1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

I. To enable the graduates to pursue Clinical Research or lead a successful career in the academic field of medical electronics.
II. To enable the graduates to acquire all the required Medical Electronics Manufacturing skills for Industrial Application or for Hospital Requirement.
III. To enable the graduates to critically analyse, acquire essential skills, innovate medical products and to become successful Entrepreneurs in the field of medical electronics.
IV. To facilitate the graduates to exhibit leadership skills, make decisions with societal and ethical responsibilities, function and communicate effectively in multidisciplinary settings.
V. To enable the graduates to identify, analyze sustainable solutions and to develop ethical practicing ability to collaborate with team members for building medical electronics systems with cutting-edge technology.

2. PROGRAM OUTCOMES (POs)

1. An ability to independently carry out research/investigation and development work to solve practical problems.
2. An ability to write and present a substantial technical report/document.
   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.
3. Ability to acquire and understand, synthesize and generate hypotheses using knowledge of mathematics and electronics.
4. Model, design and realize devices and systems using the techniques and tools of Medical Electronics Engineering in healthcare domain.
5. Optimize, maintain and Provide sustainable solutions for health care devices / systems and its allied fields by imbibing managerial and techno-social values.
### M.E. Medical Electronics
#### Regulations – 2021

**Choice Based Credit System**

I to IV Semesters Curricula and Syllabi

#### Semester I

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### PROFESSIONAL ELECTIVES

**SEMESTER II, PROFESSIONAL ELECTIVES – I**

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### SUMMARY

**NAME OF THE PROGRAMME: M.E. MEDICAL ELECTRONICS**

<table>
<thead>
<tr>
<th>Sl. No.</th>
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COURSE 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 parodic functions and to solve partial differential equations.

UNIT – I  LINEAR ALGEBRA

UNIT – II  ONE DIMENSIONAL RANDOM VARIABLES

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

UNIT – IV  LINEAR PROGRAMMING

UNIT – V  FOURIER TRANSFORM FOR PARTIAL DIFFERENTIAL EQUATIONS

TOTAL: 60 PERIODS

COURSE 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:

RM4151 RESEARCH METHODOLOGY AND IPR L T P C 2 0 0 2

UNIT I RESEARCH DESIGN
Overview of research process and design, Use of Secondary and exploratory data to answer the research question, Qualitative research, Observation studies, Experiments and Surveys.

UNIT II DATA COLLECTION AND SOURCES
Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods.
Data - Preparing, Exploring, examining and displaying.

UNIT III DATA ANALYSIS AND REPORTING
Overview of Multivariate analysis, Hypotheses testing and Measures of Association. Presenting Insights and findings using written reports and oral presentation.

UNIT IV INTELLECTUAL PROPERTY RIGHTS

UNIT V PATENTS

TOTAL: 30 PERIODS

REFERENCES

MX4101 BIOMEDICAL INSTRUMENTATION AND EQUIPMENT L T P C 3 0 0 3

COURSE OBJECTIVES:
- Study about the different bio potential and electrodes for its measurement.
- Understand the biosignal characteristics and the electrode placement for recording.
- Familiarize the different signal conditioning circuits.
- Learn the different measurement techniques for non-electrical parameters.
- Familiarize the different biochemical measurements.

UNIT I BIO POTENTIAL ELECTRODES

UNIT II ELECTRODE CONFIGURATIONS
Biosignals characteristics – frequency and amplitude ranges. ECG – Einthoven’s triangle, standard 12 lead system. EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG–unipolar and bipolar mode. Recording of ERG, EOG and EGG.

UNIT III BIOAMPLIFIERS

UNIT IV MEASUREMENT OF NON-ELECTRICAL PARAMETERS

UNIT V BIO-CHEMICAL MEASUREMENT
Ion selective Field effect Transistor (ISFET), Immunologically sensitive FET (IMFET), Blood glucose sensors, Blood gas analyzers - colorimeter, Sodium Potassium Analyser, spectrophotometer, blood cell counter, auto analyzer (simplified schematic description) – Bio Sensors – Principles – Amperometric and Voltometric techniques.
TOTAL: 45 PERIODS

SUGGESTED ACTIVITIES:
1: Demonstration on various electrodes and study of its characteristics
2: Demonstration about ECG, EEG, ERG, EOG & EGG
3: Design of amplifiers for ECG, EMG, EEG, EGG & EOG
4: Conduct experiments to measure BP, SpO2, Heart Rate, Body temperature
5: Conduct experiments to measure Blood Glucose, Blood cell counts,

COURSE OUTCOMES:
Upon Completion of the course, the students will be able to:
CO1: Understand the origin of bio potentials and electrodes for its measurement.
CO2: Describe the biosignal characteristics and the electrode placement for various physiological recording
CO3: Design bio amplifier for various physiological recording.
CO4: Perform various techniques for measuring non-electrical parameters.
CO5: Apply different techniques for biochemical measurements.

REFERENCES:

MX4102 EMBEDDED SYSTEMS AND INTERNET OF THINGS FOR MEDICAL APPLICATION L T P C 3 0 2 4

COURSE OBJECTIVES:
- To understand hardware and software for ARM processor.
- To understand ARM processor and Building Blocks of Embedded Systems
- To provide information about sensor interfacing with microcontroller boards
- To provide information about various protocols for IoT
- To familiarize the student with the various applications in healthcare using IOT

UNIT I HARDWARE AND SOFTWARE OF ARM PROCESSOR 9
ARM processor fundamentals, architecture, Instruction set, Memory system, Exception/ Interrupt handling. Cortex-M Processors, Embedded Software Development- Introduction to C language and C preprocessor.

UNIT II DATA ACQUISITION SYSTEMS 10
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 III  SENSOR INTERFACING WITH MICROCONTROLLER BOARDS  
Basics of hardware design, functions of passive components-sensors and actuators, Introduction to Arduino Due; Arduino integrated development environment and programming.

UNIT IV  IOT: AN INTRODUCTION  

UNIT V  EMBEDDED WEB-SERVER & IOT CLOUD SERVICES APPLICATION & CASE STUDY  
Embedded web server: Basic introduction and its application in IOT.  
Case Study1: Wireless Patient Monitor system  
Case Study2: Wearable Fitness & Activity Monitor  
Application Design: Design of IOT based pulse oximeter, block diagram, concepts of analog front end, signal process and Wi-Fi integration, Design of single channel and multi-channel ECG and EMG amplifier systems incorporating analog, digital communication.

45 PERIODS

PRACTICAL EXERCISES:  
LIST OF EXPERIMENTS  
1. Interfacing with Pressure sensor, Light sensor, IR sensor.  
2. Temperature sensor Interfacing using ARM processor  
3. Experiments with Atmega -Digital: - Button, Digital Input Pullup, Blink Without Delay  
4. Introduction to ARM7- Cortex processor Instruction set  
5. EPROM Interfacing using ARM processor.  
6. Study of basic image processing algorithm using Single board computers such as Raspberry Pi, Beagle Bone black etc

COURSE OUTCOMES:  
Upon Completion of the course, the students will be able to:  
CO1: Develop hardware and software for ARM processor, Understand ARM processor and Building Blocks of Embedded Systems  
CO2: Understand the data acquisition system.  
CO3: Acquire Knowledge on sensor interfacing with Arduino  
CO4: Analyze various protocols for IoT,  
CO5: Build various applications in healthcare using IOT based approach and substantiate the same with appropriate

TOTAL:75 PERIODS

REFERENCES:  
2. Getting Started with Internet of Things- CunoPfister, 2011  
4. Interconnecting Smart Objects with IP- J. P Vasseur, Adam Dunkels, 2010 24 Course

BM4151 BIO SIGNAL PROCESSING L T P C
3 0 0 3

COURSE OBJECTIVES:
- To introduce the characteristics of different biosignals
- To discuss linear and non-linear filtering techniques to extract desired information
- To demonstrate the significance of wavelet detection applied in biosignal processing.
- To extract the features from the biosignal
- To introduce techniques for automated classification and decision making to aid diagnosis

UNIT I SIGNAL, SYSTEM AND SPECTRUM

UNIT II TIME SERIES ANALYSIS AND SPECTRAL ESTIMATION

UNIT III ADAPTIVE FILTERING AND WAVELET DETECTION
Filtering – LMS adaptive filter, adaptive noise cancelling in ECG, improved adaptive filtering in FECG, EEG and other applications in Bio signals, Wavelet detection in ECG – structural features, matched filtering, adaptive wavelet detection, detection of overlapping wavelets.

UNIT IV ANALYSIS OF BIOSIGNAL
Removal of artifact – ECG, Event detection –ECG, P Wave, QRS complex, T wave, Correlation analysis of ECG signals, Average of Signals-PCG, ECG and EMG.

UNIT V BIOSIGNAL CLASSIFICATION AND RECOGNITION
Statistical signal classification, linear discriminate function, direct feature selection and ordering, Back propagation neural network based classification.
Case study: 1. Various methods used to extract features from EEG signal
Case Study 2: Diagnosis and monitoring of sleep apnea

COURSE OUTCOMES:
Upon Completion of the course, the students will be able to:
CO1: Analyse the different types of signals & systems
CO2: Analyse signals in time series domain & estimate the spectrum
CO3: Understand the significance of wavelet detection applied in biosignal processing
CO4: Extract the features from biosignal
CO5: Describe the performance of the classification of biosignals

TOTAL: 45 PERIODS

REFERENCES:
5. Willis J. Tompkins, Biomedical Digital Signal Processing, Prentice Hall of India, New Delhi, 2006

BM4152  HUMAN ANATOMY AND PHYSIOLOGY L T P C

3 0 0 3

COURSE OBJECTIVES:
- To identify all the organelles of an animal cell and their function.
- To understand the structure and functions of the different types of systems of the human body.
- To understand about sensory organs and accessory organs of human being
- To demonstrate their knowledge of importance of anatomical features and physiology of human systems
- Gain knowledge in regulatory mechanism of human body

UNIT I ORGANIZATION OF THE HUMAN BODY 8

UNIT II INTEGUMENTARY, SKELETAL, MUSCULAR AND RESPIRATORY SYSTEMS 9

UNIT III CARDIOVASCULAR, LYMPHATIC AND ENDOCRINE SYSTEMS 10
UNIT IV  
NERVOUS, SENSE ORGANS AND REPRODUCTIVE SYSTEMS

UNIT V  
DIGESTIVE AND URINARY SYSTEMS

COURSE OUTCOMES:
Upon Completion of the course, the students will be able to:
CO1: Explain the general terminology, cell structure and function, histology, gross anatomy, and physiology related to the various human systems
CO2: Acquire knowledge various anatomical parts of the human systems
CO3: Understand about interconnectedness of anatomy and physiology of various systems
CO4: Acquire knowledge in human organ systems interrelation and apply a holistic approach to human health.
CO5: Apply concept and knowledge of human systems to novel technical and/or clinical scenarios

REFERENCES:

MX4111  
BIOMEDICAL INSTRUMENTATION LABORATORY

COURSE OBJECTIVES:
- Familiarize the preamplifiers and signal conditioning circuits for ECG acquisition.
- Understand the designing of amplifiers for acquiring bio signals like EEG, EOG, and EMG.
- Study the concept of designing an isolation amplifier.
- Learn the different measurement techniques for non-electrical parameters.
- Design the PCB layout for any bio amplifier.

LIST OF EXPERIMENTS:
1. Design of pre amplifiers to acquire bio signals along with impedance matching circuit using suitable IC’s.
2. Design of ECG Amplifiers with appropriate filter to remove power line and other artefacts.
3. Design of EMG amplifier.
4. Design a suitable circuit to detect QRS complex and measure heart rate.
5. Design of frontal EEG amplifier.
6. Design of EOG amplifier to detect eye blink.
7. Design a right leg driven ECG amplifier.
8. Design a Pulse Oximeter and Measure O2 Saturation and HR
9. Design and study the characteristics of optical Isolation amplifier.
14. Design a PCB layout for any bio amplifier using suitable software tool.

COURSE OUTCOMES:
Upon completion of this course the students will be able to

CO1: Design and implement preamplifiers and signal conditioning circuits for ECG signal acquisition.
CO2: Design and implement amplifiers for different bio signals like EEG, EOG, EMG.
CO3: Design an optical isolation amplifier
CO4: Acquire various non-electrical parameters using suitable sensors/transducers.
CO5: Implement PCB layout for any bio amplifier.

TOTAL:45 PERIODS

BM4161 BIO SIGNAL PROCESSING LABORATORY

COURSE OBJECTIVES:
- To understand the analysis of biosignals
- To know the various methods for denoising of biosignals.
- To understand the extraction of features in biosignals
- To gain knowledge about biosignal compression.
- To detect and classify the abnormalities in biosignals

LIST OF EXPERIMENTS: MATLAB / EQUIVALENT SOFTWARE PACKAGE
1. Removal of noise and artifact using filtering
2. Denoising of biosignals using wavelets
3. Noise cancellation using Adaptive filters
4. QRS detection using Pan-Tompkins algorithm
5. Heart rate variability analysis in ECG signals
6. Event detection in EEG signals
7. Cepstral analysis of speech signals
8. Multiresolution analysis of EEG signal using wavelet transform
9. Feature extraction in EMG signals
10. Adaptive segmentation of EEG signals
11. Feature reduction using PCA
12. Disease classification of biosignals
13. Autoregressive modelling of biosignals
14. Biosignal compression
15. Biosignal analysis in virtual instrumentation platform

15
COURSE OUTCOMES:
On completion of the laboratory course, the students will be able to:
CO1: Develop an algorithm for preprocessing of biosignals.
CO2: Perform denoising and analyze the spectral characteristics of biosignals.
CO3: Perform biosignal compression.
CO4: Analyze the biosignals in virtual instrumentation platform

TOTAL: 45 PERIODS

MX4291 MEDICAL IMAGE PROCESSING L T P C
3 0 2 4

COURSE OBJECTIVES:
- To understand the fundamentals of medical image processing techniques.
- To understand the basic concepts of image enhancement, image restoration, morphological image processing, image segmentation, feature recognition in medical images
- To provide information about various medical imaging modalities
- To provide information about classification and image visualization in medical image processing projects.
- To familiarize the student with the image processing facilities in Matlab, Python and openCV

UNIT I FUNDAMENTALS OF IMAGE PROCESSING 9
Image perception, MTF of the visual system, Image fidelity criteria, Image model, Image sampling and quantization – two dimensional sampling theory, Image quantization, Optimum mean square quantizer, Image transforms – 2D-DFT and other transforms. DFT, DCT, KLT, SVD

UNIT II MEDICAL IMAGE ENHANCEMENT AND RESTORATION 9
Image Enhancement operation, Noise distributions, Spatial averaging, Directional Smoothing, Median, Geometric mean, Harmonic mean, Contra harmonic mean filters, Homomorphic filtering, Color image enhancement. Image Restoration - degradation model, Unconstrained and constrained restoration, Inverse filtering- Wiener filtering

UNIT III MEDICAL IMAGE REPRESENTATION 9
Pixels and voxels – algebraic image operations - gray scale and color representation- depth-color and look up tables - image file formats- DICOM- other formats- Analyze 7.5, NifTI and Interfile, Image quality and the signal to noise ratio

UNIT IV MEDICAL IMAGE ANALYSIS AND CLASSIFICATION 9
Image segmentation- pixel based, edge based, region based segmentation. Image representation and analysis, Feature extraction and representation, Statistical, Shape, Texture, feature and image classification – Statistical, Rule based, Neural Network approaches

UNIT V IMAGE REGISTRATIONS AND VISUALIZATION 9
Image Registration: Rigid body transformation – Affine transformation, Principal axes registration, Iterative principal axes registration, Feature based registration, Elastic deformation based registration, Registration of Images from Different modalities, Evaluation of Registration Methods. Image visualization: 2-D display methods, 3-D display methods,
surface and volume based 3-D display methods – Surface Visualization and Volume visualization, 3-D Echocardiography, 3D+time Echocardiography, virtual reality based interactive visualization.

**PRACTICAL EXERCISES:**
45 PERIODS
30 PERIODS
The following experiments should be performed in OpenCV / Python / Scilab / Matlab Octave / other Open source software.

**LIST OF EXPERIMENTS**
1. Preprocessing of medical images
2. Filtering of medical images.
3. Edge detection using Python
4. Segmentation of ROI in medical images.
5. Feature extraction in medical images
6. Steganography using OpenCV.
7. Medical image fusion.
8. Statistical analysis of features

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

- **CO1:** Apply basic medical image processing algorithms
- **CO2:** Image pre-processing applications that incorporates different concepts of filters for medical Image Processing and reconstruction of an image
- **CO3:** Describe the image representation model
- **CO4:** Analysis of image segmentation, feature extraction and image classification
- **CO5:** Explore the knowledge in image registration and visualization and possibility of applying Image processing concepts in modern hospitals

**TOTAL:** 75 PERIODS

**REFERENCES**
COURSE OBJECTIVES:
- To explore the concepts in designing power systems for medical electronics.
- To understand the essential circuitry needed for sensor design.
- To develop an understanding of data acquisition system design.
- To provide knowledge about noise cancellation system.
- To gain necessary knowledge about the hardware implementation of DSP.

UNIT I DESIGN OF POWER SUBSYSTEMS IN MEDICAL ELECTRONICS
9
Transient voltage protections- Electromagnetic interference- Inrush current control-
Overvoltage protection- Under voltage protection- Overload protection- Output filtering- Power
failure warning- Flightback switch back power supplies- Half-bridge Flyback converters

UNIT II SENSOR DESIGN FUNDAMENTALS
9
Sensor parameters- Sensor Interfacing- Signal conditioning amplifiers- Instrumentation
amplifiers- Isolation amplifiers- Charge-coupled device sensors- Position and motion sensors-
Accelerometers- Temperature sensors- Fiber optics based medical sensors

UNIT III DATA ACQUISITION SYSTEMS
9
Sample and hold conversion- Multichannel acquisition- High speed sampling in ADC- Selection
of drive amplifier for ADC performance- Driving ADCs with switched capacitor inputs- ADC
input protection- External protection of amplifiers- High speed ADC architectures

UNIT IV NOISE AND INTERFERENCE ISSUES IN ANALOG CIRCUITS
9
Noise calculations in Op-Amp- Internal noise in Op-Amps- Proper power supply decoupling-
Bypass capacitors and resonances- Designing power bus rails in power-ground planes for
noise control- ASIC

UNIT V HARDWARE APPROACH TO DIGITAL SIGNAL PROCESSING
9
DSP hardware- Arithmetic logic unit- Multiplier-accumulator- Shifter- Data address generators-
Program sequencer- Serial ports- Interfacing ADCs and DACs to digital signal processors-
Parallel ADCs o DSP interface- Parallel DAC to DSP interface- Serial interfacing to DSP
processors

COURSE OUTCOMES:
CO1: Understand the power systems used in the design of medical electronics devices
CO2: Classify the biosensors design according the type of device
CO3: Interpret the data acquired from the sensors.
CO4: Enumerate the noise and interference issues in the devices
CO5: Understand the signal processing of the medical electronic device

REFERENCES
1. Kunal Pal, Heinz-Bernhard Kraatz, Anwesha Khasnobish, Bioelectronic and medical

MX4202 MEDICAL IMAGING SYSTEMS AND RADIO THERAPY

COURSE OBJECTIVES:
- To understand the production of x-rays and its application to different medical Imaging
- To explore the different types of Radio diagnostic techniques.
- To understand the special imaging techniques for visualizing the cross sections of the body.
- To understand the production of Magnetic resonance images for various pulse sequences.
- To realize the importance of image quality assessments for medical imaging systems.

UNIT I X – RAYS

UNIT II CT AND ULTRASOUND IMAGING
CT principle- Multi section Radiography, Computerized Axial Tomography, Type of Detection, image reconstruction, Spiral CT, Transverse Tomography,3D Imaging. Ultrasonic frequency for medical application, different modes of Display A, B and M, ultrasonic probes, Real time echo and 2D scanner.

UNIT III COMPUTER AIDED TOMOGRAPHY
Need for sectional images, Principles of sectional scanning, Method of convolution and Back Propagation, Methods of reconstruction, Multislice CT, artifacts.

UNIT IV MAGNETIC RESONANCE IMAGING AND EMISSION COMPUTED TOMOGRAPHY IMAGING
Principle of MRI, MRI instrumentation, Imaging Different Sections of the Body, Tissue Characterization, MR Spectroscopy, Functional MRI. Alpha, Beta, Gamma Emission, different types of Radiation Detectors, Functions of Gamma Camera, PET, SPECT, PET/CT, PET/MRI.

UNIT V QUALITY METRICS FOR IMAGING SYSTEMS

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On successful completion of this course, the student will be able to
CO1: Explain the functionalities and applications of X ray in medicine.
CO2: Demonstrate the images acquisition procedures using CT.
CO3: Explain the suitable projection methods for anatomy and biology specific.
CO4: Demonstrate the applications of magnetic fields in the field of medicine.
CO5: Explain the assessment method to quantify the presence of noise in the image.

REFERENCES

BM4251 AI AND MACHINE LEARNING

COURSE OBJECTIVES:
- To introduce the concept of machine learning
- To learn and apply neural networks for pattern classification and regression problems
- To introduce the ideas of fuzzy sets, fuzzy logic
- To familiarize with genetic algorithms for seeking global optimum in self-learning situations
- To introduce the Deep learning concept for medical image analysis

UNIT I INTRODUCTION TO MACHINE LEARNING

UNIT II NEURAL NETWORKS

UNIT III FUZZY LOGIC SYSTEMS
Fuzzy Logic System: Basic of fuzzy logic theory, crisp and fuzzy sets, Basic set operation like union, interaction, complement, T-norm, T-conorm, fuzzy relations, fuzzy if-then rules, fuzzy reasoning, Neuro-Fuzzy Modeling: Adaptive Neuro-Fuzzy Inference System (ANFIS), ANFIS architecture, Hybrid Learning Algorithm

UNIT IV EVOLUTIONARY COMPUTATION & GENETIC ALGORITHMS

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.

45 PERIODS
PRACTICAL EXERCISES: 30 PERIODS
1. Implement Simple Programs like vector addition in TensorFlow.
2. Implement a simple problem like regression model in Keras.
4. Implement a Feed-Forward Network in TensorFlow/Keras.
5. Implement an Image Classifier using CNN in TensorFlow/Keras.
6. Develop an abnormal detection system for bio signal data using fuzzy logic.
7. Develop a system to implement Neural Networks techniques to define predictive models for Abnormal detection.
8. Develop a system that can optimize the solution of the abnormal detection system developed by fuzzy logic.
9. Implement a biosignal/medical image Classifier using CNN.

COURSE OUTCOMES:
On completion of this course the student will be able to:
CO1: Identify and describe machine learning techniques and their roles in building intelligent system
CO2: Design neural networks for pattern classification and regression problems
CO3: Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems.
CO4: Apply genetic algorithms to optimization problems.
CO5: Apply Deep learning concept for biomedical signal analysis and Medical image analysis

TOTAL: 75 PERIODS
REFERENCES

MX4211 MEDICAL ELECTRONICS DEVICE DESIGN LABORATORY
L T P C
0 0 4 2
COURSE OBJECTIVES
- To understand the production of x-rays and its application to different medical Imaging
- To explore the different types of Radio diagnostic techniques.
- To understand the special imaging techniques for visualizing the cross sections of the body.
- To understand the production of Magnetic resonance images for various pulse sequences.
- To realize the importance of image quality assessments for medical imaging systems.
LIST OF EXPERIMENTS:
1. Simulation of over voltage protection circuit
2. Simulation of under voltage protection circuit
3. Simulation of instrumentation amplifier
4. Accelerometer data acquisition and displaying system
5. Multichannel data acquisition for EEG recording
6. Simulation of switched capacitor system
7. Modeling and simulation of internal noise cancellation circuit.
8. Cross talk cancellation system
9. Serial Interfacing to DSP
10. Parallel interfacing to DSP

TOTAL: 60 PERIODS

COURSE OUTCOMES:
On successful completion of this course, the student will be able to:
CO1: Explain the functionalities and applications of X ray in medicine.
CO2: Demonstrate the images acquisition procedures using CT.
CO3: Explain the suitable projection methods for anatomy and biology specific.
CO4: Demonstrate the applications of magnetic fields in the field of medicine.
CO5: Explain the assessment method to quantify the presence of noise in the image.

MX4212  TERM PAPER WRITING AND SEMINAR

In this course, students will develop their scientific and technical reading and writing skills that they need to understand and construct research articles. A term paper requires a student to obtain information from a variety of sources (i.e., Journals, dictionaries, reference books) and then place it in logically developed ideas. The work involves the following steps:

1. Selecting a subject, narrowing the subject into a topic
2. Stating an objective.
3. Collecting the relevant bibliography (atleast 15 journal papers)
4. Preparing a working outline.
5. Studying the papers and understanding the authors contributions and critically analysing each paper.
6. Preparing a working outline
7. Linking the papers and preparing a draft of the paper.
8. Preparing conclusions based on the reading of all the papers.
9. Writing the Final Paper and giving final Presentation

Please keep a file where the work carried out by you is maintained.
Activities to be carried out

<table>
<thead>
<tr>
<th>Activity</th>
<th>Instructions</th>
<th>Submission week</th>
<th>Evaluation</th>
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<tr>
<td>Selection of area of interest and</td>
<td>You are requested to select an area of interest, topic and state an objective</td>
<td>2nd week</td>
<td>3 % Based on clarity of</td>
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<tr>
<td>Topic</td>
<td>thought, current relevance and clarity in writing</td>
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<tr>
<td>Stating an Objective</td>
<td>3rd week</td>
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<tr>
<td>Collecting Information about your area &amp; topic</td>
<td>3% (the selected information must be area specific and of international and national standard)</td>
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1. List 1 Special Interest Groups or professional society  
2. List 2 journals  
3. List 2 conferences, symposia or workshops  
4. List 1 thesis title  
5. List 3 web presences (mailing lists, forums, news sites)  
6. List 3 authors who publish regularly in your area  
7. Attach a call for papers (CFP) from your area.

Collection of Journal papers in the topic in the context of the objective – collect 20 & then filter

- You have to provide a complete list of references you will be using- Based on your objective -Search various digital libraries and Google Scholar  
  - When picking papers to read - try to:  
    - Pick papers that are related to each other in some ways and/or that are in the same field so that you can write a meaningful survey out of them,  
    - Favour papers from well-known journals and conferences,  
    - Favour “first” or “foundational” papers in the field (as indicated in other people’s survey paper),  
    - Favour more recent papers,  
    - Pick a recent survey of the field so you can quickly gain an overview,  
    - Find relationships with respect to each other and to your topic area (classification scheme/categorization)  
  - Mark in the hard copy of papers whether complete work or section/sections of the paper are being considered

Reading and notes for first 5 papers

- For each paper form a Table answering the following questions:  
  - What is the main topic of the article?  
  - What was/were the main issue(s) the author said they want to discuss?  
  - Why did the author claim it was

Reading Paper Process

- In the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper

4th week

5th week

6th week
<table>
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<th>Reading and notes for next 5 papers</th>
<th>Repeat Reading Paper Process</th>
<th>6th week</th>
<th>8% (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)</th>
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<tbody>
<tr>
<td>Reading and notes for final 5 papers</td>
<td>Repeat Reading Paper Process</td>
<td>7th week</td>
<td>8% (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)</td>
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<td>Draft outline 1 and Linking papers</td>
<td>Prepare a draft Outline, your survey goals, along with a classification / categorization diagram</td>
<td>8th week</td>
<td>8% (this component will be evaluated based on the linking and classification among the papers)</td>
</tr>
<tr>
<td>Abstract</td>
<td>Prepare a draft abstract and give a presentation</td>
<td>9th week</td>
<td>6% (Clarity, purpose and conclusion) 6% Presentation &amp; Viva Voce</td>
</tr>
<tr>
<td>Introduction Background</td>
<td>Write an introduction and background sections</td>
<td>10th week</td>
<td>5% (clarity)</td>
</tr>
<tr>
<td>Sections of the paper</td>
<td>Write the sections of your paper based on the classification / categorization diagram in keeping with the goals of your survey</td>
<td>11th week</td>
<td>10% (this component will be evaluated based on the linking and classification among the papers)</td>
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<tr>
<td>Your conclusions</td>
<td>Write your conclusions and future work</td>
<td>12th week</td>
<td>5% (conclusions – clarity and your ideas)</td>
</tr>
<tr>
<td>Final Draft</td>
<td>Complete the final draft of your paper</td>
<td>13th week</td>
<td>10% (formatting, English, Clarity and linking)</td>
</tr>
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<td>4% Plagiarism Check Report</td>
</tr>
<tr>
<td>Seminar</td>
<td>A brief 15 slides on your paper</td>
<td>14th &amp; 15th week</td>
<td>10% (based on presentation and Viva-voce)</td>
</tr>
</tbody>
</table>

TOTAL: 30 PERIODS

MX4001  NANOTECHNOLOGY AND ITS APPLICATIONS  L T P C  3 0 0 3

COURSE OBJECTIVES:
- To understand the essential features of biology and nanotechnology that are converging to create the new areas of bio nanotechnology 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 nano centric applications

UNIT I  INTRODUCTION OF NANOPARTICLES  9
Overview of nanotechnology from a medical perspective, different types of nanobiomaterials and nanostructure interactions. Synthesis and characterization of smart nanomaterials, surface modification, biofunctionalization of nanomaterials.

UNIT II  NANOMATERIALS AND NANOENGINEERING  9
Lipid- based (liposomes, micelles, solid lipid nanoparticles) and magnetic based particles and their delivery for biomedical applications. Inorganic nanoparticles, carbon- based (fullerenes, buckyballs and carbon nanotubes), biodistribution and its fate.

UNIT III  NANOTECHNOLOGY IN DRUG DELIVERY  9
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 NANOTECHNOLOGY IN IMAGING, DIAGNOSTIC AND DETECTION
Nuclear imaging systems –SPECT and PET, advanced MR imaging, optical imaging and CT. Ultrasound imaging and therapy, nanomaging systems, micro/nano fluidics, diagnostics, and biosensors.

UNIT V APPLICATION IN CANCER THERAPY

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.

TOTAL: 45 PERIODS

REFERENCES
2. Nicholas A. Kotov, Nanoparticle Assemblies and Superstructures. 2006 -CRC.

MX4002 BIOMECHANICS

COURSE OBJECTIVES:
- To get a clear understanding of the 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 accidents and injuries.

UNIT I INTRODUCTION
Introduction to biomechanics, relation between mechanics and Medicine, Newton's laws, stress, strain, shear rate, viscosity, viscoelasticity, 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 microvessels, dynamics of circulatory system, turbulence flow around prosthetic heart valves.

UNIT III MECHANICS APPLIED TO ORTHOPEDICS 9

UNIT IV MECHANISM OF BIOLOGICAL SYSTEMS 9
Skeletal muscles servo mechanism, Cardiovascular control mechanism, respiratory control mechanism, Finite element analysis in Biomechanics - case study.

UNIT V BIOMECHANICAL ASPECT OF ACCIDENT INVESTIGATION 9
Experimental and Analytical method of analysis, Clinical evaluation, Head Injury tolerance, rotational injury, spine injury – Accident reconstruction, Analysis of impact, skid analysis – Damage analysis.

COURSE OUTCOMES: On completion of this course the student will be able to:
CO1: To get a 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

TOTAL: 45 PERIODS

REFERENCES
4. C.R Ethier and C.A.Simmons, Biomechanics from cells to organisms,
5. D.Dawson and Right, Introduction to Biomechanics of joints and joint replacement, Mechanical Engineering, publications Ltd. 1989
COURSE OBJECTIVES:
- To understand the basics of Biometrics and its functionalities
- To learn the role of physiological traits in biometrics
- To identify the concept of behavioral traits
- To expose the user interface in context of Biometric Applications
- To learn to develop applications with biometric security

UNIT I INTRODUCTION
Biometrics versus traditional techniques, Characteristics, Processes, Performance measures, Assessing the privacy risks of biometrics - Designing privacy sympathetic biometric systems, Biometric standards, Applications and properties, Biometrics in medicine.

UNIT II PHYSIOLOGICAL TRAITS
Face, Ear, Retina, Iris, Finger, Automated fingerprint identification system, Palm print, Hand vascular geometry analysis, , Dental, Cognitive Biometrics: ECG, EEG

UNIT III BEHAVIORAL TRAITS
Signature, Keystroke, Voice, Gait, Gesture recognition, Video face, Mapping the body technology, Case Study.

UNIT IV USER INTERFACE
Biometric interfaces: Human machine interface - Iris image interface - Hand geometry and fingerprint sensor, - Securing Biometric templates - Cancellable biometrics

UNIT V APPLICATION AREAS
Surveillance applications- personal applications –design and deployment -user system interaction-operational processes – architecture –application development –design validation disaster recovery plan-maintenance-privacy concerns

COURSE OUTCOMES:
CO1: Knowledge on the general principles of design of biometric systems and the underlying trade-offs
CO2: Identify the technologies of fingerprint, iris, face and speech recognition
CO3: Understand the various Behavioral Biometrics.
CO4: Enumerate the user interfaces
CO5: Inculcate knowledge on personal privacy and security implications of biometrics based identification technology and the issues involved.

REFERENCES
COURSE OBJECTIVES:
- To introduce concepts of materials and interaction of surfaces 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
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
Sterilization techniques: Process and mechanism of action of steam sterilization, radiation sterilization, electron beam sterilization, ethylene oxide, chlorine dioxide and plasma gas sterilization

UNIT IV  TESTING OF MATERIALS

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

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 them in designing a device

CO3: Select the materials for designing an implant in tissue replacement

CO4: Identify significant gaps required to overcome challenges and further developments

CO5: Critically review papers from the scientific journals and identify areas of research opportunities

TOTAL: 45 PERIODS

REFERENCES
3.  Jacob Cline, HandBook of BioMedical Engineering, Academic Press in Sandiego,

MX4072 MEDICAL OPTICS L T P C
3 0 0 3

COURSE OBJECTIVES:
- To understand various optical properties of tissue
- To gain the knowledge of photonics instruments
- To know the engineering and practical applications of optics related to diagnostics applications
- To acquire knowledge about therapeutic and surgical applications of lasers in medical fields
- To gain the knowledge of fiber optic sensors used in medical application

UNIT I OPTICAL PROPERTIES OF THE TISSUES
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 II INSTRUMENTATION IN PHOTONICS
Review of basic properties of light – Reflection, Refraction, Scattering, fluorescence and phosphorescence. Instrumentation for absorption, scattering and emission measurements. Optical sources – high pressure arc lamps, LEDs, Medical Lasers. Optical filters. Optical detectors - Time resolved and phase resolved detectors, optical tweezers

UNIT III DIAGNOSTIC APPLICATIONS
Wood’s lamp, Imaging techniques - Optical coherence tomography, Elastography, Fluorescence Imaging, Raman Imaging, FLIM, FRAP, NIRS-Application, X-Ray Diagnostic Techniques, Speckle Correlometry, Near-Field Imaging in Biological and Biomedical Applications

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

UNIT V FIBER OPTIC SENSORS AND APPLICATIONS
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

COURSE OUTCOMES:
On completion of this course the student will be able to:
CO1: Understand various optical properties of tissue
CO2: Describe the photonics instruments
CO3: Know the diagnostic applications of lasers in medical fields
CO4: Explain the therapeutic and surgical applications of lasers in medical fields
CO5: Describe the types of fiber optic sensors used in medical application

TOTAL: 45 PERIODS

REFERENCES

MX4071 HUMAN ASSIST DEVICES

COURSE OBJECTIVES:
- To know the principle and design of Heart lung machine and artificial heart
- To acquire knowledge of various cardiac assist devices,
- To study implantation of artificial kidney
- To understand the principle of prosthetic and orthotic devices for the disability
- To Gain knowledge in respiratory devices and hearing aids

UNIT I HEART LUNG MACHINE AND ARTIFICIAL HEART
Condition to be satisfied by the H/L System. Different types of Oxygenators, Pumps, Pulsatile and Continuous Types, Monitoring Process, Shunting, The Indication for Cardiac Transplant, Driving Mechanism, Blood Handling System, Functioning and different types of Artificial Heart, Mock test setup for assessing its Functions

UNIT II CARDIAC ASSIST DEVICES
Synchronous Counter pulsation, Assisted through Respiration Right Ventricular Bypass Pump, Left Ventricular Bypass Pump, Open Chest and closed Chest type, Intra Aortic Balloon Pumping Veno Arterial Pumping, Prosthetic Cardiac Valves, Principle and problem, Biomaterials for implantable purposes, its characteristics and testing.

UNIT III ARTIFICIAL KIDNEY
Indication and Principle of Haemodialysis, Membrane, Dialysate, Different types of hemodialyzers, Monitoring Systems, Wearable Artificial Kidney, Implanting Type
UNIT IV  PROSTHETIC AND ORTHOTIC DEVICES  9

UNIT V  RESPIRATORY AND HEARING AIDS  9
Ventilator and its types-Intermittent positive pressure, Breathing Apparatus Operating Sequence, Electronic IPPB unit with monitoring for all respiratory parameters. Types of Deafness, Hearing Aids, Construction and Functional Characteristics

TOTAL:45 PERIODS

COURSE OUTCOMES:
CO1: Knowledge about the importance of Heart lung machine and artificial Heart
CO2: Knowledge about the importance of different types of assist devices and related issues
CO3: Understand about the implantation of artificial kidney
CO4: Explore the different types of models for Prosthetic and orthotic purpose
CO5: Perceive the knowledge in different types of respiratory and hearing aids

REFERENCES

BM4074  WEARABLE TECHNOLOGIES  L T P C  3 0 0 3

COURSE OBJECTIVES:
• Identify the motivation, guiding principles, and challenges of Wearable Computing.
• Develop skills pertaining to the design of a holistic interactive wearable system comprising of the physical, digital, and the human aspects.
• To provide the basic understanding of measurement and instrumentation systems and the insight of the resistive sensors and its applications in real life..
• To introduce the concept of the reactive sensors and self-generating sensors and its applications in real life
• To impart the importance of smart sensors, sensor interface standards for wearable device applications and to provide a brief overview of the wearable technology and its impact on social life

UNIT I  INTRODUCTION  9
Attributes of wearables, Meta-wearable, Challenges and opportunities, Future of wearables -

UNIT II WEARABLE SENSORS
Chemical and Biochemical sensors, System design, Challenges in chemical Bio-chemical sensing, Application areas - Inertia sensors, Parameters from inertia sensors - Applications for wearable motion sensors - Measurement of energy expenditure by body worn heat flow sensors.

UNIT III FLEXIBLE ELECTRONICS

UNIT IV ENERGY HARVESTING SYSTEMS

UNIT V MONITORING PHYSICAL AND PHYSIOLOGICAL PARAMETERS
Wearable sensors for physiological signal measurement - Physical measurement: Cardiovascular diseases, Neurological diseases, Gastrointestinal diseases - Wearable and non-invasive assistive technologies: Assistive devices for individuals with severe paralysis, Wearable tongue drive system, Sensor signal-processing algorithm, Dual-mode tongue drive system.

COURSE OUTCOMES:
CO1: Understand the fundamentals of wearables, wearable design issues and user interfaces
CO2: Identify the different types of sensors used in wearable devices
CO3: Recognize the materials used in the field of flexible electronics technology and its power constraints
CO4: Summarize the techniques and issues associated with energy harvesting from human body
CO5: Elucidate the applications of wearable technology in health care

TOTAL: 45 PERIODS

REFERENCES
COURSE OBJECTIVES:
The objective of this course is to enable the student to
- Understand the basic concepts of brain computer interface.
- Explore the various signal acquisition methods.
- Understand the signal processing methods used in BCI.
- Understand the various machine learning methods of BCI.
- Learn the various applications of BCI.

UNIT I INTRODUCTION TO BCI
Introduction - Brain structure and function, Brain Computer Interface Types - Synchronous and Asynchronous - Invasive BCI - Partially Invasive BCI - Non Invasive BCI, Structure of BCI System, BCI Monitoring Hardware, EEG, MEG, fMRI.

UNIT II BRAIN ACTIVATION

UNIT III FEATURE EXTRACTION METHODS
Data Processing – Spike sorting, Frequency domain analysis, Wavelet analysis, Time domain analysis, Spatial filtering - Principal Component Analysis (PCA), Independent Component Analysis (ICA), Artefacts reduction, Feature Extraction - Phase synchronization.

UNIT IV MACHINE LEARNING METHODS FOR BCI
Classification techniques – Binary classification, Multiclass Classification, Evaluation of classification performance, Regression - Linear, Polynomial, RBF’s, Support vector machine, Graph theoretical functional connectivity analysis.

UNIT V APPLICATIONS OF BCI
Case Studies - Invasive BCIs: decoding and tracking arm (hand) position, controlling prosthetic devices such as orthotic hands, Cursor and robotic control using multi electrode array implant, Cortical control of muscles via functional electrical stimulation. Ethics of Brain Computer Interfacing.

COURSE OUTCOMES
On successful completion of this course, the student will be able to
- Evaluate concept of BCI.
- Describe the different brain activation signals.
- Select appropriate feature extraction methods.
- Use machine learning algorithms for translation.
- Develop high-fidelity BCI prototypes.

REFERENCE BOOKS:

BM4091 GENETIC ALGORITHMS AND FUZZY LOGICS L T P C

COURSE OBJECTIVES:
- To provide basic knowledge about the fundamentals of genetic algorithm
- To familiarize with the ant colony and particle swarm optimization techniques
- To learn the basics of fuzzy logic
- To enrich the students knowledge with fuzzy systems and its applications
- To lean the neuro fuzzy system and fuzzy logic controller

UNIT I GENETIC ALGORITHMS
Introduction, Building block hypothesis, working principle, Basic operators and Terminologies like individual, gene, encoding, fitness function and reproduction, Genetic modeling: Significance of Genetic operators, Inheritance operator, cross over, inversion & deletion, mutation operator, Bitwise operator, GA optimization problems, Applications of GA.

UNIT II OTHER OPTIMIZATION TECHNIQUES

UNIT III FUZZY LOGIC

UNIT IV FUZZY RULE BASED SYSTEM

UNIT V ADVANCES AND APPLICATIONS
Case studies: Fuzzy logic control of Blood pressure during Anaesthesia, Fuzzy logic application to Biosignals and medical Image processing, Adaptive fuzzy system. Introduction to Neuro-fuzzy logic

COURSE OUTCOMES:
CO1: Apprehend the principles of genetic algorithms as well as techniques used in its implementation.
CO2: Apply the optimization algorithms for real time applications
CO3: Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems.
CO4: Design a fuzzy rule based system for biomedical application
CO5: Apply the fuzzy controller for resulting the blood pressure

TOTAL:45 PERIODS

REFERENCES

MX4073 MEDICAL ROBOTICS

COURSE 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
- To explore various applications of Robots in Medicine
- To impart knowledge on wearable robots

UNIT I INTRODUCTION TO ROBOTICS
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
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
Da Vinci Surgical System, Image guided robotic systems for focal ultrasound based surgical applications, System concept for robotic Tele-surgical system for off-pump, CABG surgery, Urologic applications, Cardiac surgery, Neuro-surgery, Pediatric and General Surgery, Gynecologic Surgery, General Surgery and Nanorobotics. Case Study

36
UNIT IV  REHABILITATION AND ASSISTIVE ROBOTS
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
Augmented Reality, Kinematics and Dynamics for Wearable Robots, Wearable Robot technology, Sensors, Actuators, Portable Energy Storage, Human–robot cognitive interaction (cHRI), Human–robot physical interaction (pHRI), Wearable Robotic Communication - case study

COURSE OUTCOMES:
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

REFERENCES

BD4251  BIG DATA MINING AND ANALYTICS

COURSE OBJECTIVES:
• To understand the computational approaches to Modeling, Feature Extraction
• To understand the need and application of Map Reduce
• To understand the various search algorithms applicable to Big Data
• To analyse and interpret streaming data
• To learn how to handle large data sets in main memory and learn the various clustering techniques applicable to Big Data

UNIT I  DATA MINING AND LARGE SCALE FILES  9

UNIT II  SIMILAR ITEMS  9

UNIT III  MINING DATA STREAMS  9

UNIT IV  LINK ANALYSIS AND FREQUENT ITEMSETS  9

UNIT V  CLUSTERING  9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to

CO1: Design algorithms by employing Map Reduce technique for solving Big Data problems.
CO2: Design algorithms for Big Data by deciding on the apt Features set.
CO3: Design algorithms for handling petabytes of datasets.
CO4: Design algorithms and propose solutions for Big Data by optimizing main memory consumption.
CO5: Design solutions for problems in Big Data by suggesting appropriate clustering techniques.

REFERENCES:
WEB REFERENCES:
1. https://swayam.gov.in/nd2_arp19_ap60/preview

ONLINE RESOURCES:
1. https://examupdates.in/big-data-analytics/

BM4072 REHABILITATION ENGINEERING L T P C 3 0 0 3

COURSE OBJECTIVES:
- To learn the basics of rehabilitation engineering
- To study about principle of rehabilitation engineering
- To understand different types of Therapeutic Exercise Technique.
- To understand the tests to assess the hearing loss and development techniques of electronic devices for visually and auditory impaired
- To study about various orthopaedic devices and prosthetic devices

UNIT I INTRODUCTION TO REHABILITATION 9
Rehabilitation: Epidemiology of Rehabilitation, Health, Levels of Prevention, Preventive Rehabilitation, Diagnosis of Disability, Functional Diagnosis, Importance of Psychiatry in Functional diagnosis, Impairment disability handicap, Primary & secondary Disabilities, Rehabilitation team Classification of members, The Role of Psychiatrist, Occupational therapist, Physical therapist, Recreation therapist, Prosthetist - Orthotist, Speech pathologist, Rehabilitation nurse, Social worker, Corrective therapist, Psychologist, Music therapist, Dance therapist & Biomedical engineer

UNIT II PRINCIPLE OF REHABILITATION 9

UNIT III THERAPEUTIC EXERCISE TECHNIQUE 9

UNIT IV MANAGEMENT OF COMMUNICATION & VIRTUAL REALITY 9
Impairment-introduction to communication, Aphasia, Types of aphasia, Treatment of aphasic patient, Augmentative communication-general form of communication, types of visual aids, Hearing aids, Types of conventional hearing aid, Writing aids. Introduction to virtual reality, Virtual reality based rehabilitation, Hand motor recovery systems with Phantom haptics, Robotics and Virtual Reality Applications in Mobility Rehabilitation.

UNIT V ORTHOTIC, PROSTHETIC DEVICES & RESTORATION TECHNIQUES 9
General orthotics, Classification of orthotics-functional & regional, General principles of Orthosis, Calipers- FO, AFO, KAFO, HKAFO. Prosthetic devices: Hand and arm replacement,
Body powered prosthetics, Myoelectric controlled prosthetics and Externally powered limb prosthetics. Functional Electrical Stimulation systems—Restoration of hand function, restoration of standing and walking, Hybrid Assistive Systems (HAS).

COURSE OUTCOMES:
CO1: Explain the fundamentals of rehabilitation and rehabilitation team members.
CO2: Describe the key engineering principles of rehabilitation and assistive technology.
CO3: Apply the types of therapeutic exercises to benefit the society
CO4: Design and apply different types Hearing aids, visual aids and their application in biomedical field and hence the benefit of the society.
CO5: Explain engineering concepts in Virtual reality based rehabilitation devices
CO6: Identify prosthetic and orthotic devices for restoration of limb function

TOTAL: 45 PERIODS

REFERENCES

BM4073 TELE HEALTH TECHNOLOGY

COURSE 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, diagnosis
- To make student understand the applications of health care sectors

UNIT I TELEMEDICINE AND HEALTH
History and Evolution of telemedicine, Functional diagram of telemedicine system, Telemedicine, Tele health, Tele care, Organs of telemedicine, Global and Indian scenario, International regulations in e-health and telemedicine, Ethical and legal aspects of Telemedicine - Confidentiality, Social and legal issues, Safety and regulatory issues, Advances in Telemedicine.

UNIT II TELEMEDICAL TECHNOLOGY
Principles of Multimedia - Text, Audio, Video, data, Data communications and networks, PSTN, POTS, ANT, ISDN, Internet, Air/ wireless communications: GSM satellite, and Microwave, Modulation techniques, Types of Antenna, Integration and operational issues, Communication infrastructure for telemedicine – LAN and WAN technology. Satellite communication. Mobile hand held devices and mobile communication. Internet technology and telemedicine using world

UNIT III  TELEMEDICAL STANDARDS SECURITY AND LEGAL ISSUES  9


UNIT IV  m-HEALTH AND TELEMEDICINE  9

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  TELEMEDICAL APPLICATIONS  9

Telemedicine access to health care services – health education and self-care. · Introduction to robotics surgery, telesurgery. Telecardiology, Teleoncology, Telemedicine in neurosciences, Electronic Documentation, e-health services security and interoperability., Telemedicine access to health care services– health education and self-care, Business aspects - Project planning and costing, Usage of telemedicine. Telemedicine and in loco assistance of patients, Interactive videoconferencing consults, Store and forward consults, Remote monitoring and home care.

TOTAL:45 PERIODS

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.

REFERENCES

MX4005 HEALTH CARE, HOSPITAL AND EQUIPMENT MANAGEMENT

COURSE OBJECTIVES:

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

UNIT I HEALTH SYSTEM
Health organization 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 ORGANIZATION 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

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

MX4006 ULTRA SOUND IN MEDICINES

COURSE OBJECTIVES:
- To understand ultrasound principles and explain the basic physical properties of ultrasound
- To describe the indications of ultrasound, particularly in the evaluation of disease
- To describe the advantages and limitations of Ultrasound compared to other imaging modalities.
- To describe various types of ultrasound-guided diagnostic and therapeutic procedures
- To Describe the normal ultrasound anatomy of various organs and recognize the ultrasound characteristics of various pathologic conditions

UNIT I INTRODUCTION
History - Role of Ultrasound in Medical Imaging - Stress And Strain Relationships – Acoustic Wave Equation - Acoustic Properties of Biological Tissues - Doppler Effect.
- Continuous mode and pulsed mode. Measurement of ultrasonic energy, Manipulation of ultrasonic beam – Beam profile and intensity distribution in different axes.

UNIT II ULTRASOUND TRANSDUCERS

UNIT III GRAY-SCALE ULTRASONIC IMAGING
Scan converters, Signal processing, signal controls- TGC, Flares and acoustic shadows, artefact

UNIT IV DOPPLER FLOW MEASUREMENTS
Non-directional CW Flow Meters - Directional Doppler Flow Meters - Pulsed Doppler Flow Meters - Techniques for direction detection – Envelope Fluctuation Methods,
Phase Tracking Methods - Clinical Applications And Doppler Indices - fetal heart rate detection, blood flow detection using Doppler signal and imaging technique. Color Doppler Flow Imaging - Elasticity Imaging - Intravascular imaging

UNIT V BIOLOGICAL EFFECTS AND APPLICATIONS

COURSE OUTCOMES:
CO1: Understand the basic principle of Ultrasound in biomedical engineering
CO2: Identify and use appropriate transducers based on their characteristics
CO3: Understand the principles of gray scale imaging
CO4: Identify various Doppler flow measurements
CO5: Understand the different applications of ultrasound in biomedical field

TOTAL: 45 PERIODS

REFERENCES
4. Govind B Chavhan, "MRI made easy (for Beginners)", Jaypee, New Delhi, 2013
UNIT IV HOSPITAL SAFETY STANDARDS


UNIT V MEDICAL EQUIPMENT SAFETY STANDARDS

General requirements for basic safety & essential performance of medical equipment. IEC 60601 standards, Indian and International standards, ISO standards - Base Standard-general requirement of electrical medical devices, Collateral Standards- EMC radiation protection & programmable medical device system, Particular Standards-type of medical device

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.

TOTAL: 45 PERIODS

REFERENCES

4. Physical Environment Online: A Guide to The Joint Commission’s Safety Standards is published by HCPro, Inc. 2010
7. Nils Hoppe and Jose Miola - Medical law and Medical Ethics - Cambridge University Press-2014

BM4092 MEDICAL DEVICE STANDARDS AND REGULATION L T P C

COURSE OBJECTIVES:

- Understand standards and safety aspects of medical devices.
- Understand the hospital safety standards and maintenance.
- Describe the medical equipment safety standards.
- Describe medical device regulations
- Describe medical device risk assessment and regulatory requirements.

UNIT I STANDARDS AND SAFETY

Quality management system for medical devices (ISO 9001 and ISO13485), safety and standardization for risk management (ISO 14971), European standard conformity (CE
marking), FDA guidelines for medical devices approval and classification based on risk assessment

**UNIT II  HOSPITAL SAFETY STANDARDS**  9

**UNIT III  MEDICAL EQUIPMENT ESSENTIAL REQUIREMENTS**  9
General requirements for basic safety & essential performance of medical equipment, IEC 60601 standards- Base Standard-general requirement of electrical medical devices, Collateral Standards- EMC radiation protection &programmable medical device system, Particular Standards-type of medical device.

**UNIT IV  MEDICAL DEVICE REGULATION**  9

**UNIT V  MEDICAL DEVICE RISK ASSESSMENT**  9

**TOTAL:45 PERIODS**

**COURSE OUTCOMES:**
On completion of this course the student will be able to:
**CO1:** Describe the key point in standard and safety of medical devices
**CO2:** Introduce the students with the knowledge of hospital safety and standards.
**CO3:** Introduce the students with the knowledge of essential requirements in medical equipments
**CO4:** Introduce device regulation and its types.
**CO5:** Acquire knowledge medical device risk assessment.

**REFERENCES**
4. https://nptel.ac.in/courses/127106136
5. MDR17, Regulation of Medical Devices,
COURSE OBJECTIVES:

- To understand basics of tissue engineering
- To learn basics of cell mechanics in tissue engineering
- To know the importance of biomaterials in tissue engineering
- To understand basics of Immunology
- To understand the importance of applied immunology for therapy

UNIT I  INTRODUCTION TO TISSUE ENGINEERING  9
History and scope of tissue engineering – Scientific and Social Challenges - Structure and organization of Tissues – Development of Tissue – Cell and Extracellular matrix interaction – Morphogenesis and Tissue Engineering – Cell Determination and Differentiation

UNIT II  FUNDAMENTALS OF CELL MECHANISMS  9

UNIT III  BIOMATERIALS IN TISSUE ENGINEERING  9
Biological vs Nonbiological materials – Extra Cellular Matrix – Collagen, Chitin & Degradable and Nondegradable materials – Polymer, Ceramics and Metals – Cell interaction with different materials — Scaffolds - Control releaser agents in Tissue Engineering – Cell interaction with suspension and gels – Tissue response to implants

UNIT IV  INTRODUCTION TO IMMUNOLOGY  9
Introduction of Immunology – Antigen; Antibody; Cytokine; Heparin; Histamine; Innate and Adaptive Immunity. Immune Recognition – Immune Effectors function – Immune Regulation – Immune memory. Introduction of Stem cells - Induced Pluripotent Stem cells - Stem cell identification - Surface markers & FACS analysis

UNIT V  APPLIED IMMUNOLOGY  9

COURSE OUTCOMES:

CO1: Define the statement of tissue engineering in healthcare
CO2: Explain the invitro organization of tissue culture
CO3: Explain different methods involved in characterization and preparation of biomaterials in tissue engineering
CO4: Explain different types of stem cells and its application in tissue engineering
CO5: Explain the basics of immunology in human being
CO6: Explain the applications of immunoengineering to healthcare sector

TOTAL:45 PERIODS
REFERENCES

MX4009 MEDICAL EQUIPMENT L T P C 3 0 0 3

COURSE OBJECTIVES:
- To learn about cardiac care unit, pulmonary analyzers and aid equipments and their functions
- To understand the principle involved in physiotherapy and electrotherapy equipments
- To gain knowledge about instruments used to kidney and bones measurements
- To study about the instruments used for sensory measurements and be able to design sensors
- To provide latest knowledge of special medical assistive and therapeutic equipments

UNIT I CARDIAC CARE UNIT AND PULMONARY ANALYSERS 9

UNIT II PHYSIOTHERAPY AND ELECTROTHERAPY 9 EQUIPMENTS
Tissue response - Short wave diathermy - Microwave diathermy - Ultrasonic therapy Unit - Electrotherapy - FES, TENS - Bladder stimulator - Lithotripter system - Extra corporeal Shock wave therapy- Electrical safety-IEC-60601 standard, Physiological effects of current, Leakage current, Micro and macro electric shock, GFI units, Earthing Scheme, Electrical safety Analyzer.

UNIT III INSTRUMENTS DEALING WITH KIDNEY AND BONES 9
UNIT IV SENSORY INSTRUMENTATION


UNIT V SPECIAL EQUIPMENTS AND RECENT TRENDS


TOTAL:45 PERIODS

COURSE OUTCOMES:

Upon completion of this course the student will be able to

CO1: Describe the working of the pacemaker, pulmonary analyzers and aid equipments and their functions

CO2: Obtain knowledge on different physiotherapy equipments and

CO3: Obtain the domain knowledge of instruments dealing with kidney and bones

CO4: Develop measurement systems for sensory parameter measurements

CO5: Familiar with the special therapeutic equipments available

REFERENCES


MX4010 BIOMEMS AND ARTIFICIAL ORGANS L T P C
3 0 2 4

COURSE OBJECTIVES:

- To understanding of the basics with current advancement and challenges associated with operations
- To understand the uses of bioinstrumentation, processes for microelectromechanical systems and their applications in the biomedical areas
- To give a basic idea of the artificial organs that can aid a human to live a normal life.
- To comprehend the processes and challenges involved in implants and prosthesis using alloys.
- To determine and selection of right materials for its bio applications

UNIT I INTRODUCTION

Historical perspective, Development of MEMS Technology, MEMS Technology: Present, Future and Challenges, MEMS Applications, Comparison of MEMS and Microelectronics.
UNIT II  SENSORS AND ACTUATORS  9

UNIT III  ARTIFICIAL ORGANS / IMPLANTS  9

UNIT IV  REPLACEMENT DEVICES FOR RESPIRATORY AND DIGESTIVE SYSTEM  9

UNIT V  TISSUE REPLACEMENT IMPLANTS  9
Soft-tissue replacements, sutures, surgical tapes, adhesive, and Dental implants - Fracture plates - Joint and Spinal replacement - Artificial skin: Current treatment for skin loss, Design principles for skin replacement - Ear and Eye implants.

45 PERIODS

PRACTICAL EXERCISES:  30 PERIODS
1. Simulation of structures for MEMS sensors
2. Designing of MEMS based accelerometer
3. Modeling and simulation of MEMS biosensor
4. Designing of micro cantilever for medical application
5. Modeling and simulation of chemical sensor
6. Modeling and simulation of prosthetic heart valves
7. Modeling and simulation of dialyzer membrane for hemodialysis
10. Designing of bone plates and comparison of its mechanical properties with selected biocompatible materials

COURSE OUTCOMES:
CO1: Compare and explain about the characteristics of MEMs Physical and chemical sensor
CO2: Classify the biosensors according to its working principle and discuss its application as an implantable device
CO3: Design various grafts for tissue repair and artificial organs.
CO4: Enumerate biomaterials for implants, soft and hard tissue 5 replacements
CO5: Recall the cell-biomaterial interactions for constructing artificial organs

TOTAL: 75 PERIODS
REFERENCES
1. BioMEMS and Biomedical Nanotechnology, volume III Tejaldesai, sangetha Bhatia

mx4011 physiological modeling l t p c
3 0 2 4

course objectives:
- To identify and describe general principles for modeling and simulating a system.
- To apply these principles when designing mathematical models for a number of realistic systems.
- To model the dynamic systems.
- To analyze models for cardio, pulmonary and respiration activities.
- To implement and use computer based modeling and simulation for studying physiological systems.

unit i introduction
introduction to physiological system and mathematical modeling of physiological system, classification of model – gray box & black box, parametric & non parametric, lumped & distributed models, linear & non-linear, characteristics of models. Purpose of physiological modelling and signal analysis, linearization of nonlinear models. Engineering system and physiological system, System variables & properties- Resistance, Compliance & their analogy.

unit ii dynamic physiological system
Dynamic systems and their control, modeling and block diagrams, Types of Eye movement, Eye movement system and Wetheimer's saccadic eye model. Robinson's Model, Oculomotor muscle model, Linear Reciprocal Innervations Oculomotor Model. Open & close loop systems instability, automatic aperture control.

unit iii non linear models

unit iv cardio, pulmonary and respiratory modeling

unit v simulation of physiological systems
Simulation of physiological systems using OpenCV / MATLAB software. Biological receptors: - Introduction, receptor characteristics, transfer function models of receptors, receptor.

45 periods
PRACTICAL EXERCISES: 30 PERIODS
1. Design Lumped and Distributed SIMULINK model for simple lung mechanism.
2. Design a SIMULINK model for steady-state analysis of muscle stretch reflex.
3. Design a SIMULINK model for steady-state respiratory control.
4. Design a SIMULINK model of neuromuscular reflex models.
5. Design a SIMULINK model to compute frequency response of linearized lung mechanics model.
6. Design a SIMULINK model to compute frequency response of glucose-insulin regulation (Stolwijk and Hardy model).
7. Design a SIMULINK model for respiratory sinus arrhythmia (Saul model).
8. Design a SIMULINK model of simplified and linearized version of Hodgkin-Huxley model.
9. Design a SIMULINK model for cardiovascular variability. (stroke volume constant)
10. Design a SIMULINK model for cardiovascular variability. (stroke volume variable)

COURSE OUTCOMES:
CO1: Build on a basic understanding of physiology to develop a more in-depth level of understanding that will enable engineering analysis of selected physiological systems
CO2: Describe the dynamic models, simulate and visualize, dynamic responses of physiological models using software
CO3: Describe nonlinear models of physiological systems.
CO4: Be able to translate the understanding of physiological function into an engineering model for cardio, and respiratory systems
CO5: Compute the Simulation of physiological systems

REFERENCES

MX4074 PATTERN RECOGNITION TECHNIQUES AND APPLICATIONS L T P C
3 0 2 4

COURSE OBJECTIVES:
- To understand the fundamentals of Pattern recognition
- To impart knowledge on various clustering techniques
- To study about feature extraction and selection
- To explore different classification models
- To understand Fuzzy Pattern Classifiers and applications

UNIT I PATTERN CLASSIFIER
UNIT II  CLUSTERING  
Clustering Concept – Hierarchical Clustering Procedures – Partitional Clustering, k- means algorithm – Clustering of Large Data Sets – EM Algorithm – Grid Based Clustering– Density Based Clustering.

UNIT III  FEATURE EXTRACTION AND SELECTION  
Entropy Minimization – KL Transforms – Regression-Linear, Non-linear and Logistic, Prediction, Feature Selection through Functions Approximation – Binary Feature Selection

UNIT IV  HIDDEN MARKOV MODELS AND SUPPORT VECTOR MACHINE  

UNIT V  RECENT ADVANCES AND APPLICATIONS  
Elementary Neural Network for Pattern Recognition, Fuzzy pattern classifier, Application of PR in image segmentation, CAD system in breast cancer detection, ECG signal classification, Fingerprint recognition, cell cytology classification

45 PERIODS

PRACTICAL EXERCISES:  30 PERIODS
1. Implementation of Image classification using Perceptron model in Matlab / python.
2. Implementation of Fuzzy pattern classifier in Matlab/OpenCV/python.
3. Implementation of Feature extraction using KL transform in Matlab / Open CV / python.
5. Implementation of density based clustering in Matlab/OpenCV/ python
8. Implementation of Bayes classifier in Matlab/OpenCV/python.
9. Implementation of Classification using Neural Networks in Matlab / OpenCV / python.
10. Implementation of image segmentation in Matlab/OpenCV/python

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

CO1: Perform classification using Bayes approach  
CO2: Implement clustering algorithms for classification  
CO3: Perform Feature extraction, feature reduction  
CO4: Apply HMM and SVM for real time applications  
CO5: Apply pattern recognition techniques for biosignal and medical image applications

TOTAL: 75 PERIODS

REFERENCES
6. Robert J.Schalkoff, “Pattern Recognition Statistical, Structural and Neural Approaches”,
OBJECTIVES:
- To study about Fundamental Concept and Components of Virtual Reality
- To study about Interactive Techniques in Virtual Reality
- To study about Visual Computation in Virtual Reality
- To study about Augmented and Mixed Reality and Its Applications
- To know about I/O Interfaces and its functions.

UNIT I
INTRODUCTION TO VIRTUAL REALITY

Suggested Activities:
- Flipped classroom on uses of MR applications.
- Videos – Experience the virtual reality effect.
- Assignment on comparison of VR with traditional multimedia applications.

Suggested Evaluation Methods:
- Tutorial – Applications of MR.
- Quizzes on the displayed video and the special effects

UNIT II
INTERACTIVE TECHNIQUES IN VIRTUAL REALITY

Suggested Activities:
- Flipped classroom on modeling three dimensional objects.
- External learning – Collision detection algorithms.
- Practical – Creating three dimensional models.

Suggested Evaluation Methods:
- Tutorial – Three dimensional modeling techniques.
- Brainstorming session on collision detection algorithms.
- Demonstration of three dimensional scene creation.

UNIT III
VISUAL COMPUTATION IN VIRTUAL REALITY
Animating the Virtual Environment: Introduction, The dynamics of numbers, Linear and
Nonlinear interpolation, the animation of objects, linear and non-linear translation, shape & object inbetweening, free from deformation, particle system. Physical Simulation: Introduction, Objects falling in a gravitational field, Rotating wheels, Elastic collisions, projectiles, simple pendulum, springs, Flight dynamics of an aircraft.

Suggested Activities:
- External learning – Different types of programming toolkits and Learn different types of available VR applications.
- Practical – Create VR scenes using any toolkit and develop applications.

Suggested Evaluation Methods:
- Tutorial – VR tool comparison.
- Brainstorming session on tools and technologies used in VR.
- Demonstration of the created VR applications.

UNIT IV AUGMENTED AND MIXED REALITY
Taxonomy, technology and features of augmented reality, difference between AR and VR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality, wireless displays in educational augmented reality applications, mobile projection interfaces, marker-less tracking for augmented reality, enhancing interactivity in AR environments, evaluating AR systems

Suggested Activities:
- External learning - AR Systems

Suggested Evaluation Methods:
- Brainstorming session different AR systems and environments.

UNIT V I/O INTERFACE IN VR & APPLICATION OF VR
Human factors: Introduction, the eye, the ear, the somatic senses. VR Hardware: Introduction, sensor hardware, Head-coupled displays. Acoustic hardware, Integrated VR systems. VR Software: Introduction, Modeling virtual world, Physical simulation, VR toolkits, Introduction to VRML, Input -- Tracker, Sensor, Digitalglobe, Movement Capture, Video-based Input, 3D Menus & 3DScanner etc. Output -- Visual /Auditory / Haptic Devices. VR Technology in Film & TV Production. VR Technology in Physical Exercises and Games. Demonstration of Digital Entertainment by VR.

Suggested Activities:
- External learning – Different types of sensing and tracking devices for creating mixed reality environments.
- Practical – Create MR scenes using any toolkit and develop applications.

Suggested Evaluation Methods:
- Tutorial – Mobile Interface Design.
- Brainstorming session on wearable computing devices and games design.
- Demonstration and evaluation of the developed MR application.

OUTCOMES:
CO1: Understand the Fundamental Concept and Components of Virtual Reality
CO2: Able to know the Interactive Techniques in Virtual Reality
CO3: Can know about Visual Computation in Virtual Reality
CO4: Able to know the concepts of Augmented and Mixed Reality and Its Applications
CO5: Know about I/O Interfaces and its functions.

PERIODS: 45

PRACTICALS:
PERIODS: 30
1. Study of tools like Unity, Maya, 3DS MAX, AR toolkit, Vuforia and Blender.
2. Use the primitive objects and apply various projection methods by handling the camera.
3. Download objects from asset stores and apply various lighting and shading effects.
4. Model three dimensional objects using various modeling techniques and apply textures over them.
5. Create three dimensional realistic scenes and develop simple virtual reality enabled mobile applications which have limited interactivity.
6. Add audio and text special effects to the developed application.
7. Develop VR enabled applications using motion trackers and sensors incorporating full haptic interactivity.
8. Develop AR enabled applications with interactivity like E learning environment, Virtual walkthroughs and visualization of historic places.
10. Develop simple MR enabled gaming applications.

TOTAL: 75 PERIODS

REFERENCES

MX4012 3D PRINTING IN MEDICINES

COURSE OBJECTIVES:
- To apply the concepts of medical imaging, 3D scanning and digitizing for accurate 3D model construction.
- To identify the errors during processing of medical image data and minimize them.
- To select the suitable material for the given medical application.
- To analyze and select an additive manufacturing technology for a given medical application.
- To analyze and design the virtual models of the patient for planning the surgery

UNIT I DESIGN OF POWER SUBSYSTEMS IN MEDICAL ELECTRONICS
Overview, Workshop on Medical Applications for Reverse Engineering and Rapid
Prototyping, Background on Rapid Prototyping, Stereolithography and Other Resin-type Systems, Fused Deposition Modelling and Selective Laser Sintering, Droplet/Binder Systems, Related Technology: Microsystems and Direct Metal Systems, File Preparation, Relationship with Other Technologies, Disadvantages with RP for Medical Applications

UNIT II BIOMODELLING

UNIT III MEDICAL DATA TRANSFER
Introduction, Medical Imaging: from Medical Scanner to 3D Model, Computer Approach in Dental Implantology. Bio Build Paradigm - Importing a dataset, Volume reduction, Anatomical orientation confirmation, Volume editing, Image processing, Build orientation optimization, 3D visualization, RP file generation, Future Enhancements

UNIT IV ORTHOPEDIC IMPLANTS
Introduction to orthopedic implants, Electron Beam Melting Technology, Direct Fabrication of Titanium Orthopedic Implants - EBM fabrication of custom knee implants, EBM fabrication of custom bone implants, Direct fabrication of bone ingrowth surfaces.

UNIT V SCAFFOLD BASED TISSUE ENGINEERING

PRACTICAL EXERCISES:
1) Review of CAD Modeling Techniques and Introduction to Rapid Prototyping
2) Forming Groups & Assigning Creative Idea
3) Generating STL files from the CAD Models & Working on STL files
4) Modeling Creative Designs in CAD Software
5) Assembling Creative Designs in CAD Software
6) Processing the CAD data in Catalyst software (Selection of Orientation, Supports generation, Slicing, Tool path generation)
7) Simulation in Catalyst Software
8) Fabricating the physical part on FDM RP machine
9) Removing the supports & post processing (cleaning the surfaces)
10) Demonstrating Creative Working Models

COURSE OUTCOMES:
CO1: Apply the concepts of medical imaging, 3D scanning and digitizing for accurate 3D model construction
CO2: Identify the errors during processing of medical image data and minimize them
CO3: Interpret the data acquisition and data transfer mechanisms.
CO4: Analyze and select an additive manufacturing technology for orthopedic implants
CO5: Analyze and select models suitable for scaffold based tissue engineering

TOTAL: 75 PERIODS
REFERENCES

AUDIT COURSES

AX4091 ENGLISH FOR RESEARCH PAPER WRITING

COURSE 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

COURSE 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
REFERENCES:

AX4092 DISASTER MANAGEMENT L T P C
2 0 0 0

COURSE 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 6
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 6

UNIT III DISASTER PRONE AREAS IN INDIA 6
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 6
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 6
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

TOTAL : 30 PERIODS

COURSE 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

REFERENCES:

AX4093

CONSTITUTION OF INDIA

COURSE 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 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
Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

**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**

**COURSE 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.

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**AX4094**

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<td>2. ஆகநொனூறு (82)</td>
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<td>3. குறிஞ்சிப்பொட்டின் மலர்க்கொட்சி</td>
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<td>2. பிற அறநூல்கள் - இலக்கியம் மருந்து</td>
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<td>1. கண்களசிப்பிர புரை</td>
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UNIT IV

1. சிறுபொணின்றும் பலத்திக்கு தரை
2. மூக்கிலகனும் பலேயிக்கு
   - கொண்டுசெய்யப்பட்ட அருகிக்கும் மாற்றங்கள்

UNIT V

1. உருவநிலை குறிப்பிட்டு
   - தமிழில் விக்கிப்பீடியொ
     (Tamil Wikipedia)
   - வொழ்வியல் களஞ்சியம்

TOTAL : 30 PERIODS
5. தமிழ்கல்கல கல்கலியம்
   - தமிழ் வளார் கல்கலியம் (thamilvalarchithurai.com)

6. அறிவியல் கல்கலியம்
   - தமிழ் பல்கலைக்கழகம். குறிப்பிட்டு