Rashtreeya Sikshana Samithi Trust

R. V. College of Engineering
(Autonomous Institution Affiliated to Visvesvaraya Technological University, Belagavi)

Department of Electronics & Instrumentation Engineering

Master of Technology (M. Tech.)
Biomedical Signal Processing
&
Instrumentation

Scheme and Syllabus for
Autonomous System w.e.f 2018
Vision

Achieving academic excellence in Instrumentation Technology by adopting interdisciplinary research with a focus on sustainable and inclusive technologies.

Mission

- To create an environment for students to excel in domain areas and get motivated to involve in interdisciplinary research by utilizing state of the art infrastructure.
- To impart technical knowledge, encourage experiential learning and develop future professional leaders.
- To establish industry-academia networking and develop industry-ready students and future entrepreneurs, to meet societal & industrial challenges.
- To motivate lifelong learning and research in sustainable technologies to find improved solutions for the betterment of society.
Program Outcomes (PO)

M. Tech. in Biomedical Signal Processing & Instrumentation Program graduates will be able to:

**PO1:** An ability to independently carry out research/investigation and development work to solve practical problems

**PO2:** ability to write and present a substantial technical report/document

**PO3:** 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

**PO4:** Develop innovative techniques for health care applications using modern engineering hardware, and software simulation tools.

**PO5:** Adapt interdisciplinary research leading to successful biomedical professionals, with an aptitude for life-long learning.

**PO6:** Practice intellectual integrity, ethical research, and become capable of developing functional prototypes worth the patenting and technology transfer.
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Total: 22

* 2 Hrs of teaching

LIST OF ELECTIVE COURSES

**Elective 1**
- 18MBS 141 Embedded Controller
- 18MBS 142 Wireless Technologies for medical Applications
- 18MBS 143 Healthcare and Hospital Management

**Elective 2**
- 18MBS151 OOPS with Java
- 18MBS152 Python Programming
- 18MBS153 Bioinformatics & programming
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**LIST OF ELECTIVE COURSES**

**Elective 3**
- 18MBS241: Bio statistics
- 18MCS242: Machine Learning
- 18MBS243: Biomechanics

**Elective 4**
- 18MBS251: Lasers in medicine
- 18MBS252: IoT for Healthcare
- 18MBS253: Basics of orthopaedics, Medicine & Ethics

**Global Elective**
- 18 GCS 261: Business Analytics
- 18 GCV 262: Industrial & occupational health and safety
- 18 GIM 263: Modeling Using Linear Programing
- 18 GIM 264: Project Management
- 18 GCH 265: Energy Management
- 18 GME 266: Industrial 4.0
- 18 GME 267: Advanced Materials
### THIRD SEMESTER

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**Elective 3**

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(An Autonomous Institution Affiliated to Visvesvaraya Technological University, Belagavi)
Department of Electronics & Instrumentation Engineering
M. Tech. in Biomedical Signal Processing & Instrumentation

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# FIRST SEMESTER

## MATHEMATICS FOR BIO MEDICAL SIGNAL PROCESSING

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### UNIT – I


### UNIT – II

**FIR Filter Design**: Introduction to FIR filters, Design of FIR filters using Hamming, Rectangular, Bartlet window method, FIR filter design using frequency mapping method.

**IIR Filter Design**: Design of IIR filters from analog filters (Butterworth and Chebyshev). Impulse invariance method and bilinear transformation methods.

### UNIT – III

**ECG**: ECG signal origin, ECG parameters-QRS detection different techniques, ST segment analysis.

**Signal averaging**: Basics of signal averaging, Signal averaging as a digital filter, A typical averager, Software and limitations of signal averaging.

**Adaptive Filtering**: Introduction, General structure of adaptive filters, LMS adaptive filter, adaptive noise cancellation, Cancellation of 60 Hz interference in ECG, Cancellation of maternal ECG in fetal ECG.

### UNIT – IV

**Frequency Domain Analysis**: Introduction, Spectral analysis, linear filtering, cepstral analysis and homomorphic filtering. Removal of high frequency noise (power line interference), motion artifacts (low frequency) and power line interference in ECG.


### UNIT – V


### Tutorial

**Tutorial Class Topics:**

1) Acquisition And Display Of Biomedical Signals.
2) Display Of Noised ECG Signal And Its Filtering.
3) A) Realization of Low pass Integer Filter.
   B) Realization of High pass Integer Filter
   C) Realization of Band pass Integer Filter
4) Design Of Fir Notch Filter.
5) A) Realization of IIR One-Pole Filter
   B) Realization of IIR Two-Pole Low pass Filter
   C) Realization of IIR Two-Pole High pass Filter
   D) Realization of IIR Two-Pole Band pass Filter
   E) Realization of IIR Two-Pole Band Reject Filter
6) PSD Using Periodogram Technique And Computation Of FFT
7) Compression of ECG Using Turning Point Algorithm
8) QRS Detection And Heart Rate Measurement.
9) Plotting of ECG Spectrum With 60 Hz Noise Using FFT
10) ECG Signal Averaging Using Delayed Samples.

**Tutorial Class Topics:**

1) Problems on FIR Filter Design.
2) Problems on IIR Filter Design.

Discussion and Analysis of Time domain and Frequency domain signals.

**Course Outcomes:**

After going through this course the student will be able to:

- CO1: Understand the basic concepts (mathematics & Signal processing) and tools for real time processing of signals.
- CO2: Analyze signal processing of physiological signals through digital signal processing techniques to address biomedical problems.
- CO3: Apply DSP techniques to solve complex problems related to biomedical domain.
- CO4: Evaluate and develop the effectiveness of techniques applied to biomedical signals against specific benchmarks.

**Reference Books:**


**Scheme of Continuous Internal Evaluation (CIE) for Theory 100 marks:**

CIE will consist of THREE Tests, THREE Quizzes and TWO assignments. Each test will be for 50 marks, each quiz will be for 10 marks and each assignment for 10 marks each. The total marks of tests, quizzes, assignment will be divided by 2 for computing the CIE marks. All three tests, quizzes and assignments are compulsory.

**Scheme of Semester End Examination (SEE) for Theory 100 marks:**

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit.
MEDICAL PHYSIOLOGY AND INSTRUMENTATION  
(Theory & Practice)

Course Code : 18MBS 12  
Hrs/Week : L: T: P 4:0:1  
CIE Marks : 100+50  
CIE Duration : 03+03 Hrs

UNIT – I  
09 Hrs

General Physiology: Cell, Cell junctions, Transport through cell membrane. Bio-Electric Potentials. Introduction to Medical Instrumentation System and General constraints in design of Medical instruments


UNIT – II  
10 Hrs

Renal Physiology: Kidney, Nephron, Juxtaglomerular apparatus, Urine formation, Concentration of urine, Acidification of urine, Renal function tests.

Artificial Kidney: Principle and Hemodialysis Machine.

Cardiovascular System: Introduction to cardiovascular system, Properties of cardiac muscle, Cardiac cycle& heart sounds, Pace-Makers External Pacemaker, Implantable Pacemaker, Cardiac output, Arterial blood pressure & its Measurement

UNIT – III  
10 Hrs

GIS: GIS, Functions of stomach, pancreas, liver, intestine, function tests: Endoscopies.

Nervous System: Introduction to nervous system, Neuron, Classification of nerve fibers, Properties of nerve fibers, Degeneration & regeneration of nerve fibers, Neuroglia, Receptors, Synapse, Neurotransmitters, Reflex activity, cerebrospinal fluid, Cerebral circulation and tests. Electroencephalogram

UNIT – IV  
09 Hrs

Muscle Physiology: Classification of muscles, Structure of skeletal muscles, Properties of skeletal muscles, Changes during muscular contraction, Neuromuscular junction. Electro-Myograms.(EMG)


Endocrine system: Introduction to Endocrine System, Thyroid gland, Pituitary gland

UNIT - V  
09 Hrs


Unit – VI (Lab Component)  
12 Hrs

Analyze the acquired bio signals from the following equipment, Compare the same with standard normal values and interpret the signals.

1. Electrocardiogram and determine the cardiac vector.
2. EMG biofeedback system with nerve conduction velocity.
3. Audiogram and determine the percentage of hearing.
4. Air conduction thresholds testing using audiometer.
5. Phonocardiograph
6. LAB-VIEW & its Bio-Medical Applications
7. Analysis of Lung function tests using Spirometry.
8. Perform an experiment on acquisition of PPG and Realization of a Pacemaker circuit.

Observe and record heart sound using Electronic stethoscope.

Course Outcomes:
After going through this course the student will be able to:

   CO1: Understand human physiology at a cellular, tissue, and organ systems level and biomedical instrumentation.
CO2: Analyze the integration and control of different physiological systems and their roles in maintaining homeostasis.
CO3: Develop basic knowledge about working of human body and the physiological parameters associated with them.
CO4: Apply the knowledge of human physiology & instrumentation to develop Bio-medical instrumentation systems.

**Reference Books:**


**Scheme of Continuous Internal Evaluation (CIE) for Theory 100 marks:**
CIE will consist of THREE Tests, THREE Quizzes and TWO assignments. Each test will be for 50 marks, each quiz will be for 10 marks and each assignment for 10 marks each. The total marks of tests, quizzes, assignment will be divided by 2 for computing the CIE marks. All three tests, quizzes and assignments are compulsory.

**Scheme of Semester End Examination (SEE) for Theory 100 marks:**
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit.

**Scheme of Continuous Internal Evaluation (CIE) for Practical 50 Marks:**
CIE for the practical courses will be based on the performance of the student in the laboratory, every week. The laboratory records will be evaluated for 30 marks. One test will be conducted for 20 marks. The total marks for CIE (Practical) will be for 50 marks

**Scheme of Semester End Examination (SEE) for Practical 50 Marks:**
SEE for the practical courses will be based on conducting the experiments and proper results for 40 marks and 10 marks for viva-voce. The total mark is 50.
## BIO-MEMS AND NEMS
(Theory & Practice)

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### UNIT – I
**09 Hrs**

**Over view of MEMS & Microsystems and Working Principles of Microsystems:**

### UNIT – II
**09 Hrs**

**Scaling Laws in Miniaturization, Materials for MEMS and Microsystems:**

### UNIT – III
**09 Hrs**

**NANO Fabrication Processes:**

### UNIT – IV
**09 Hrs**

**Introduction to BioMEMS, Micro actuators and Drug Delivery:**
What are BioMEMS, the Driving force behind Biomedical Applications, Biocompatibility, Reliability Considerations Regulatory Considerations, Activation Methods, Micro actuators for Microfluidics, Equivalent Representation, Drug Delivery, Introduction to Clinical Laboratory Medicine, Chemistry, Hematology, Immunology, Microbiology, Urinalysis, Coagulation Assays, Arterial Blood gases.

### UNIT – V
**09 Hrs**

**Micro-Total-Analysis Systems (μTAS):**

### Unit – VI (Lab Component)
**12 Hrs**

Simulation Experiments: Simulation of different types of Sensors and actuators Using Comsol Multiphysics or Coventorware Software.

### Course Outcomes:
After going through this course the students will be able to:

- **CO1:** Describe the fundamentals of micro technology and nanotechnology, especially those related to bioengineering.
- **CO2:** Explain the main bioengineering-related techniques and processes of micro and nanotechnology.
- **CO3:** Apply micro and nanotechnology to fabricate P micro-bio devices and nano devices for biomedical
Applications.

CO4: Adapt the acquired knowledge to Bio engineering field and develop Bio-MEMS devices.

**Reference Books:**


**Scheme of Continuous Internal Evaluation (CIE) for Theory 100 marks:**

CIE will consist of THREE Tests, THREE Quizzes and TWO assignments. Each test will be for 50 marks, each quiz will be for 10 marks and each assignment for 10 marks each. The total marks of tests, quizzes, assignment will be divided by 2 for computing the CIE marks. All three tests, quizzes and assignments are compulsory.

**Scheme of Semester End Examination (SEE) for Theory 100 marks:**

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit.

**Scheme of Continuous Internal Evaluation (CIE) for Practical 50 Marks:**

CIE for the practical courses will be based on the performance of the student in the laboratory, every week. The laboratory records will be evaluated for 30 marks. One test will be conducted for 20 marks. The total marks for CIE (Practical) will be for 50 marks.

**Scheme of Semester End Examination (SEE) for Practical 50 Marks:**

SEE for the practical courses will be based on conducting the experiments and proper results for 40 marks and 10 marks for viva-voce. The total mark is 50.
## EMBEDDED CONTROLLER
(Elective-1)

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### UNIT – I

Motivation for advanced microcontrollers – Low Power embedded systems, On-chip peripherals, low-power RF capabilities. Examples of applications.


**MSP430 RISC CPU architecture:**
- Compiler-friendly features, Clock system, Memory subsystem.
- Key differentiating factors between different MSP430 families, Understanding the muxing scheme of the MSP430 pins

### UNIT – II

**Functions, Interrupts and Low Power modes:** Functions and subroutines, Interrupts, Low Power modes of operation.

**Digital I/O** – Digital Input and Output: Parallel ports, programming examples.

### UNIT – III

**Development for Programming MSP430:** Development Environment, Instruction set, The Assembly Language /C programming, Access to the Microcontroller for Programming and Debugging

### UNIT – IV

**On-chip peripherals:** Watchdog Timer, Comparator, Op-Amp, Basic Timer, ADC, DAC, SD16

### UNIT – V

**Case Studies and Applications:** Security Applications, Wireless Sensor Networking, Low-Power RF circuits and Pulse Width Modulation (PWM) in Power Supplies

**Biomedical Applications:** Design Considerations, Blood Pressure Monitors, Blood Glucose and Other Diagnostic Meters, Asset Security/Authentication, Patient Monitoring, Electrocardiogram (ECG)/ Portable ECG and Electroencephalogram (EEG), Pulse Oximeter

### Course Outcomes:

After going through this course the student will be able to

1. Understand fundamentals of embedded controllers.
2. Apply the programming concepts to develop an application.
3. Analyze and compare the application developed with embedded controllers.
4. Develop real time applications using any practical controllers.

### Reference Books:

Scheme of Continuous Internal Evaluation (CIE) for Theory 100 marks:
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Scheme of Semester End Examination (SEE) for Theory 100 marks:
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit.
## WIRELESS TECHNOLOGIES FOR MEDICAL APPLICATIONS
( Elective-1 )

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### UNIT – I
09 Hrs


### UNIT – II
09 Hrs

**Wireless Body Area Network (WBAN):** Network Architecture, Network Components, Design Issues, Network Protocols, WBAN Technologies, WBAN Applications

### UNIT – III
09 Hrs

**Wireless Personal Area Networks:** Wireless Personal Area Network (WPAN), Network Architecture, WPAN Components, WPAN Technologies and Protocols, WPAN Applications

### UNIT – IV
09 Hrs

**Wireless Local Area Networks:** Network Components, Design Requirements of WLAN, Network Architecture, WLAN Standards, Case studies in biomedical domain

### UNIT - V
09 Hrs

**Applications of Wireless Sensor Networks:** Introduction, Background Examples of Category of WSN Applications Home Control, Building Automation, Industrial Automation, Medical Applications, Case studies in biomedical domain

### Course Outcomes:

After going through this course the student will be able to

- CO1: Understand the fundamentals of wireless technologies involved in health domain application.
- CO2: Apply advanced wireless technologies for biomedical applications.
- CO3: Analyze sensor network techniques for the hospital management.
- CO4: Evaluate the impact of the technology on society, and relate this to global issues, governmental issues and economics

### Reference Books:


### Scheme of Continuous Internal Evaluation (CIE) for Theory 100 marks:

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Scheme of Semester End Examination (SEE) for Theory 100 marks:
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit.
HEALTHCARE AND HOSPITAL MANAGEMENT
(Elective-1)

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UNIT – I
09 Hrs

Forms Of Organization: Sole proprietorship, Partnership, Company-public and private sector enterprises, Principles of management, Evolution of management

UNIT – II
09 Hrs

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

UNIT – III
09 Hrs

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

UNIT – IV
09 Hrs

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

UNIT - V
09 Hrs

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

Course Outcomes:
After going through this course, the students will be able to:

CO1: Understanding the principles of hospital management.
CO2: Apply the practices essential for managing a hospital organization.
CO3: Analyze and compare the practices essential for managing a hospital organization.
CO4: Develop solutions at the interdisciplinary level related to strategic and Operative Management of hospitals.

Reference Books:

Scheme of Continuous Internal Evaluation (CIE) for Theory 100 marks:
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Scheme of Semester End Examination (SEE) for Theory 100 marks:
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OOPS WITH JAVA
(Elective-2)

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<tr>
<td>100</td>
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</table>

UNIT – I 09 Hrs


UNIT – II 09 Hrs

Inheritance: Classes, Super classes, and Subclasses, The Cosmic Superclass, Generic Array Lists, Object Wrappers and Auto boxing, Methods with a Variable Number of Parameters, Enumeration Classes, Reflection, Design Hints for Inheritance.

UNIT – III 09 Hrs
Interfaces, Lambda Expressions, and Inner Classes: Interfaces, Lambda Expressions, Inner Classes, Proxies.


UNIT – IV 09 Hrs


UNIT - V 09 Hrs
Event Handling: Basics of Event Handling, Actions, Mouse Events, The AWT Event Hierarchy.


Course Outcomes:
After going through this course the student will be able to

1. Understand the basic concepts of JAVA language.
2. Apply the knowledge of coding for various applications.
3. Analyze the implemented code to compare the various concepts of Java programming.
4. Design and model the real time application using Java programming.

Reference Books:
Scheme of Continuous Internal Evaluation (CIE) for Theory 100 marks:
CIE will consist of THREE Tests, THREE Quizzes and TWO assignments. Each test will be for 50 marks, each quiz will be for 10 marks and each assignment for 10 marks each. The total marks of tests, quizzes, assignment will be divided by 2 for computing the CIE marks. All three tests, quizzes and assignments are compulsory.

Scheme of Semester End Examination (SEE) for Theory 100 marks:
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit.
**PYTHON PROGRAMMING**  
(Elective-2)

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<td align="left">100</td>
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<td>03 Hrs</td>
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**UNIT – I**  
09 Hrs

**Getting Started with Python**: Why should you learn to write programs in python.

**Program development using IDLE**: Interacting with the Python shell, creating and editing programs in IDLE.

**Data and Expressions**: Literals, Variables, Operators, Data types

**UNIT – II**  
09 Hrs

**Control Structures**: Selection Control, Iterative Control

**Strings**: len(), looping and counting, in operator, string methods, parsing, strings, lists and strings.

**Lists**: definition, common list operations, list traversal, nested lists, iterating over lists using for and range(), while and lists, assigning and copying lists, list comprehensions.

**UNIT – III**  
09 Hrs

**Tuples**: creating, accessing elements, slicing, changing or deleting a tuple, membership test, basic tuple operations – concatenation, repetition, built In tuple functions, advantages over lists

**Dictionaries**: creating a dictionary, accessing values, updating, deleting, operations in dictionary-traversal, membership, built-in dictionary methods

**UNIT – IV**  
09 Hrs

**Files**: using text files – opening, reading, writing, file positioning, deleting a file.

**Functions**: Definition, Keyword arguments, default arguments and positional arguments, variable scope

**UNIT – V**  
09 Hrs

**Object-Oriented Programming**: Classes and Objects, Classes and functions, Classes and methods

CGI programming, Database Access, Networking

**Course Outcomes:**
After going through this course the student will be able to:

- CO1: Understand the fundamentals of python programming.
- CO2: Apply the concepts of data structures in Python programming.
- CO3: Analyze Object-Oriented Programming as used in Python.
- CO4: Develop a application using python with suitable libraries.

**Reference Books:**
4. Introduction to Programming Using Python, Y. Daniel Liang, Pearson, 2017

**Scheme of Continuous Internal Evaluation (CIE) for Theory 100 marks:**
CIE will consist of THREE Tests, THREE Quizzes and TWO assignments. Each test will be for 50 marks, each quiz will be for 10 marks and each assignment for 10 marks each. The total marks of tests, quizzes, assignment will be divided by 2 for computing the CIE marks. All three tests, quizzes and assignments are compulsory.

**Scheme of Semester End Examination (SEE) for Theory 100 marks:**
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit.
### BIOINFORMATICS & PROGRAMMING
(Elective-2)

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#### UNIT – I  
09 Hrs

**Bioinformatics:** Introduction, Objectives of Bioinformatics, What kind of Data is used, Major Bioinformatics databases, Applications of Bioinformatics.

**The Central Dogma:** Watson’s definition, information flow, from data to knowledge, Convergence, the organization of DNA, the organization of Proteins.

#### UNIT – II  
09 Hrs

**Perl (BIOPERL) for Bioinformatics:** Representing sequence data, program to store a DNA sequence, concatenating DNA fragments, Transcription, Calculating the reverse complement in Perl, Proteins, files, reading proteins in files, Arrays, Flow control, finding motifs, counting Nucleotides, exploding strings into arrays, operating on strings, Reading from and writing to files.

#### UNIT – III  
09 Hrs

**Designing a Biological Databases:**

**MySQL:** Creating and Selecting Database, Creating a table, Loading Data into Table, Retrieving information from table

**Introduction to PHP**

#### UNIT – IV  
09 Hrs

**Sequence Alignment Algorithms:** Biological motivations of sequence analysis, the models for sequence analysis and their biological motivation, global alignment, local alignment, End free-space alignment and gap penalty, Sequence Analysis tools and techniques.

#### UNIT – V  
09 Hrs

**Phylogenetic Analysis:** Introduction, methods of Phylogenetic analysis, distance methods, the neighbor-Joining (NJ) method, The Fitch/ Margoliash method, character-based methods, Other methods, Tree evaluation and problems in phylogenetic analysis.

#### Course Outcomes:

After going through this course the student will be able to:

1. Understand the relationship of molecular biology and bioinformatics to computer science.
2. Apply the Perl, Php and MySQL programming to bioinformatics applications.
3. Analyze the biomedical databases, Alignment and phylogenetic techniques.
4. Create the databases for bioinformatics applications and evaluate various alignment and phylogenetic techniques.

#### Reference Books:


#### Scheme of Continuous Internal Evaluation (CIE) for Theory 100 marks:

CIE will consist of THREE Tests, THREE Quizzes and TWO assignments. Each test will be for 50 marks, each quiz will be for 10 marks and each assignment for 10 marks each. The total marks of tests, quizzes, assignment will be divided by 2 for computing the CIE marks. All three tests, quizzes and assignments are compulsory.

#### Scheme of Semester End Examination (SEE) for Theory 100 marks:

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit.
PROFESSIONAL SKILL DEVELOPMENT  
(AUDIT COURSE)  

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**Unit-I**  
03 Hrs  

Resume Writing: Understanding the basic essentials for a resume, Resume writing tips Guidelines for better presentation of facts. Theory and Applications.

**Unit-II**  
08 Hrs  

**Analytical Reasoning** - Single & Multiple comparisons, Linear Sequencing.  
**Logical Aptitude,** - Syllogism, Venn-diagram method, Three statement syllogism, Deductive and inductive reasoning. Introduction to puzzle and games organizing information, parts of an argument, common flaws, arguments and assumptions.  
**Verbal Analogies/Aptitude** – introduction to different question types – analogies, Grammar review, sentence completions, sentence corrections, antonyms/synonyms, vocabulary building etc. Reading Comprehension, Problem Solving.

**Unit-III**  
03 Hrs  

**Interview Skills:** Questions asked & how to handle them, Body language in interview, and Etiquette – Conversational and Professional, Dress code in interview, Professional attire and Grooming, Behavioral and technical interviews, Mock interviews - Mock interviews with different Panels. Practice on Stress Interviews, Technical Interviews, and General HR interviews.

**Unit-IV**  
02 Hrs  

**Interpersonal and Managerial Skills:** Optimal co-existence, cultural sensitivity, gender sensitivity; capability and maturity model, decision making ability and analysis for brain storming; Group discussion(Assertiveness) and presentation skills;

**Unit-V**  
02 Hrs  

**Motivation:** Self-motivation, group motivation, Behavioral Management, Inspirational and motivational speech with conclusion. (Examples to be cited).  
**Leadership Skills:** Ethics and Integrity, Goal Setting, , leadership ability.

**Note:** The respective departments should discuss case studies and standards pertaining to their domain

**Course Outcomes:**

After going through this course the student will be able to:

**CO1:** Develop professional skill to suit the industry requirement.  
**CO2:** Analyze problems using quantitative and reasoning skills  
**CO3:** Develop leadership and interpersonal working skills.  
**CO4:** Demonstrate verbal communication skills with appropriate body language.
References Books:


Scheme of Continuous Internal Examination (CIE)

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<tr>
<td>II</td>
<td>Test 2 is conducted after completion 18 hours training program (Part A Quiz 15 Marks and Part B: Descriptive answers for 30 Marks).</td>
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BOTH THE TESTS ARE COMPULSORY; AVERAGE OF TWO TESTS WILL BE CONSIDERED. Candidates have to score 50% marks to qualify for M.Tech degree.
SECOND SEMESTER

MEDICAL IMAGE PROCESSING
(Theory & Practice)

Course Code : 18MBS 21  
Hrs/Week : L: T: P 3:1:1  
Credits : 5  
CIE Marks : 100+50  
SEE Marks : 100+50  
SEE Duration : 03+03 Hrs

UNIT – I  09 Hrs

Fundamentals: Introduction, Fundamental steps in DIP, A simple image formation model, representing digital images, Spatial & Gray level resolution, Basic relationship between pixels.


UNIT – II  10 Hrs

Image Segmentation: Detection of discontinuities, Edge linking and Boundary detection by local processing & global processing using Hough transform, Region based segmentation, Application discussion on Biomedical Digital Image Processing.

UNIT – III  09 Hrs

Morphological Image Processing: Basic concepts of set theory, Logical operations involving binary images, Dilation and erosion, Opening and closing, The hit-or-miss transformation, Basic morphological algorithms.

UNIT – IV  11 Hrs

Image Representation and Description: Representation – Chain codes, polygonal approximations, signatures, boundary segments, skeletons, Boundary descriptors – Some simple descriptors, Shape numbers, Fourier descriptors, statistical moments, Regional descriptors – Some simple descriptors, topological descriptors, texture.

UNIT – V  09 Hrs


UNIT – VI(Lab Component)  12 Hrs

LAB EXPERIMENTS:

Perform different image processing experiments as listed below by using MATLAB/SCILAB/PYTON.

1. Medical Image enhancement – Histogram based.
2. Medical Image enhancement – by varying gray levels.
3. Medical Image smoothing.
4. Medical Image sharpening.
5. Algorithm for low pass filter, high pass filter, median filter.
6. Point detection, Line detection, Edge detection (Masks operations).
9. Applications of Wavelets in Medical Image Processing.
10. Assignment on real medical image problem.
Course Outcomes:
After going through this course the student will be able to:

CO1. Understand the fundamentals of Digital image processing including the topics of filtering, transforms, morphology, image analysis and compression.

CO2. Evaluate algorithms for image analysis based on segmentation, shape & texture, registration, recognition and classification.

CO3. Analyze the different image processing algorithms of segmentation, registration, object recognition and classification using MATLAB.

CO4. Develop the necessary skill base to explore and implement Digital Image Processing algorithms.

Reference Books:


Scheme of Continuous Internal Evaluation (CIE) for Theory
CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Continuous Internal Evaluation (CIE) for Practical
CIE for the practical courses will be based on the performance of the student in the laboratory, every week. The laboratory records will be evaluated for 40 marks. One test will be conducted for 10 marks. The total marks for CIE (Practical) will be 50 marks.

Scheme of Semester End Examination (SEE) for Theory
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE) for Practical
SEE for the practical courses will be based on conducting the experiments and proper results for 40 marks and 10 marks for viva-voce. The total marks for SEE (Practical) will be 50 marks.
## BIO MEDICAL SENSORS & DATA ACQUISITION

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### UNIT – I

**Introduction to sensors & Transducers**: Classification of transducers - Resistive, Capacitive, Inductive, Photoelectric, piezoelectric and mechano electronics. Transducers for biomedical applications: Force and pressure transducers: such as piezoelectric, strain gauge, Transducer used for heart sound measurement: microphone. Ultrasonic measurement: properties of ultrasound, ultrasonic transducers, Transducers for respiration rate measurement.

### UNIT – II

**Biological Sensors**: Introduction to wearable medical devices and bio-sensing technologies. Design of on-body and in-body biosensors. Communication topologies, protocols, standards and media of body sensor networks (BSN). Usages and roles of BSN in real-life applications. Selected issues in state-of-the-art development of BSN, e.g. information security, signal interference, energy scavenging, multi-sensor fusion and context-aware sensing.

### UNIT – III

**Recording Electrodes**: Electrode-tissue interface, polarization, skin contact impedance, motion artifacts, Silver-Silver Chloride electrodes, Electrodes for ECG, Electrodes for EEG, Electrodes of EMG. Electrical Conductivity of Jellies and Creams, Microelectrodes.

**Biomedical Recorders**: ECG leads, effects of artifacts, single channel, multi-channel, ECG machine, Vectorcardiograph, Phonocardiograph-microphones and amplifiers for PCG, Electroencephalograph block diagram, computerized analysis of EEG, biofeedback instrumentation.

**Patient Monitoring Systems & Oximeters**: Bedside monitors Oximetry, pulse oximeter, skin reflectance oximeter and intravascular oximeter.

### UNIT – IV

**Fundamentals of Virtual Instrumentation Programming**: Introduction to LabVIEW, Components of LabVIEW, Context Help, Creating Sub-VIs. FOR Loop, WHILE Loop, shift registers and feedback nodes, timing function. CASE structures, formula node, Arrays and clusters, visual display types- graphs and charts, File Formats, File I/O Functions, Path Functions, String Functions, LabVIEW String Formats. Typical examples.

### UNIT – V

**Data Acquisition and Case studies**: Introduction, Measurement and Automation Explorer, DAQ Assistants, Analysis Assistants. Biomedical toolkit- ECG signal acquisition & feature extraction, EEG simulation, EMG power analysis. Image acquisition and processing.

**Case Studies**: myRiO, myDAQ

### Course Outcomes:
The student will be able to:
- CO1: Understand the fundamentals of sensors, transducer and virtual programming.
- CO2: Apply the concepts of sensors and instrumentation to acquire the real time signal using LabVIEW.
- CO3: Analyze the performance characteristics of sensor, transducers output in LabVIEW tool.
- CO4: Design and Develop a real time application using Virtual instrumentation and DAQ cards.
Reference Books:

2. Biomedical Instrumentation and Measurements, Cromwell Leslie, Fred J. Weibell and Erich A. Pfeiffer, PHI Learning, New Delhi, 2010.

Scheme of Continuous Internal Evaluation (CIE) for Theory 100 marks:
CIE will consist of THREE Tests, THREE Quizzes and TWO assignments. Each test will be for 50 marks, each quiz will be for 10 marks and each assignment for 10 marks each. The total marks of tests, quizzes, assignment will be divided by 2 for computing the CIE marks. All three tests, quizzes and assignments are compulsory.

Scheme of Semester End Examination (SEE) for Theory 100 marks:
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit.
RESEARCH METHODOLOGY

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**Unit – I** 07 Hrs

**Overview of Research:** Research and its types, identifying and defining research problem and introduction to different research designs. Essential constituents of Literature Review. Basic principles of experimental design, completely randomized, randomized block, Latin Square, Factorial.

**Unit – II** 08 Hrs

**Data and data collection:** Overview of probability and data types
Primary data and Secondary Data, methods of primary data collection, classification of secondary data, designing questionnaires and schedules.

**Sampling Methods:** Probability sampling and Non-probability sampling

**Unit – III** 07 Hrs

**Processing and analysis of Data:** Statistical measures of location, spread and shape, Correlation and regression, Hypothesis Testing and ANOVA. Interpretation of output from statistical software tools

**Unit – IV** 07 Hrs

**Advanced statistical analyses:** Non parametric tests, Introduction to multiple regression, factor analysis, cluster analysis, principal component analysis. Usage and interpretation of output from statistical analysis software tools.

**Unit-V** 07 Hrs


**Case studies:** Discussion of case studies specific to the domain area of specialization

**Course Outcomes:**

After going through this course the student will be able to

CO1: Explain the principles and concepts of research types, data types and analysis procedures.
CO2: Apply appropriate method for data collection and analyze the data using statistical principles.
CO3: Present research output in a structured report as per the technical and ethical standards.
CO4: Create research design for a given engineering and management problem situation.

**Reference Books:**
Scheme of Continuous Internal Evaluation (CIE) for 100 marks:
CIE will consist of THREE Tests, THREE Quizzes and TWO assignments. Each test will be for 50 marks, each quiz will be for 10 marks and each assignment for 10 marks each. The total marks of tests, quizzes, assignment will be divided by 2 for computing the CIE marks. All three tests, quizzes and assignments are compulsory.

Scheme of Semester End Examination (SEE) for 100 marks:
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit.
## BIOSTATISTICS

*(Elective-3)*

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### UNIT – I

**Introduction to Biostatistics:** Introduction, Some basic concepts, Measurement and Measurement Scales, Simple random sample, Computers and bio statistical analysis.

**Descriptive Statistics:** Introduction, ordered array, grouped data-frequency distribution, descriptive statistics – measure of central tendency, measure of dispersion, measure of central tendency computed from grouped data, variance and standard deviation-grouped data.

### UNIT – II

**Basic Probability Concepts:** Introduction, two views of probability – objective and subjective, elementary properties of probability, calculating the probability of an event.

**Probability Distributions:** Introduction, probability distribution of discrete variables, binomial distribution, Poisson distribution, continuous probability distributions, normal distribution and applications.

### UNIT – III

**Sampling Distribution:** Introduction, sampling distribution, distribution of the sample mean, distribution of the sample proportion, distribution of the difference between two sample proportions.

**Estimation:** Introduction, confidence interval for population mean, t-distribution, confidence interval for difference between two population means, population proportion and difference between two population proportions, determination of sample size for estimating means, estimating proportions, confidence interval for the variance of normally distributed population and ratio of the variances of two normally distributed populations.

### UNIT – IV

**Hypothesis Testing:** Introduction, hypothesis testing – single population mean, difference between two population means, paired comparisons, hypothesis testing-single population proportion, difference between two population proportions, single population variance, ratio of two population variances.

**Analysis of Variance (ANOVA):** Introduction, completely randomized design, randomized complete block design, repeated measures design, factorial experiment.

### UNIT - V

**Linear Regression and Correlation:** Introduction, regression model, sample regression equation, evaluating the regression equation, using the regression equation, correlation model, correlation coefficient.

**Multiple Regression and Chi-Square Distribution:** Multiple linear regression model, obtaining multiple regression equation, evaluating multiple regression equation, using the multiple regression equation, multiple correlation model, mathematical properties of Chi-square distribution, tests of goodness of fit, tests of independence, tests of homogeneity, nonparametric regression analysis.

### Course Outcomes:

After going through this course the student will be able to:

- CO1: Understand basic statistical concepts commonly used in Health Sciences.
- CO2: Apply the concept of Biostatistics to simplify the data aspect to solve problems.
- CO3: Analyze the biological data using the concepts of Distributions for simplification of usage.
- CO4: Evaluate a given problem and test the correctness of the analysis.
Reference Books:

Scheme of Continuous Internal Evaluation (CIE) for Theory 100 marks:
CIE will consist of THREE Tests, THREE Quizzes and TWO assignments. Each test will be for 50 marks, each quiz will be for 10 marks and each assignment for 10 marks each. The total marks of tests, quizzes, assignment will be divided by 2 for computing the CIE marks. All three tests, quizzes and assignments are compulsory.

Scheme of Semester End Examination (SEE) for Theory 100 marks:
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit.
MACHINE LEARNING
(Elective-3)

Course Code : 18MCS242  
CIE Marks : 100
Hrs/Week : L: T: P 4:0:0  
SEE Marks : 100
Credits : 04  
SEE Duration : 03 Hrs

UNIT – I  
07 Hrs
Introduction: Overview of Probability Theory, Model Selection, Introduction to Machine learning. Linear Regression – Basis Function models, Bias Variance Decomposition, Bayesian linear Regression; Stochastic gradient Descent, Discriminant Functions, Bayesian Logistic regression. Examples (3.2.1 & 4.4.2 – Reference Book 2)

UNIT – II  
07 Hrs
Supervised Learning
Kernel Methods: Dual representations, Construction of a kernel, Radial Basis Function Networks, Gaussian Process, Tree Based methods (9.2 from Reference Book 2). Sparse Kernel Machines: Maximum margin classifiers (SVM), RVM. Examples (9.2.5, 12.2.2 & 13.3 – Reference Book 2)

UNIT – III  
07 Hrs
Unsupervised Learning:

UNIT – IV  
07 Hrs
Random Forests:

UNIT - V  
07 Hrs
Ensemble Learning:

Course Outcomes:

After going through this course the student will be able to:

CO2: Apply the various dimensionality reduction techniques and learning models for the given Application.
CO3: Analyze the different types of supervised and unsupervised learning models.
CO4: Evaluate the classification and regression algorithms for given data set.

Reference Books:

2. The Elements of Statistical Learning, Trevor Hastie, Robert Tibshirani, and Jerome Friedman , Springer, 2008.
Scheme of Continuous Internal Evaluation (CIE) for Theory 100 marks:
CIE will consist of THREE Tests, THREE Quizzes and TWO assignments. Each test will be for 50 marks, each quiz will be for 10 marks and each assignment for 10 marks each. The total marks of tests, quizzes, assignment will be divided by 2 for computing the CIE marks. All three tests, quizzes and assignments are compulsory.

Scheme of Semester End Examination (SEE) for Theory 100 marks:
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit.
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**UNIT – I**

**09 Hrs**

**Bio-fluid mechanics:**
Newton's laws, Stress and Strain, Viscosity, Relationship between diameter, velocity and pressure of blood flow, Resistance against flow.

**Flow properties of blood:**
Physical, Chemical and Rheological properties of blood, Blood viscosity variation, Problems associated with extra corporeal blood flow.

**UNIT – II**

**09 Hrs**

**Bioviscoelastic fluid:**

**Rheology of blood in microvessels:**
Fahreus-Lindquist effect and inverse effect, hematocrit in very narrow tube.

**UNIT – III**

**09 Hrs**

**Cardiac mechanics:**
Cardiovascular system, Mechanical properties of Blood vessels, Blood flow, Physics of cardiovascular diseases, Prosthetic heart valves.

**Respiratory mechanics:**

**UNIT – IV**

**09 Hrs**

**Soft tissue mechanics:**
Mechanical Properties, Structure, function and mechanical properties of skin, ligaments and tendons, Measuring principles of Cutometer, Durometer, Ballistometer.

**UNIT - V**

**09 Hrs**

**Orthopaedic mechanics:**
Mechanical properties of cartilage, Mechanical properties of bone, Kinetics and Kinematics of joints, Fundamental concepts of Gait analysis, Design of force platforms, Integrating force and Kinematic data.

**Course Outcomes:**

- CO1: Understand the basic mechanical concepts and relate the same to human physiology.
- CO2: Apply core concepts of biomechanics to solve engineering problems.
- CO3: Analyze the dynamics of human movement and comprehend the biomechanical principles that relate to movement and communication disabilities.
- CO4: Develop and apply the principles of biomechanics to a range of rehabilitation strategies and problem solving.

**Reference Books:**

Scheme of Continuous Internal Evaluation (CIE) for Theory 100 marks:
CIE will consist of THREE Tests, THREE Quizzes and TWO assignments. Each test will be for 50 marks, each quiz will be for 10 marks and each assignment for 10 marks each. The total marks of tests, quizzes, assignment will be divided by 2 for computing the CIE marks. All three tests, quizzes and assignments are compulsory.

Scheme of Semester End Examination (SEE) for Theory 100 marks:
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit.
### LASERS IN MEDICINE  
( Elective-4 )

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<td>Credits</td>
<td>04</td>
<td></td>
<td>SEE Duration</td>
</tr>
</tbody>
</table>

#### UNIT – I  
09 Hrs

**Basics of Lasers:** Principle of operation of laser, Characteristics of stabilization, Q-switching and mode locking, frequency stabilization, Line shape function, lasing threshold.

**Major types of lasers:** construction of Ruby, He-Ne, Nd-YAG, semiconductor, Argon and Carbon dioxide lasers, safety with lasers.

#### UNIT – II  
09 Hrs

**Optical fibers and their properties:** Introduction to Optical Fibers, principles of light propagation through a fiber, Different types of fibers and their properties, Transmission characteristics of optical fiber, Absorption losses, Scattering losses, Dispersion, advantages and disadvantages of optical fibers.

#### UNIT – III  
09 Hrs

**Light Sources and Detectors,** Light sources for fiber optics, photo detectors, source coupling, splicing and connectors, Waveguides and Micro-Optical Fiber Bundles.


#### UNIT – IV  
09 Hrs

**Therapeutic and Diagnostic Application of Laser in Ophthalmology and Case Studies:** Transmission and absorptive properties of ocular tissues, photo thermal laser application, photo disruptive laser application, photochemical laser application.

**Case Studies:** Laser interstitial thermal therapy (LITT), Lithotripsy, photo bleaching, photofrin photodynamic therapy in head and neck cancer, surgical application of laser in cardiology, Dentistry.

**Clinical Applications of Fiberoptic Laser System:** Fiber optic Laser System in Gastroenterology, Neurosurgery, Gynecology.

#### UNIT – V  
09 Hrs


**Lasers in Hair Removal:** Hair Removal and Laser Biology, Further Laser Biology: Wavelength, Spot Size, Fluence, and Cooling Methods, IPL Devices and Hair Removal, RF Devices and Hair Removal.


#### Course Outcomes:

After going through this course, the student will be able to:

- CO1: Understand the basic concepts of lasers and optical fibers.
- CO2: Apply the knowledge of fiber optic laser system to various healthcare applications.
- CO3: Analyze the effect of using Lasers for diagnosis, therapeutic and treatment of various health issues.
- CO4: Evaluate the choice of laser for the application intended.

#### Reference Books:

Scheme of Continuous Internal Evaluation (CIE) for Theory 100 marks:
CIE will consist of THREE Tests, THREE Quizzes and TWO assignments. Each test will be for 50 marks, each quiz will be for 10 marks and each assignment for 10 marks each. The total marks of tests, quizzes, assignment will be divided by 2 for computing the CIE marks. All three tests, quizzes and assignments are compulsory.

Scheme of Semester End Examination (SEE) for Theory 100 marks:
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit.
### IoT FOR HEALTHCARE
(Elective-4)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>18MBS 252</th>
<th>CIE Marks</th>
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</thead>
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<tr>
<td>Credits</td>
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<tr>
<td>SEE Marks</td>
<td></td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>SEE Duration</td>
<td></td>
<td></td>
<td>03 Hrs</td>
</tr>
</tbody>
</table>

**UNIT – I**

**IoT Landscape:** Introduction to IoT, Applications, Architectures, Wireless Networks, Security and Privacy, Event-Driven Systems
IoT Smart X Applications- Smart health platform, Smart energy, Smart home, Smart food, water, tracking and sensitivity

**UNIT – II**

**IoT and Assistive Technologies for people with disabilities:**
IoT - integrated state-of-the-art assistive technology, IoT applications for people who are deaf/hearing impaired, blind/visually impaired, and mobility disability.

**UNIT – III**

**IoT for ambient assisted living:** Introduction, system design, general architecture, wearable devices, experimental evaluation, functional list, operation list, and results.

**Hybrid integration system for wearable sensor system:** Introduction, State-of-the-art of current health care wearable system(WHCS), a desirable WHCS, customized IC for wearable sensors, State-of-the-Art SoC technology, Bio sensing SoC architecture and applications

**UNIT – IV**

**Hybrid integration system for wearable sensor system:** Printed electrodes and their characteristics, electrode technology, active electrode, passive electrode, dry electrode.

**Hybrid integration of flexible wearable sensors:** flexible circuits and interconnection, silicon on flex bio-patch implementation and miniaturization.

**UNIT - V**

**Role of time in IoT:**
Introduction, Blood flow analysis, circulation diagnosis, flow quantification, synchronization in space, blood pressure, health things-single device, distinct times, multiple device-single time, redundant device, tolerance, data reliability.

**Case studies:** Fall detection, Physical monitoring of aged people, hygienic hand control, Chronic disease management, sports men care, remote control appliances, sleep control, animal/ human tracking, indoor climate control, waste management, etc (any one per student).

**Course Outcomes:**

After going through this course the students will be able to,

- CO1: Understand the fundamentals required for IoT.
- CO2: Apply the concepts of IoT to medical devices.
- CO3: Evaluate performance of IoT against other technologies.
- CO4: Create an IoT application for biomedical Engineering.
<table>
<thead>
<tr>
<th>Reference Books:</th>
<th></th>
</tr>
</thead>
</table>

**Scheme of Continuous Internal Evaluation (CIE) for Theory 100 marks:**
CIE will consist of THREE Tests, THREE Quizzes and TWO assignments. Each test will be for 50 marks, each quiz will be for 10 marks and each assignment for 10 marks each. The total marks of tests, quizzes, assignment will be divided by 2 for computing the CIE marks. All three tests, quizzes and assignments are compulsory.

**Scheme of Semester End Examination (SEE) for Theory 100 marks:**
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit.
BASICS OF ORTHOPAEDICS, MEDICINE & ETHICS  
(Elective-4)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>CIE Marks</th>
<th>Hrs/Week</th>
<th>SEE Marks</th>
<th>Credits</th>
<th>SEE Duration</th>
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<tr>
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<td>L: T: P</td>
<td>100</td>
<td>04</td>
<td>03 Hrs</td>
</tr>
</tbody>
</table>

UNIT – I  
09 Hrs

Introduction to Orthopedics: Basics of orthopedics, Skeletal System Organization, Bone formation and growth, Fracture healing.


UNIT – II  
09 Hrs

Medical Ethics: Theory, principles, rules and moral decisions, Belmont report, the principles of biomedical ethics: respect for autonomy, voluntariness information and informed consent, competency, non-malefeasance, the rule of the double effect, benefecience, paternalism, justice, agencies validating the medical equipments

UNIT – III  
09 Hrs

Introduction to Medicine: General Physical Examination of the patient, Case sheet writing.

Diseases associated with Respiratory system and Cardiovascular system: Basic Investigations of Respiratory and CVS, Cough and Sputum, Bronchial-Asthma, COPD, Pulmonary Tuberculosis, Cardiac arrest, Ischaemic Heart Disease

UNIT – IV  
09 Hrs

Neurology and Renal Disorders; Basic Investigations in Neurology and Renal diseases, Epilepsy, Cerebrovascular Diseases, Myasthenia gravis, Acute and chronic renal failure, Glomerular Diseases, UTI, Renal Calculi

UNIT - V  
09 Hrs


Communicable and Non-Communicable Diseases: Malaria, Typhoid, Vector borne viral fever-Dengue, Chikungunya & Yellow fever. Hypertension and Diabetes Types of Diabetes and Management of Diabetes.

Course Outcomes:
CO1: Understand common diseases, their diagnosis and treatment procedures.
CO2. Apply necessary equipment used for investigations in diagnosing of diseases.
CO3. Analyze the factors that are affecting the cause for disease using necessary medical equipment.
CO4. Develop the habit of applying medical ethics in detecting, diagnosing and use of medical equipments.

Reference Books:
4. Basic principles and acquisition of Intellectual Property Rights, Dr. T Ramakrishna ,CIPRA, NSLIU -2005.
Scheme of Continuous Internal Evaluation (CIE) for Theory 100 marks:
CIE will consist of THREE Tests, THREE Quizzes and TWO assignments. Each test will be for 50 marks, each quiz will be for 10 marks and each assignment for 10 marks each. The total marks of tests, quizzes, assignment will be divided by 2 for computing the CIE marks. All three tests, quizzes and assignments are compulsory.

Scheme of Semester End Examination (SEE) for Theory 100 marks:
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit.
<table>
<thead>
<tr>
<th>UNIT</th>
<th>HOURS</th>
<th>TOPICS</th>
</tr>
</thead>
<tbody>
<tr>
<td>III</td>
<td>08</td>
<td>Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, Predictive Analytics, Predicative Modeling, Predictive analytics analysis.</td>
</tr>
</tbody>
</table>

**Course Outcome:**

At the end of this course graduates will be able to:

- CO1. Explore the concepts, data and models for Business Analytics.
- CO2. Analyze various techniques for modelling and prediction.
- CO3. Design the clear and actionable insights by translating data.
- CO4. Formulate decision problems to solve business applications

**Reference Books**

Scheme of Continuous Internal Evaluation (CIE) for 100 marks:
CIE will consist of THREE Tests, THREE Quizzes and TWO assignments. Each test will be for 50 marks, each quiz will be for 10 marks and each assignment for 10 marks each. The total marks of tests, quizzes, assignment will be divided by 2 for computing the CIE marks. All three tests, quizzes and assignments are compulsory.

Scheme of Semester End Examination (SEE) for 100 marks:
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit.
INDUSTRIAL & OCCUPATIONAL HEALTH AND SAFETY (GLOBAL ELECTIVES)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>CIE Marks</th>
<th>Hrs/Week</th>
<th>SEE Marks</th>
<th>Credits</th>
<th>SEE Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 GCV 262</td>
<td>100</td>
<td>L: T: P</td>
<td>3:0:0</td>
<td>03</td>
<td>3Hrs</td>
</tr>
</tbody>
</table>

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

UNIT – II  

UNIT – III  

UNIT – IV  
**Wear and Corrosion and their prevention:** Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw

<table>
<thead>
<tr>
<th>UNIT – V</th>
<th>07Hrs</th>
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</thead>
<tbody>
<tr>
<td><strong>Periodic and preventive maintenance</strong>: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, over hauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.</td>
<td></td>
</tr>
</tbody>
</table>

**Expected Course Outcomes:**

After successful completion of this course the student will be able to:

CO1: Explain the Industrial and Occupational health and safety and its importance.
CO2: Demonstrate the exposure of different materials, occupational environment to which the employee can expose in the industries.
CO3: Characterize the different type materials, with respect to safety and health hazards of it.
CO4: Analyze the different processes with regards to safety and health and the maintenance required in the industries to avoid accidents.

**Reference Books:**

4. 

**Scheme of Continuous Internal Evaluation (CIE) for 100 marks:**

CIE will consist of THREE Tests, THREE Quizzes and TWO assignments. Each test will be for 50 marks, each quiz will be for 10 marks and each assignment for 10 marks each. The total marks of tests, quizzes, assignment will be divided by 2 for computing the CIE marks. All three tests, quizzes and assignments are compulsory.

**Scheme of Semester End Examination (SEE) for 100 marks:**

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit.
## Modeling Using Linear Programming

<table>
<thead>
<tr>
<th>Course Code</th>
<th>18 GIM 263</th>
<th>CIE Marks</th>
<th>100</th>
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<tr>
<td>Hrs/Week</td>
<td>L: T: P</td>
<td>SEE Marks</td>
<td>100</td>
</tr>
<tr>
<td>Credits</td>
<td>3</td>
<td>SEE Duration</td>
<td>3 hrs</td>
</tr>
</tbody>
</table>

**Unit – I** 07 Hrs

**Linear Programming**: Introduction to Linear Programming problem  
**Simplex methods**: Variants of Simplex Algorithm – Use of Artificial Variables

**Unit – II** 07 Hrs

**Advanced Linear Programming**: Two Phase simplex techniques, Revised simplex method  
**Duality**: Primal-Dual relationships, Economic interpretation of duality

**Unit – III** 07 Hrs

**Sensitivity Analysis**: Graphical sensitivity analysis, Algebraic sensitivity analysis - changes in RHS, Changes in objectives, Post optimal analysis - changes affecting feasibility and optimality

**Unit – IV** 08 Hrs

**Transportation Problem**: Formulation of Transportation Model, Basic Feasible Solution using North-West corner, Least Cost, Vogel's Approximation Method, Optimality Methods, Unbalanced Transportation Problem, Degeneracy in Transportation Problems, Variants in Transportation Problems.

**Unit-V** 07 Hrs


**Course Outcomes:**

After going through this course the student will be able to:

- CO1: Explain the various Linear Programming models and their areas of application.
- CO2: Formulate and solve problems using Linear Programming methods.
- CO3: Develop models for real life problems using Linear Programming techniques.
- CO4: Analyze solutions obtained through Linear Programming techniques.

**Reference Books:**


**Scheme of Continuous Internal Evaluation (CIE) for 100 marks:**

CIE will consist of THREE Tests, THREE Quizzes and TWO assignments. Each test will be for 50 marks, each quiz will be for 10 marks and each assignment for 10 marks each. The total marks of tests, quizzes, assignment will be divided by 2 for computing the CIE marks. All three tests, quizzes and assignments are compulsory.

**Scheme of Semester End Examination (SEE) for 100 marks:**

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit.
### PROJECT MANAGEMENT

<table>
<thead>
<tr>
<th>Course Code</th>
<th>18 GIM 264</th>
<th>CIE Marks</th>
<th>100</th>
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</thead>
<tbody>
<tr>
<td>Hrs/Week</td>
<td>L: T: P</td>
<td>SEE Marks</td>
<td>100</td>
</tr>
<tr>
<td>Credits</td>
<td></td>
<td>SEE Duration</td>
<td>3 hrs</td>
</tr>
</tbody>
</table>

#### Unit – I

#### Unit – II
**Capital Budgeting:** Capital Investments: Importance and Difficulties, phases of capital budgeting, levels of decision making, facets of project analysis, feasibility study – a schematic diagram, objectives of capital budgeting.

#### Unit – III

#### Unit – IV
**Tools & Techniques of Project Management:** Bar (GANTT) chart, bar chart for combined activities, logic diagrams and networks, Project evaluation and review Techniques (PERT) Critical Path Method (CPM), Computerized project management.

#### Unit – V
**Project Management and Certification:** An introduction to SEI, CMMI and project management institute USA – importance of the same for the industry and practitioners. PMBOK 6 - Introduction to Agile Methodology, Themes / Epics / Stories, Implementing Agile.

**Domain Specific Case Studies on Project Management:** Case studies covering project planning, scheduling, use of tools & techniques, performance measurement.

### Course Outcomes:
**After going through this course the student will be able to:**
- CO1: Explain project planning activities that accurately forecast project costs, timelines, and quality.
- CO2: Evaluate the budget and cost analysis of project feasibility.
- CO3: Analyze the concepts, tools and techniques for managing projects.
- CO4: Illustrate project management practices to meet the needs of Domain specific stakeholders from multiple sectors of the economy (i.e. consulting, government, arts, media, and charity organizations)

### Reference Books:
Scheme of Continuous Internal Evaluation (CIE) for 100 marks:
CIE will consist of THREE Tests, THREE Quizzes and TWO assignments. Each test will be for 50 marks, each quiz will be for 10 marks and each assignment for 10 marks each. The total marks of tests, quizzes, assignment will be divided by 2 for computing the CIE marks. All three tests, quizzes and assignments are compulsory.

Scheme of Semester End Examination (SEE) for 100 marks:
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit.
# ENERGY MANAGEMENT

<table>
<thead>
<tr>
<th>Course Code:</th>
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<th>CIE Marks: 100</th>
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<td>Credits:</td>
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<td>Exam Hrs: 3</td>
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</table>

<table>
<thead>
<tr>
<th>Unit – I</th>
<th>08 Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Energy conservation:</strong> Principles of energy conservation and energy audit, types of energy audit, Energy conservation approaches, Cogeneration and types of cogeneration, Heat recuperators- classification, liquid/gas and gas/liquid heat exchangers</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Unit – II</th>
<th>07 Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wet Biomass gasifiers:</strong> Introduction, Classification of feedstock for biogas generation. Biomass conversion technologies: Wet and dry processes, Photosynthesis, Biogas generation, Factors affecting biogas digestion, Classification of biogas plants, Floating drum plant and fixed dome plant their advantages and disadvantages, Biogas from aquatic weed.</td>
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</table>

<table>
<thead>
<tr>
<th>Unit – III</th>
<th>08 Hrs</th>
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</thead>
<tbody>
<tr>
<td><strong>Dry Biomass Gasifiers:</strong> Biomass energy conversion routes, Thermal gasification of biomass, Classification of gasifiers, Fixed bed systems: Construction and operation of up draught and down draught gasifiers. Pyrolysis.</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Unit – IV</th>
<th>08 Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Solar Photovoltaic:</strong> Principle of photovoltaic conversion of solar energy, types of solar cells and fabrication. Wind Energy: Atmospheric circulations, classification, factors influencing wind, wind shear, turbulence, wind speed monitoring, Betz limit, WECS: classification, characteristics, and applications</td>
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</table>

<table>
<thead>
<tr>
<th>Unit – V</th>
<th>08 Hrs</th>
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</thead>
</table>

## Course Outcomes:
After completion of the course student will be able to:
1. Understand the use alternate fuels for energy conversion
2. Develop a scheme for energy audit
3. Evaluate the factors affecting biomass energy conversion
4. Design a biogas plant for wet and dry feed

## Reference Books:

Scheme of Continuous Internal Evaluation (CIE) for 100 marks:
CIE will consist of THREE Tests, THREE Quizzes and TWO assignments. Each test will be for 50 marks, each quiz will be for 10 marks and each assignment for 10 marks each. The total marks of tests, quizzes, assignment will be divided by 2 for computing the CIE marks. All three tests, quizzes and assignments are compulsory.

Scheme of Semester End Examination (SEE) for 100 marks:
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit.
### INDUSTRY 4.0

<table>
<thead>
<tr>
<th>Course Code</th>
<th>18 GME 266</th>
<th>CIE Marks</th>
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<tr>
<td>Credits</td>
<td>03</td>
<td></td>
<td>SEE Duration</td>
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</table>

#### Unit – I [10 Hrs]
**Introduction:** Industrial, Internet, Case studies, Cloud and Fog, M2M Learning and Artificial Intelligence, AR, Industrial Internet Architecture Framework (IIAF), Data Management.

#### Unit – II [10 Hrs]

#### Unit – III [10 Hrs]


#### Unit – IV [10 Hrs]

#### Unit – V [10 Hrs]
**Augmented Reality:** The Role of Augmented Reality in the Age of Industry 4.0, Introduction, AR Hardware and Software Technology, Industrial Applications of AR, Maintenance, Assembly, Collaborative Operations, Training.

Smart Factories: Introduction, Smart factories in action, Importance, Real world smart factories, The way forward.


#### Course Outcomes:
After going through this course the student will be able to:

- **CO1:** Understand the opportunities, challenges brought about by Industry 4.0 for benefits of organizations and individuals
- **CO2:** Analyze the effectiveness of Smart Factories, Smart cities, Smart products and Smart services
- **CO3:** Apply the Industrial 4.0 concepts in a manufacturing plant to improve productivity and profits
- **CO4:** Evaluate the effectiveness of Cloud Computing in a networked economy

#### Reference Books

4. ONE MORE REQUIRED

**Scheme of Continuous Internal Evaluation (CIE) for 100 marks:**
CIE will consist of THREE Tests, THREE Quizzes and TWO assignments. Each test will be for 50 marks, each quiz will be for 10 marks and each assignment for 10 marks each. The total marks of tests, quizzes, assignment will be divided by 2 for computing the CIE marks. All three tests, quizzes and assignments are compulsory.

**Scheme of Semester End Examination (SEE) for 100 marks:**
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit.
ADVANCED MATERIALS

<table>
<thead>
<tr>
<th>Course Code</th>
<th>CIE Marks</th>
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<th>Credits</th>
<th>SEE Duration</th>
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<tbody>
<tr>
<td>03</td>
<td>3 Hours.</td>
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</tbody>
</table>

Unit – I


Unit – II


Unit – III

High Strength Materials: Methods of strengthening of alloys, Materials available for high strength applications, Properties required for high strength materials, Applications of high strength materials.

Unit – IV

Low & High Temperature Materials
Properties required for low temperature applications, Materials available for low temperature applications, Requirements of materials for high temperature applications, Materials available for high temperature applications, Applications of low and high temperature materials.

Unit – V

Nanomaterials: Definition, Types of nanomaterials including carbon nanotubes and nanocomposites, Physical and mechanical properties, Applications of nanomaterials

Course Outcomes:

After going through this course the student will be able to
- CO1: Describe metallic and non metallic materials
- CO2: Explain preparation of high strength Materials
- CO3: Integrate knowledge of different types of advanced engineering Materials
- CO4: Analyse problem and find appropriate solution for use of materials.

Reference Books:

3. Dr. VD Kodgire and Dr. S V Kodgire, Material Science and Metallurgy 42nd Edition 2018, Everest Publishing House ISBN NO: 81 86314 00 8

Scheme of Continuous Internal Evaluation (CIE) for Theory
CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE) for Theory
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.
MINOR PROJECT

<table>
<thead>
<tr>
<th>Course Code</th>
<th>18 MBS27</th>
<th>CIE Marks</th>
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</tr>
</thead>
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<tr>
<td>Hrs/Week</td>
<td>L: T: P</td>
<td>0:0:2</td>
<td>SEE Marks</td>
</tr>
<tr>
<td>Credits</td>
<td>02</td>
<td>SEE Duration</td>
<td>03 Hrs</td>
</tr>
</tbody>
</table>

GUIDELINES

1. Each project group will consist of maximum of two students.
2. Each student / group has to select a contemporary topic that will use the technical knowledge of their program of study after intensive literature survey.
3. Allocation of the guides preferably in accordance with the expertise of the faculty.
4. The number of projects that a faculty can guide would be limited to four.
5. The minor project would be performed in-house.
6. The implementation of the project must be preferably carried out using the resources available in the department/college.

Course Outcome:

After going through this course the students will be able to

CO1: Conceptualize, design and implement solutions for specific problems.
CO2: Communicate the solutions through presentations and technical reports.
CO3: Apply resource managements skills for projects
CO4: Synthesize self-learning, team work and ethics.

Scheme of Continuous Internal Examination (CIE)

Evaluation will be carried out in THREE Phases. The evaluation committee will comprise of FOUR members: guide, two senior faculty members and Head of the Department.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Activity</th>
<th>Weightage</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Synopsis submission, Preliminary seminar for the approval of selected topic and Objectives formulation</td>
<td>20%</td>
</tr>
<tr>
<td>II</td>
<td>Mid-term seminar to review the progress of the work and documentation</td>
<td>40%</td>
</tr>
<tr>
<td>III</td>
<td>Oral presentation, demonstration and submission of project report</td>
<td>40%</td>
</tr>
</tbody>
</table>

**Phase wise rubrics to be prepared by the respective departments

CIE Evaluation shall be done with weightage / distribution as follows:

- Selection of the topic & formulation of objectives 10%
- Design and simulation/ algorithm development/experimental setup 25%
- Conducting experiments / implementation / testing 25%
- Demonstration & Presentation 15%
- Report writing 25%
Scheme for Semester End Evaluation (SEE):

The evaluation will be done by ONE senior faculty from the department and ONE external faculty member from Academia / Industry / Research Organization. The following weightages would be given for the examination. Evaluation will be done in batches, not exceeding 6 students.

1. Brief write-up about the project 05%
2. Presentation / Demonstration of the project 20%
3. Methodology and Experimental Results & Discussion 25%
4. Report 20%
5. Viva Voce 30%