
Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNIT II BIOMASS PYROLYSIS
Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT III BIOMASS GASIFICATION

UNIT IV BIOMASS COMBUSTION
Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT V BIO ENERGY
Properties of biogas (Calorific value and composition), Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production -Urban waste to energy conversion - Biomass energy programme in India.

TOTAL: 45 PERIODS

OUTCOMES:
Students will be able to:
CO1 – Understand the various types of wastes from which energy can be generated
CO2 – Gain knowledge on biomass pyrolysis process and its applications
CO3 – Develop knowledge on various types of biomass gasifiers and their operations
CO4 – Gain knowledge on biomass combustors and its applications on generating energy
CO5 – Understand the principles of bio-energy systems and their features
REFERENCES:

AUDIT COURSES (AC)

AX5091 ENGLISH FOR RESEARCH PAPER WRITING

OBJECTIVES
• Teach how to improve writing skills and level of readability
• Tell about what to write in each section
• Summarize the skills needed when writing a Title
• Infer the skills needed when writing the Conclusion
• Ensure the quality of paper at very first-time submission

UNIT I INTRODUCTION TO RESEARCH PAPER WRITING
Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT II PRESENTATION SKILLS

UNIT III TITLE WRITING SKILLS
Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check

UNIT IV RESULT WRITING SKILLS
Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT V VERIFICATION SKILLS
Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first-time submission

TOTAL: 30 PERIODS

OUTCOMES
CO1 – Understand that how to improve your writing skills and level of readability
CO2 – Learn about what to write in each section
CO3 – Understand the skills needed when writing a Title
CO4 – Understand the skills needed when writing the Conclusion
CO5 – Ensure the good quality of paper at very first-time submission

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AX5092 DISASTER MANAGEMENT

OBJECTIVES
- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches

UNIT I INTRODUCTION
Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS

UNIT III DISASTER PRONE AREAS IN INDIA
Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics

UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT
Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT V RISK ASSESSMENT
Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People’s Participation in Risk Assessment. Strategies for Survival

OUTCOMES
CO1: Ability to summarize basics of disaster
CO2: Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
CO3: Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
CO4: Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO5: Ability to develop the strengths and weaknesses of disaster management approaches

TOTAL : 30 PERIODS
REFERENCES

AX5093 SANSKRIT FOR TECHNICAL KNOWLEDGE L T P C

OBJECTIVES
- Illustrate the basic sanskrit language.
- Recognize sanskrit, the scientific language in the world.
- Appraise learning of sanskrit to improve brain functioning.
- Relate sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.
- Extract huge knowledge from ancient literature.

UNIT I ALPHABETS
Alphabets in Sanskrit

UNIT II TENSES AND SENTENCES
Past/Present/Future Tense - Simple Sentences

UNIT III ORDER AND ROOTS
Order - Introduction of roots

UNIT IV SANSKRIT LITERATURE
Technical information about Sanskrit Literature

UNIT V TECHNICAL CONCEPTS OF ENGINEERING
Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

TOTAL: 30 PERIODS

OUTCOMES
- CO1 - Understanding basic Sanskrit language.
- CO2 - Write sentences.
- CO3 - Know the order and roots of Sanskrit.
- CO4 - Know about technical information about Sanskrit literature.
- CO5 - Understand the technical concepts of Engineering.
REFERENCES
1. “Abhyaspustakam” – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi
2. “Teach Yourself Sanskrit” Prathama Deeksha-Vempati Kutumbhashatri, Rashtriya Sanskrit Sansthanam, New Delhi Publication

AX5094 VALUE EDUCATION

OBJECTIVES
Students will be able to
- Understand value of education and self-development
- Imbibe good values in students
- Let the should know about the importance of character

UNIT I

UNIT II

UNIT III

UNIT IV

TOTAL: 30 PERIODS

OUTCOMES
Students will be able to
- Knowledge of self-development.
- Learn the importance of Human values.
- Developing the overall personality.

SUGGESTED READING
OBJECTIVES
Students will be able to:
- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional
- Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

UNIT I  HISTORY OF MAKING OF THE INDIAN CONSTITUTION
History, Drafting Committee, (Composition & Working)

UNIT II  PHILOSOPHY OF THE INDIAN CONSTITUTION
Preamble, Salient Features

UNIT III  CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES

UNIT IV  ORGANS OF GOVERNANCE
Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT V  LOCAL ADMINISTRATION

UNIT VI  ELECTION COMMISSION
Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

TOTAL: 30 PERIODS

OUTCOMES
Students will be able to:
- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization
- of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party (CSP) under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

SUGGESTED READING
1. The Constitution of India, 1950 (Bare Act), Government Publication.
OBJECTIVES

Students will be able to:

- Review existing evidence on there view topic to inform programme design and policy
- Making under taken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

UNIT I
INTRODUCTION AND METHODOLOGY:
Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions - Overview of methodology and Searching.

UNIT II
INTRODUCTION AND METHODOLOGY:
Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions - Overview of methodology and Searching.

UNIT III
THEMATIC OVERVIEW
Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

UNIT IV
EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES
Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT V
PROFESSIONAL DEVELOPMENT
Professional development: alignment with classroom practices and follow up support - Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning: limited resources and large class sizes

UNIT VI
RESEARCH GAPS AND FUTURE DIRECTIONS
Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to understand:

- What pedagogical practices are being used by teachers informal and informal classrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

SUGGESTED READING

AX5097  
STRESS MANAGEMENT BY YOGA  
L T P C  
2 0 0 0

OBJECTIVES
• To achieve overall health of body and mind
• To overcome stress

UNIT I
Definitions of Eight parts of yoga.(Ashtanga)

UNIT II
Yam and Niyam - Do’s and Don’ts in life - i) Ahinsa, satya, astheya, bramhacharya and aparigraha, ii) Ahinsa, satya, astheya, bramhacharya and aparigraha.

UNIT III
Asan and Pranayam - Various yog poses and their benefits for mind & body - Regularization of breathing techniques and its effects-Types of pranayam

TOTAL: 30 PERIODS

OUTCOMES
Students will be able to:
• Develop healthy mind in a healthy body thus improving social health also
• Improve efficiency

SUGGESTED READING
1. “Yogic Asanas for Group Tarining-Part-I”. Janardan Swami Yoga bhyasi Mandal, Nagpur
2. “Rajayoga or conquering the Internal Nature” by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

AX5098  
PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS  
L T P C  
2 0 0 0

OBJECTIVES
• To learn to achieve the highest goal happily
• To become a person with stable mind, pleasing personality and determination
• To awaken wisdom in students

UNIT I
Neetisatakam-holistic development of personality - Verses- 19,20,21,22 (wisdom) - Verses- 29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue) - Verses- 52,53,59 (don't's) - Verses- 71,73,75,78 (do's)

UNIT II
Approach to day to day work and duties - Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48.
UNIT III
Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter 12 - Verses 13, 14, 15, 16, 17, 18 - Personality of role model - shrimad bhagwad geeta - Chapter2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63

TOTAL: 30 PERIODS

OUTCOMES
Students will be able to
- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and mankind to peace and prosperity
- Study of Neet is hatakam will help in developing versatile personality of students.

SUGGESTED READING
1. Gopinath, Rashtriya Sanskrit Sansthanam P, Bhartrihari's Three Satakam, Niti-sringar-vairagya, New Delhi,2010