SYLLABUS & CURRICULUM

Of

B.Tech.
BIOMEDICAL ENGINEERING
(3rd to 8th Semesters)

UNIVERSITY OF CALICUT
(2014 Admission)
### SCHEME OF III SEMESTER B.Tech COURSE

<table>
<thead>
<tr>
<th>Code</th>
<th>Subject</th>
<th>Hours/ Week</th>
<th>Marks</th>
<th>Duration of End Semester examination</th>
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<tbody>
<tr>
<td>EN14 301</td>
<td>Engineering Mathematics III</td>
<td>L: 3</td>
<td>T: 1</td>
<td>P/D 0</td>
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<tr>
<td>EN14 302</td>
<td>Computer Programming in C</td>
<td>L: 3</td>
<td>T: 0</td>
<td>P/D 1</td>
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<tr>
<td>BM14 303</td>
<td>Electrical Technology</td>
<td>L: 3</td>
<td>T: 1</td>
<td>P/D 0</td>
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<tr>
<td>BM14 304</td>
<td>Life Science</td>
<td>L: 3</td>
<td>T: 1</td>
<td>P/D 0</td>
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<tr>
<td>BM14 305</td>
<td>Digital Principles and Design</td>
<td>L: 3</td>
<td>T: 1</td>
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<tr>
<td>BM14 306</td>
<td>Analog Electronics</td>
<td>L: 3</td>
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<tr>
<td>BM14 307 (P)</td>
<td><strong>Basic Electronics Lab</strong></td>
<td>L: 0</td>
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<tr>
<td>BM14 308 (P)</td>
<td><strong>Electrical Engineering Lab</strong></td>
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<td>P/D 3</td>
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<td>L: 18</td>
<td>T: 6</td>
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**Note:** For EN 14 302 Computer Programming in C, the end semester examination will be held by the University as a theory paper.

### SCHEME OF IV SEMESTER B.Tech COURSE

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<tr>
<th>Code</th>
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<th>Hours/ Week</th>
<th>Marks</th>
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<tbody>
<tr>
<td>EN14 401B</td>
<td>Engineering Mathematics IV</td>
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<tr>
<td>EN14 402</td>
<td>Environmental Science</td>
<td>L: 3</td>
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<tr>
<td>BM14 403</td>
<td>Signals and Systems</td>
<td>L: 3</td>
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<tr>
<td>BM14 404</td>
<td>Electronic Instrumentation</td>
<td>L: 3</td>
<td>T: 1</td>
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<tr>
<td>BM14 405</td>
<td>Linear Integrated Circuits</td>
<td>L: 3</td>
<td>T: 1</td>
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<tr>
<td>BM14 406</td>
<td>Microprocessors and Interfacing</td>
<td>L: 3</td>
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<td>BM14 407 (P)</td>
<td><strong>Electronic Circuits Lab</strong></td>
<td>L: 0</td>
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<td>BM14 408 (P)</td>
<td><strong>Digital Electronics Lab</strong></td>
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### SCHEME OF V SEMESTER B.Tech COURSE

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<tr>
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<td>P/D</td>
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<tr>
<td>BM14 501</td>
<td>Medical Physics</td>
<td>3</td>
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<tr>
<td>BM14 502</td>
<td>Medical Instrumentation</td>
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<tr>
<td>BM14 503</td>
<td>Digital Signal Processing</td>
<td>3</td>
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<tr>
<td>BM14 504</td>
<td>Advanced Microprocessors and Microcontrollers</td>
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<tr>
<td>BM14 505</td>
<td>Computer Organization and Architecture</td>
<td>3</td>
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<tr>
<td>BM14 506</td>
<td>Biosensors and Transducers</td>
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<td>BM14 508 (P)</td>
<td>Microprocessors and Microcontrollers Lab</td>
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### SCHEME OF VI SEMESTER B.Tech COURSE

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<th>Marks</th>
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<tr>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P/D</td>
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<tr>
<td>BM14 601</td>
<td>Engineering Economics</td>
<td>3</td>
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### BM14 602
Medical Imaging Techniques
3 1 0

### BM14 603
Advanced Digital signal Processing
3 1 0

### BM14 604
Control Systems
3 1 0

### BM14 605
Digital Systems Design
3 1 0

### BM14 606
Hospital Engineering and Management
3 1 0

### BM14 607 (P)
Medical Embedded & Virtual Instrumentation Lab
0 0 3

### BM14 608 (P)
Mini Project
0 0 3

**TOTAL**
18 6 6

**Note:** The End semester examination for Mini Project shall be conducted internally at Institution Level.

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### SCHEME OF VII SEMESTER B.Tech.

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<th>Code</th>
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<tr>
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<tr>
<td>BM14 701</td>
<td>Digital Image Processing</td>
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<td>BM14 702</td>
<td>Soft Computing Techniques</td>
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<td>BM14 703</td>
<td>Biomechanics</td>
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<td>BM14 704</td>
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<td>BM14 706 (P)</td>
<td>Biomedical and Clinical Instrumentation Lab</td>
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<td>BM14 707 (P)</td>
<td>Biomedical Signal Processing Lab</td>
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<td>BM14 708 (P)</td>
<td>Project</td>
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**Elective I**

<table>
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<tbody>
<tr>
<td>BM14 704(A)</td>
<td>Bio-Nanotechnology (Global Elective)</td>
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<tr>
<td>BM14 704(B)</td>
<td>Pattern Recognition (Global Elective)</td>
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<td>BM14 704(C)</td>
<td>Advanced Medical Instrumentation</td>
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<td>BM14 704(D)</td>
<td>Rehabilitation Engineering</td>
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<td>BM14 704(E)</td>
<td>Fundamentals of Bioacoustics</td>
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<td>BM14 705(A)</td>
<td>Human Factors in Engineering and Design</td>
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<td>BM14 705(B)</td>
<td>Advanced Signal Processing</td>
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<tr>
<td>BM14 705(C)</td>
<td>Fundamentals of BIOMEMS and Medical Micro devices</td>
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<td>BM14 705(D)</td>
<td>Computer Based Numerical Methods (Global Elective)</td>
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<td>BM14 705(E)</td>
<td>Research methodology (Global Elective)</td>
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**SCHEME OF VIII SEMESTER B.Tech COURSE**

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<tr>
<td>BM14 801</td>
<td>Communication Systems</td>
<td>3</td>
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<tr>
<td>BM14 802</td>
<td>Advanced Biomedical Techniques &amp; Applications</td>
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<tr>
<td>BM14 803</td>
<td>Biomaterials</td>
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<td>BM14 804</td>
<td>Elective III</td>
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<td>BM14 805</td>
<td>Elective IV</td>
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<td>BM14 806 (P)</td>
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<td>BM14 808 (P)</td>
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**Elective III**

- BM14 804(A) Artificial Organs and Implants
- BM14 804(B) Total Quality Management (Global Elective)
- BM14 804(C) Reliability and Quality Control
- BM14 804(D) Virtual Instrumentation
- BM14 804(E) Mobile Communications (Global Elective)

**Elective IV**

- BM14 805(A) Principles of Radiography & Radiology
- BM14 805(B) Robotics and Automation (Global Elective)
- BM14 805(C) Entrepreneurship (Global Elective)
- BM14 805(D) Probability and Random Processes
- BM14 805(E) Embedded System Design
THIRD SEMESTER

EN14 301: ENGINEERING MATHEMATICS III
(Common for all branches)

<table>
<thead>
<tr>
<th>Teaching scheme</th>
<th>Credits: 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 hours lectures and 1 hour Tutorial per week</td>
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</table>

Objective

- To provide a quick overview of the concepts and results in complex analysis that may be useful in engineering.
- To introduce the concepts of linear algebra and Fourier transform which are wealths of ideas and results with wide area of application.

Module I: Functions of a Complex Variable (13 hours)

Module II: Functions of a Complex Variable (13 hours)

Module III: Linear Algebra (13 hours) – (Proofs not required)

Module IV: Fourier Transforms (13 hours)


Text Books

Module I:
Erwin Kreysig, Advanced Engineering Mathematics, 8e, John Wiley and Sons, Inc.
Sections: 12.3, 12.4, 12.5, 12.6, 12.7, 12.9

Module II:
Erwin Kreysig, Advanced Engineering Mathematics, 8e, John Wiley and Sons, Inc.
Sections: 13.1, 13.2, 13.3, 13.4, 14.4, 15.1, 15.2, 15.3, 15.4

Module III:
BernadKolman, David R Hill, Introductory Linear Algebra, An Applied First Course, Pearson Education.
Sections: 6.1, 6.2, 6.3, 6.4, 6.8, Appendix.B.1

Module IV:
Sections: 9.1, 9.3, 9.5

Reference books
3. Anuradha Gupta, Complex Analysis, Ane Books India.
7. Inder K Rana, An Introduction to Linear Algebra, Ane Books India.
10. Anthony Croft, Robert Davison, Martin Hargreaves, Engineering Mathematics, Pearson Education.

Internal Continuous Assessment (Maximum Marks-50)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Attendance and Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions \( 8 \times 5 \text{ marks} = 40 \text{ marks} \)
Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions \( 4 \times 15 \text{ marks} = 60 \text{ marks} \)
Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

EN14 302: COMPUTER PROGRAMMING IN C
(Common for all branches)

Teaching scheme
Credits: 4
3 hours lectures and 1 hour lab per week

Objectives

• To Impart the basic concepts of Computer and Information Technology
• To develop skill in problem solving concepts through learning C programming in practical approach.

Module I (13 hours)


**Module II (13 hours)**

**Basic elements of C**: Flow chart and algorithm – Development of algorithms for simple problems. Structure of C program – Operators and expressions – Procedure and order of evaluation – **Input and Output functions**. while, do-while and for statements, if, if-else, switch, break, continue, goto, and labels. Programming examples.

**Module III (13 hours)**


**Module IV (13 hours)**

**Structures** – declaration, definition and initialization of structures, unions, **Pointers**: Concepts, declaration, initialization of pointer variables simple examples **Concept of a file** – File operations File pointer.

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**Text Books**


**Reference Books**


### Internal Continuous Assessment (Maximum Marks-50)
- 50% - Lab Practical Tests
- 20% - Assignments
- 20% - Main Record
- 10% - Regularity in the class

### University Examination Pattern

**PART A:** Analytical/problem solving SHORT questions  
8 x 5 marks = 40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B:** Analytical/Problem solving DESCRIPTIVE questions  
4 x 15 marks = 60 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*

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**BM14 303: Electrical Technology**

**Teaching scheme**

<table>
<thead>
<tr>
<th>Teaching scheme</th>
<th>Credits:</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 hours lecture and 1 hour tutorial per week</td>
<td>4</td>
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</tbody>
</table>

Objectives

To give fundamental knowledge about the following topics of electrical technology

- DC generators and motors
- Principle of Transformers
- AC machines

Module I (13 hours)


Module II (13 hours)


Module III (13 hours)


Module IV (13 hours)

Text Books
1. Vincent Del Toro, Electrical Engineering Fundamentals, Prentice-Hall of India
2. Hughes, Electrical technology, Tata McGraw Hill

Reference Books
2. P.S. Bhimbra, Electrical Machinery, Khanna Publishers
3. K. Murukesh Kumar, DC machines and Transformers, Vikas Publishing house Pvt Ltd.

Internal Continuous Assessment (Maximum Marks-50)
60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions 8x 5 marks=40 marks
Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks=60 marks
Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

BM14 304: Life Science

Teaching scheme
3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives

*To give fundamental knowledge about Cell biology, Anatomy and Physiology of the human body, & Different systems of the human body*

**MODULE 1 (13 hours)**

**MODULE II (13 hours)**
Muscular & Nervous System: Type of muscles and functional differences, Salient properties of muscles, Muscles as energy transducer, Muscle contraction (E-C coupling mechanism), Structure and function of neurons, Electrical potentials (Generator & receptor), Nerve conduction, synapse and properties, motor unit, Neuromuscular junction, receptors and reflex arc, Brain, spinal cord.
Skeletal System & Joints: Types of bones, classification, Structure and composition of bone, mechanical and electrical properties of bone, blood supply, Cartilage, tendon, ligament, Classification of joints, structure of synovial joint, major joints of the body, Teeth- Functional parts.

**MODULE III (13 hours)**
Cardiac & Respiratory System: Structure of heart and role as pump, Heart valves, Special junction tissues of heart, Cardiac cycle, Cardiac output, Coronary and peripheral circulation, Nerve control of heart, Blood Pressure, Feedback Control for Blood Pressure, Mechanism of respiration, respiratory membrane and gaseous exchange, feedback control mechanism of respiration. Artificial respiration – Cardio-Pulmonary Resuscitation.

**MODULE IV (13 hours)**

Text Books

3. Ross and Wilson: Anatomy and physiology in health and illness (ELBS pub)
4. A. Vander, J. Sherman and D. Luciante: Human Physiology

Reference Books

5. Gordon Sears and Winwood: “Anatomy and Physiology for Nurses”, ZELPS4
7. Paul and Reich: “Hematology PhysioPathological Basis for clinical Practice”, Little Brown

Internal Continuous Assessment (Maximum Marks-50)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions 8x 5 marks=40 marks
Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks=60 marks
Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

BM14 305: Digital Principles and Design

<table>
<thead>
<tr>
<th>Teaching scheme</th>
<th>Credits: 4</th>
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</thead>
<tbody>
<tr>
<td>3 hours lecture and 1 hour tutorial per week</td>
<td></td>
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</tbody>
</table>

Objectives

To introduce the concepts of digital logic systems such as Boolean algebra, flip-flops, counters, shift registers, Digital IC technologies, and sequential networks.

Module I (13 hours)
Analog and digital representation, Review of number systems-representation-conversions, 1’s and 2’s complement representation. Binary codes- error detection and error correction. Review of Boolean algebra-theorems, sum-of product and product of sum simplification, canonical forms - minterm and maxterm, Simplification of Boolean expressions - Karnaugh map (upto 4 variables), completely and incompletely specified functions, implementation of Boolean expressions using universal gates.

Module II (13 hours)
Module III (13 hours)
Shift registers, Universal shift register, applications. Binary counters - Synchronous and asynchronous up/down counters, mod-N counter, Counters for random sequence, Multivibrators - Astable and Monostable multivibrators using gates.

Module IV (13 hours)
Integrated circuit technologies - Characteristics and parameters. TTL Circuit-totem pole output-open collector-tristate gates-Schottky TTL, ECL.NMOS and PMOS logic, CMOS logic, Introduction to synchronous sequential networks, analysis- state tables and state diagrams, Modeling- Moore machine and Mealy machine-sequence recognizer.

Text Books

Reference Books
3. W. H. Gothmann, Digital Electronics- An Introduction to theory & Practice, PHI India.

Internal Continuous Assessment (Maximum Marks-50)
60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class
University Examination Pattern

PART A: Analytical/problem solving SHORT questions 8 x 5 marks = 40 marks
Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks = 60 marks
Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

BM14 306: Analog Electronics

<table>
<thead>
<tr>
<th>Teaching scheme</th>
<th>Credits: 4</th>
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<tbody>
<tr>
<td>3 hours lecture and 1 hour tutorial per week</td>
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</table>

Objectives

This course is designed as a foundation course in the field of analog electronic circuits. Analyses of electronic circuits using BJT, FET, UJT, MOSFET, etc are covered.

Module I (13 hours)
General characteristics of amplifiers - Amplifier classification - Transistor hybrid model - CF, CB and CC configuration - Comparison - Analysis of Transistor amplifier using h-parameters - current gain, voltage gain, input impedance, and output impedance - The amplifier with emitter resistor - FET - Small signal model - Low frequency CS and CD amplifier - FET biasing.
Power amplifiers - Class A large signal amplifiers - Transformer coupled Class A power amplifier - efficiency, Push pull amplifiers - Class B push pull amplifier, class B push pull circuit with complementary symmetry, Class AB amplifier. Biasing the class AB circuit, Class C amplifiers.

Module II (13 hours)
Feedback amplifiers - principles of feedback in amplifiers, advantages of negative feedback, Voltage series, current series, voltage shunt and current shunt feedback circuits. Oscillators-criteria for oscillation-RC phase shift and Wien bridge oscillator, Hartley, Colpitts and crystal oscillator frequency stability.

Module III (13 hours)
Enhancement type MOSFET - device structure, operation, current-voltage characteristics, depletion type MOSFET, DC analysis of MOSFET circuits, MOSFET as an amplifier- Biasing in MOSFET amplifier circuits, MOSFET as an analog switch, MOSFET internal capacitances and high frequency model, The MESFET UJT - Construction, Working principle and characteristics – UJT relaxation oscillator. Introduction to Thyristors – its characteristics & SCR characteristics.

Module IV (13 hours)

Text Books

1. C. Sedra and K. C. Smith, Microelectronic Circuits, Oxford Univ. Press, ND.

Reference Books

Internal Continuous Assessment (Maximum Marks-50)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions 8x 5 marks = 40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks = 60 marks

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

BM14 307 (P): Basic Electronics Lab

Objectives

• To train the students to obtain the characteristic curves of semiconductor devices like diode, transistor, FET, and UJT.

• To provide experience on design, testing, and analysis of electronic circuits—clipping and clamping circuits, RC filters, rectifiers, amplifier, etc.

• To expose the students to simulation of electronic circuits using any software

(Any 15 experiments)

1) Familiarization of important electronic components – Property, Numbering, Coding, Symbol.

2) Familiarization of Bread board, Cathode ray oscilloscope, Multimeters, DC source and signal generator.

3) Testing of Electronic components.

4) Characteristics of diode and Zener diode.

5) Clipping and Clamping circuits.

6) Rectifiers – Half wave, full wave, bridge – Ripple factor assessment.

7) Zener as a Voltage regulator.

8) Frequency response of RC low pass filter and high pass filter.

9) Characteristics of Transistor – Common emitter/Common Base configuration.

10) Transistor as an amplifier.

11) Emitter follower.

12) Transistor as a switch-timing calculation.

13) RC Phase shift Oscillator.

14) Characteristics of UJT,UJT Relaxation Oscillator.

15) Characteristics of MOSFET.

16) MOSFET as a switch and amplifier.

17) Introduction to any circuit simulation software (eg. PSPICE/EDSPICE/MULTISIM etc)

Simulation of following experiments
a) Diode characteristics
b) Transistor/MOSFET characteristics
c) Rectifier circuits
d) Clipping and clamping circuits.
e) RC Low pass and high pass fillers-frequency response
f) Common emitter amplifier

**Internal Continuous Assessment (Maximum Marks-50)**

60% - Laboratory practical and record

30% - Test/s

10% - Regularity in the class

**University Examination Pattern (Maximum Marks-100)**

70% - Procedure and tabulation form, Conducting experiment, results and inference

20% - Viva voce

10% - Fair record

**BM14 308 (P): Electrical Engineering Lab**

<table>
<thead>
<tr>
<th>Teaching scheme</th>
<th>Credits: 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 hours Practical per week</td>
<td></td>
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</tbody>
</table>
Objectives

*To provide practical experience to students in electrical instruments and machines especially*

- **DC machines and transformers**
- **AC machines**

1. Plot open circuit characteristics of DC shunt generator for rated speed - Predetermine O.C.C. for other speeds - Determine critical field resistance for different speeds.
2. Load test on DC shunt generator - Plot external characteristics - Deduce internal characteristics
3. Load test on DC series motor - Plot the performance characteristics.
4. OC and SC tests on single phase transformer - Determine equivalent circuit parameters – Predetermine efficiency and regulation at various loads and different power factors - verify for unity power factor with a load test.
5. Load test on 3 phase-cage induction motor - Plot performance curves.
6. Resistance measurement using a) Whetstone’s bridge b) Kelvin's double bridge.
8. Power measurement in 3 phase circuit - Two wattmeter method.
10. Calibration of single phase energy meter by direct loading.

**Internal Continuous Assessment** *(Maximum Marks-50)*

60% - Laboratory practical and record

30% - Test/s

10% - Regularity in the class

**University Examination Pattern** *(Maximum Marks-100)*
FOURTH SEMESTER

EN14 401B: Engineering Mathematics IV
(Common for IC, EC, EE, AI, BM, CS, and IT)

<table>
<thead>
<tr>
<th>Teaching scheme</th>
<th>Credits: 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 hours lecture and 1 hour tutorial per week</td>
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</table>

Objective
- To inculcate the students an adequate understanding of the basic concepts of probability theory.
- To make them develop an interest in the area which may find useful to pursue their studies
- To stimulate the students understanding of the z-transform
- To make the student get acquainted with the basics of PDE

Module I: Probability Distributions (13 hours)

Module II: Z– Transforms (13 hours)

**Module III: Series Solutions of Differential Equations (13 hours)**


**Module IV: Partial Differential Equations (13 hours)**

Introduction – Solutions of equations of the form $F(p,q) = 0$; $F(x,p,q) = 0$; $F(y,p,q) = 0$; $F(z,p,q) = 0$; $F_1(x,q) = F_2(y,q)$; Clairaut’s form, $z = px + qv + F(p,q)$; Lagrange’s form, $Pp + Qq = R$ – Classification of Linear PDE’s – Derivation of one dimensional wave equation and one dimensional heat equation – Solution of these equation by the method of separation of variables.
Text Books

Module I:

Richard A Johnson, CB Gupta, *Miller and Freund’s Probability and statistics for Engineers, 7e*, Pearson Education - Sections: 4.1, 4.2, 4.3, 4.4, 4.6, 4.8, 5.1, 5.2, 5.5, 5.7

Module II:


Sections: 12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.7.

Module III:


Sections: 4.1, 4.4, 4.5

Module IV:


Sections: 16.1, 16.2, 16.3, 16.4, 16.5, 16.6, 16.7, 16.8, 16.9


Sections: 11.2, 11.3, 9.8 Ex.3, 11.5

Reference books

**Internal Continuous Assessment** *(Maximum Marks-50)*

<table>
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<tr>
<th>Component</th>
<th>Percentage</th>
<th>Description</th>
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<tbody>
<tr>
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<td></td>
</tr>
<tr>
<td>Assignments (minimum 2)</td>
<td>30%</td>
<td>such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.</td>
</tr>
<tr>
<td>Attendance and Regularity</td>
<td>10%</td>
<td>in the class</td>
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</table>

**University Examination Pattern**

**PART A:**

*Analytical/problem solving*

8x 5 marks = 40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B:**

*Analytical/Problem solving*

4 x 15 marks = 60 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*

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**EN14 402  ENVIRONMENTAL SCIENCE**

(Common for all branches)

<table>
<thead>
<tr>
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<th>Credits: 4</th>
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<tr>
<td>3 hours lecture and 1 hour tutorial per week</td>
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</table>

**Objectives**
- To understand the problems of pollution, loss of forest, solid waste disposal, degradation of environment, loss of biodiversity and other environmental issues
- To create awareness among the students to address these issues and conserve the environment in a better way.

Module I (13 hours)
The Multidisciplinary nature of environmental science. Definition-scope and importance-need for public awareness. Natural resources. Renewable and non-renewable resources: Natural resources and associated problems-forest resources: Use and over exploitation, deforestation, case studies. Timber extraction, mining, dams and their defects on forests and tribal people- water resources: Use and over utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.- Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.- Food resources: World food problems, changes caused by agriculture over grazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.-Energy resources: Growing energy needs, renewable and non-renewable energy resources, use of alternate energy resources, Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

Module II (13 hours)
Ecosystems-Concept of an ecosystem-structure and function of an ecosystem – producers, consumers, decomposers-energy flow in the ecosystem-Ecological succession- Food chains, food webs and Ecological pyramids-Introduction, types, characteristics features, structure and function of the following ecosystem-Forest ecosystem- Grassland ecosystem –Desert ecosystem-Aquatic ecosystem(ponds, streams, lakes, rivers, oceans, estuaries)

Module III (13 hours)
Environmental pollution Definition-Causes, effects and control measures of Air pollution- Water pollution –soil pollution-Marine pollution-Noise pollution-Thermal pollution-Nuclear hazards-Solid waste
management: Causes, effects and control measures of urban and industrial wastes-Role of an individual in prevention of pollution. Pollution case studies-Disaster management: floods, earth quake, cyclone and landslides-Environmental impact assessment

Module IV (13 hours)
Environment and sustainable development-Sustainable use of natural resources-Conversion of renewable energy resources into other forms-case studies-Problems related to energy and Energy auditing-Water conservation, rain water harvesting, water shed management-case studies-Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust-Waste land reclamation-Consumerism and waste products-Reduce, reuse and recycling of products-Value education.

Text Books:
1. Daniels & Krishnaswamy, Environmental studies, Wiley India pvt ltd, 2009

References:
2. S.P Misra, S.N Pandey, Essential Environmental studies, Ane books, Pvt Ltd, 2009

Internal Continuous Assessment (Maximum Marks-50)
60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Attendance and Regularity in the class

Note: Field work can be Visit to a local area to document environmental assets-river/forest/grass land/mountain or Visit to local polluted site-urban/rural/industrial/agricultural etc. or Study of common plants, insects, birds etc. or Study of simple ecosystems-pond, river, hill slopes etc.

mini project work on renewable energy and other natural resources, management of wastes etc.

### University Examination Pattern

**PART A:** Analytical/problem solving SHORT questions

8x 5 marks = 40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B:** Analytical/Problem solving DESCRIPTIVE questions

4 x 15 marks = 60 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*

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**BM14 403: Signals and Systems**

**Teaching scheme**

3 hours lecture and 1 hour tutorial per week

**Credits: 4**

**Objectives**

- To impart the basic concepts of continuous and discrete signals and systems
- To develop understanding about frequency domain approaches for continuous and discrete time signals and systems.
- To establish the importance of z-transform and its properties for analyzing discrete time signals and systems.

---

Module I (13 hours)
Introduction to signals and systems-classification of signals- Basic operations on signals- Elementary signals- Concept of system- Properties of systems- Stability, Invertibility, Time invariance, Linearity, Causality, memory, Time domain description- Convolution- Impulse response representation of LTI systems- Differential equation and Difference equation representation of LTI systems.

MATLAB Exercise: Basic operations on elementary signals

Module II (13 hours)
Fourier representation of continuous time signals-Fourier transform- Existence of the Fourier integral-FT theorems- Frequency response of LTI systems- Condition for distortion less transmission through an LTI system- Transmission of a rectangular pulse through an ideal low pass filter-Sampling and reconstruction.

MATLAB Exercise: Convolution, Sampling of signals

Module III (13 hours)
Fourier representation of discrete time signals- Discrete Fourier series and Discrete Fourier transform- Frequency response of discrete LTI systems- Energy spectral density and power spectral density- Correlation theory of deterministic signals.

MATLAB Exercise: DTFT & Correlation

Module IV (13 hours)
Laplace Transform analysis of systems- Relation between the transfer function and differential equation- Causality and stability- Inverse system- Determining the frequency response from poles and zeroes. Z-transform- Definition- Properties of the region of convergence- Properties of the Z-transform. Analysis of LTI systems- Relating the transfer function and difference equation- Stability and causality tests of stability- Inverse systems- Determining the frequency response from poles and zeroes.

Text Books
1. S. Haykin and B. V. Veen, Signals and Systems, John Wiley & Sons, N. Y

Reference Books

Internal Continuous Assessment (Maximum Marks-50)
60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions 8x 5 marks = 40 marks
Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks = 60 marks
Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

BM14 404: Electronic Instrumentation

Teaching scheme

$$\text{Credits: 4}$$

3 hours lecture and 1 hour tutorial per week

Objectives

- To impart knowledge in the area of measurement principles
- To provide in depth understanding of operation, performance, and applications of important measuring instruments used in electronics laboratories.

Module I (13 hours)


Module II (13 hours)

Analog to digital converters-Tracking, successive approximation, charge distribution, flash, sub ranging, and integrating type ADCs -Digital to analog converters-weighted resistor, weighted capacitor, potentiometric, and R-2R ladder type DACs. Bipolar DACs, Master-slave DACs. Digital voltmeter: – Introduction – Ramp technique – Dual slope - Integrating type DVM – successive approximations type DVM – Resolution and sensitivity of digital meters – General specification of a DVM.

Module III (13 hours)


**Module IV (13 hours)**

Introduction, Basic principles, CRT features, Block diagram and working of each block, Typical CRT connections, Dual beam and dual trace CROs, Electronic switch. Graphic Recording Instruments: strip chart recorder, X-Y recorder, Plotter, Servo magnetic, U-V recorders, LEDs, liquid crystal display (LCD).

**Text Books**

1. D. A. Bell, Electronic Instrumentation and Measurements, Prentice Hall of India
2. S. Franco, Design with Operational Amplifiers and Analog Integrated Circuits, Tata Mc-Graw Hill, New Delhi (for ADCs and DACs only)
3. J. J. Carr, Elements of Electronic Instrumentation and Measurements, Pearson Education.

**Reference Books**


**Internal Continuous Assessment** *(Maximum Marks-50)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.

10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions  8 x 5 marks = 40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions  4 x 15 marks = 60 marks

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

BM14 405: Linear Integrated Circuits

Teaching scheme

3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives

- To expose the students to the principles of integrated circuit fabrication
- To provide in depth understanding of the fundamentals of Op-Amp and various circuits using 741 Op-Amp, 555 timer, and voltage regulator ICs.

Module I (13 hours)

Integrated circuit-fabrication, Introduction to Operational amplifier: Block diagram representation, analysis of a typical Op-Amp circuit, constant current bias, current mirror, the ideal Op-Amp, equivalent circuit of an Op-Amp, ideal voltage transfer curve, offset error voltages and currents, CMRR, PSRR. Frequency Response of an Op-Amp (brief discussion): Compensating networks, high frequency Op-Amp

equivalent, open loop and closed loop frequency response, Slew rate, causes of slew rate, effect of slew rate in applications. 741 Op-amp-Simplified internal circuit.

Module II (13 hours)
Op-Amp with negative feedback-non Inverting and inverting amplifiers- I/P resistance with feedback, O/P resistance, band width, voltage follower, concept of virtual ground, I to V converter, differential amplifier with one Op-Amp, instrumentation amplifier, AC amplifiers with single supply voltage, summing, scaling and averaging amps, V to I converter with floating load, V to I converter with grounded load. integrator, differentiator, comparator, zero crossing detector, timing mark generator, sample and hold circuit, Precision Diode, Precision rectifier, average detector, peak detector, logarithmic and antilog amplifiers, analog Multiplier.

Module III (13 hours)
Oscillators: principles, types, frequency stability, phase shift oscillator, Wien bridge oscillator. Active Filters: first order Butterworth low pass, high pass, band pass and band stop filters, second Order Butter worth low pass, high pass, band pass and band stop filters, all pass filter, universal active filters, switched capacitor filter-theory of operation, switched capacitor integrator.

Module IV (13 hours)
Astable, Monostable, Bistable multivibrators using op amps, triangular wave generator, saw tooth wave generator. Time base generators (Basic principle), Timer IC 555- Block diagram- Astable and Monostable circuits using IC 555, PLL - Basic principles & applications. Voltage regulators-Voltage Regulators, Design of Series Voltage Regulator- 723 switching regulators, Voltage regulator ICs – 78XX and 79XXseries , 8038 Function generator chip applications.
Text Books

1. S. Franco, Design with Operational Amplifiers and Analog Integrated Circuits, Tata Mc-Graw Hill, New Delhi (for ADCs and DACs only)
3. J. J. Carr, Elements of Electronic Instrumentation and Measurements, Pearson Education, Delhi
7. D. A. Bell, Electronic Instrumentation and Measurements, Prentice Hall of India, New Delhi

Reference Books


Internal Continuous Assessment (Maximum Marks-50)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

**PART A:** Analytical/problem solving SHORT questions  
\[ 8 \times 5 \text{ marks} = 40 \text{ marks} \]

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B:** Analytical/Problem solving DESCRIPTIVE questions  
\[ 4 \times 15 \text{ marks} = 60 \text{ marks} \]

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*

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**BM14 406: Microprocessors and Interfacing**

<table>
<thead>
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<th>Teaching scheme</th>
<th>Credits: 4</th>
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<tbody>
<tr>
<td>3 hours lecture and 1 hour tutorial per week</td>
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</table>

**Objectives**

*This course aims to equip the students with the basic knowledge of architecture, programming and interlacing of the microprocessor 8086 & various Interfacing circuits.*

**MODULE I (13 hours)**

Concept of Microprocessors, Microcomputers and Assembly language, 8085 Microprocessor architecture, Instruction set, Timing diagrams. Memory mapped I/O and I/O mapped I/O modes. Programming the 8085 (Simple Programs).

**MODULE II (13 hours)**

Intel 8086 processor: Architecture, Concept of memory segmentation, Addressing modes, Instruction set. 8086 processor - Assembly language programming, Assembler directives and operators, Assembly process, Linking and relocation, stacks, procedures, interrupt routines, macros. Timing diagrams, 8086 hardware design - Bus structure, bus buffering and latching, system bus timing with diagram. Minimum and Maximum mode.

MODULE III (13 hours)
Interfacing: Address decoding, interfacing chips, Programmable Peripheral Interface (8255), Programmable. Timer (8253/54), Programmable Interrupt Controller (8259), Programmable Keyboard/display controller (8279), DMA and DMA controller (8237/57), ADC & DAC, Serial I/O and Data communication.

MODULE IV (13 hours)
8051 Microcontroller: Overview of 8051 family, architecture of 8051, Program counter, ROM space in 8051, data types and directives, flags and PSW register, register bank and stack, Addressing modes. Instruction set-.Arithmetic instructions JUMP, LOOP, CALL instructions, time delay generations. Assembly Language programming in 8051 (some simple programs), programs using arithmetic and logic instructions, single bit instructions and programs, Timer/counter programming 8051 serial communication programming, programming timer, interrupts.

Text Books
1. D. V. Hall, Microprocessors and Interfacing: Programming and Hardware, Tata Graw Hill
2. B. Brey, The Intel Microprocessors, 8086/8088, 80186, 80286, 80386 and 80486 architecture, Programming and interfacing, Prentice Hall of India, New Delhi

Reference Books
**Internal Continuous Assessment** *(Maximum Marks-50)*

- 60% - Tests (minimum 2)
- 30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
- 10% - Regularity in the class

---

**University Examination Pattern**

**PART A:** Analytical/problem solving SHORT questions  
8x 5 marks=40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B:** Analytical/Problem solving DESCRIPTIVE questions  
4 x 15 marks=60 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*

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**BM14 407 (P): Electronic Circuits Lab**

**Teaching scheme**

<table>
<thead>
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<th>Credits: 2</th>
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<tbody>
<tr>
<td>3 hours practical per week</td>
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**Objectives**

- *To provide hands-on experience on design, testing, and analysis of various transistor circuits.*
- *To provide hands-on experience on design, testing, and analysis of OP-Amp circuits.*
- *To provide training on simulation of transistor and OP-Amp circuits using any suitable software.*

(Any 12 experiments)

1. Measurement of important OP-Amp parameters such as CMRR, slew rate, open loop gain, input and output impedances, GBW product.
2. Op-Amp basic circuits – voltage follower, inverting and non-inverting amplifiers
3. Op-Amp basic circuits-zero crossing detectors, integrator and differentiator
4. Wien bridge oscillator using 741C
5. Second order Low pass filter and high pass filter
6. Precision rectifier
7. Sample and hold circuit
8. Logarithmic and anti-logarithmic amplifiers
9. Voltage regulators: IC 723
10. Voltage regulators: 78XX and 79XX
11. Design of PLL for given lock and capture ranges, frequency multiplication
12. Active band-pass filter
13. Active band-reject filter
14. Data visualization, plotting, and storage for data acquisition using technical computing software such as MATLAB/ Octave/ Scilab

**Internal Continuous Assessment (Maximum Marks-50)**

60%-Laboratory practical and record

30%- Test/s

10%- Regularity in the class
**Semester-End Examination** *(Maximum Marks-100)*

70% - Procedure, conducting experiment, results, tabulation, and inference

20% - Viva voce

10% - Fair record

**BM14 408: Digital Electronics Lab**

<table>
<thead>
<tr>
<th>Teaching scheme</th>
<th>Credits: 2</th>
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<tbody>
<tr>
<td>3 hours Practical per week</td>
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</table>

**Objectives**

- To provide hands-on experience on design, testing, and analysis of various digital circuits.
- To provide training on simulation of digital circuits using any suitable Software

*(Any 12 experiments)*

1. Characteristics of TTL and CMOS gates.
3. 4-bit adder/subtractor, BCD adder-7483 circuits.
4. Astable and Monostable multivibrators using TTL/CMOS gates
5. Binary to gray and gray to binary converter
6. BCD to Decimal and BCD to 7-segment decoder and display
9. Up/down Counter - asynchronous
10. Up/down Counter - synchronous
11. Study of Counter ICs
   12. Study of Monostable multivibrator
   IC-74123
13. Multiplexers and Demultiplexers- Realization of
   combinational Circuits
14. Simulation of Digital circuits- combinational and sequential circuits- using any
   technical soft-ware
   a) Adder / Subtractor circuits
   b) JK Master Slave flip-flops using gates
   c) Shift register
   d) UP/DOWN Counter
   e) Arbitrary Sequence Generator.
15. VHDL Implementation: 2 simple examples

**Internal Continuous Assessment (Maximum Marks-50)**

- 60% - Laboratory practical and record
- 30% - Test/s
- 10% - Regularity in the class

**Semester-End Examination (Maximum Marks-100)**

- 70% - Procedure, conducting experiment, results, tabulation, and inference
- 20% - Viva voce
- 10% - Fair record

FIFTH SEMESTER

BM14 501: Medical Physics

<table>
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<th>Teaching scheme</th>
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<tr>
<td>3 hours lecture and 1 hour tutorial per week</td>
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</table>

Objectives

To provide an understanding about

- Bioelectric and Bio-magnetic signals
- Electrical properties of biological materials
- Applications of radioactivity and ultrasonics in biological field
- Various biological effects of electromagnetic radiations

Module I (13 hours)

Cell membrane - Nernst equation, Resting membrane potential, action potential propagation of nerve impulses, monophasic and biophasic recordings, Principles of electrocardiography, electromyography & electroencephalography - Skin contact impedance - Hodgkin Huxley model of squid gait axon membranes. Bio magnetism- Principles of Magnetocardiography and Magnetoencephalography

Module II (13 hours)


Module III (13 hours)

Module IV (13 hours)
Ultrasonic wave motion, wave characteristics, intensity, and ultrasound properties in body (velocity, attenuation, reflection, refraction and absorption). Use of ultrasound in biological field. Biological effects of electromagnetic radiations & its applications in biology.

Text Books

Reference Books
2. D. Cooney, Biomedical Engineering Principles: An Introduction to Fluid, Heat, and Mass Transport Processes (Biomedical engineering and instrumentation series), Marcel Decker

Internal Continuous Assessment (Maximum Marks-50)
60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey,

University Examination Pattern

**PART A:** Analytical/problem solving SHORT questions \[8 \times 5 \text{ marks} = 40 \text{ marks}\]

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B:** Analytical/Problem solving DESCRIPTIVE questions \[4 \times 15 \text{ marks} = 60 \text{ marks}\]

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*

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**BM14 502: Medical Instrumentation**

<table>
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<td>3 hours lecture and 1 hour tutorial per week</td>
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</table>

**Objectives**

- *To familiarize the students with the principle and applications various analytical and diagnostic instruments*
- *To expose the students to the diagnostic features of ECG, EEG and EMG.*

**Module I (13 hours)**

Analytical instruments used in clinical environment-Spectrometry-UV, visible and infrared

spectrometers. Autoanalysers, flame photometers, principles and applications-densitometers, gas and liquid chromatography, Electrophoresis, Oximeters,

**Module II (13 hours)**
Cardiac output measurement- Different techniques, pulmonary function tests- Spirometry- parameters measured- Lung sounds-different types-importance, blood cell counters-methods, Coutler counters-Automatic recognition and differential counting. Audiometers, Drug delivery devices, Dialysis equipment, Heart lung machine (block diagram approach)

**Module III (13 hours)**
Electrical activity of the heart, effect of electric field on cardiac muscles and laws of stimulation. Arrhythmias- Detection, Amplification, measurement and displaying/recoding of ECG, Principle of Electromyography-detection and applications, diagnostic features of EMG, Measurement principles of electroencephalography-applications-diagnostic features of EEG.
Electrogastogram, Electroneurography- Electroretinography – Electrooculography.

**Module IV (13 hours)**
Cardiac pacemakers regular and ectopic pace maker’s electrocardiogram, phonocardiography, Ballistocardiography, external and internal pacemakers-programmable pacemakers - power sources-design of encapsulation of leads. Defibrillators-principle and comparison of output waveforms of different types of DC defibrillators-energy requirements-synchronous operation-defibrillator analyzers, treatment for arrhythmia.

**Text Books**
1. R. S. Khandpur, Handbook of Biomedical Instrumentation, Tata McGraw Hill, New Delhi

**Internal Continuous Assessment (Maximum Marks-50)**
60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey,

Seminar, term-project, software exercises, etc.

10% - Regularity in the class

**University Examination Pattern**

**PART A:** Analytical/problem solving SHORT questions

8x 5 marks = 40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B:** Analytical/Problem solving DESCRIPTIVE questions

4 x 15 marks = 60 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*

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**BM14 503: Digital Signal Processing**

**Teaching scheme**

3 hours lecture and 1 hour tutorial per week

**Credits: 4**

**Objectives**

To cover the following topics of Digital Signal Processing.

- Discrete Fourier transform and fast Fourier transform
- Techniques of IIR and FIR digital filter design and various filter structures
- Finite word length effects in DSP
- Brief ideas about computer architectures for signal processing with emphasis on TMS320series processor

**Module 1 (13 hours)**

Review of Discrete Fourier Series and Discrete-Time Fourier Transform - Frequency domain sampling and reconstruction of discrete time signals - The Discrete Fourier Transform - DFT as a linear transformation - relationship to other transforms - properties of DFT - frequency analysis of signals using DFT - Linear filtering methods based on DFT - convolution using overlap add and overlap save methods - Efficient computations of the DFT - Fast Fourier Transform algorithms – decimation in time - decimation in frequency - in place computation - direct computation, radix-2 algorithm, implementation of FFT algorithms - Applications of FFT.

Module II (13 hours)

Module III (13 hours)
Structures for realization of discrete time systems - structures for FIR and IIR systems - signal flow graphs, direct-form, cascade-form, parallel form, frequency sampling, lattice and transposed structures - representation of numbers and errors due to rounding and truncation - Quantization of filter coefficients - round off effects in digital filters - limit cycle oscillations, scaling for overflow prevention.

Module IV (13 hours)
Computer architectures for signal processing - Harvard architecture, pipelining, multiplier-accumulator, special instructions for DSP, replication, on chip storage, extended parallelism - general purpose DSP Processors - implementation of DSP algorithms for various operations - special purpose DSP hardware - hardware digital filters and FFT processors - case study and overview of TMS320 series processor.
Text Books

Reference Books

Internal Continuous Assessment (Maximum Marks-50)
60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions 8x 5 marks=40 marks
Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks=60 marks
Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

BM14 504: Advanced Microprocessors and Microcontrollers

Objectives

- To expose the students to the features of advanced microprocessors like 80386, and Pentium processor.
- To introduce the architecture, programming, and interfacing of the microcontroller 8051
- To introduce the architecture, programming, and interfacing of the PIC microcontroller

MODULE I (13 hours)
Introduction to 80386 - Memory management unit - Descriptors, selectors, description tables and TSS-Real and protected mode - Memory paging - Pentium processor -Special features of the Pentium processor - Branch prediction logic -Superscalar architecture, microprocessors - state of the art.

MODULE II (13 hours)
PIC 18F microcontrollers: history and features, Architecture and assembly language programming: WREG register, file register, data format and directives, assembling and linking, branch, call and time delay loop, I/O port programming, arithmetic and logical instructions, Bank switching, table processing, macros and modules, hardware connections and ROM loaders.

MODULE III (13 hours)
Programming PIC 18F: Programming with CCP – standard and enhanced CCP, Compare mode and capture mode programming, ECCP and PWM programming. Programming the timers – timers 0 and 1, timers 2 and 3, counter programming, assembly and C. Programming the serial port – basics, connection to RS232, assembly level programming and C. Programming interrupt – basics of interrupts, timer interrupt, external interrupts, serial interrupts. Interfacing LCD, ADC, DAC.
MODULE IV (13 hours)

Text Books

Reference Books
1. B. Brey, The Intel Microprocessors, 8086/8088, 80186, 80286, 80386 and 80486 architecture, Programming and interfacing, 6th ed., Prentice Hall of India, New Delhi,

2. PIC Microcontroller Data Manual, Microchip 2002

Internal Continuous Assessment (Maximum Marks-50)
60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class
University Examination Pattern

**PART A:** Analytical/problem solving SHORT questions  
8x 5 marks = 40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B:** Analytical/Problem solving DESCRIPTIVE questions  
4 x 15 marks = 60 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*

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**BM14 505: Computer Organization and Architecture**

<table>
<thead>
<tr>
<th>Teaching scheme</th>
<th>Credits: 4</th>
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</thead>
<tbody>
<tr>
<td>3 hours lecture and 1 hour tutorial per week</td>
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</table>

**Objectives**

- *To introduce the basic principles of computer organization operation & performance.*
- *To familiarize with advanced concepts of Parallel processing, Multicomputing, Networking etc.*

**Module I (13 hours)**

Module II (13 hours)

Module III (13 hours)

Module IV (13 hours)
Advanced computer systems: Classification of Parallel structures, Array Processors, Multiprocessors & its memory organizations, Interconnection Networks, Shared Variables, Multicomputers, Shared Memory, Performance considerations.

Text Books


Reference Books

2. Linda Null and Julia Lobur, Essentials of Computer Organization and Architecture

**Internal Continuous Assessment** (*Maximum Marks-50*)

60% - Tests (minimum 2)

30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.

10% - Regularity in the class

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**University Examination Pattern**

**PART A:** Analytical/problem solving SHORT questions  
8x 5 marks=40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B:** Analytical/Problem solving DESCRIPTIVE questions  
4 x 15 marks=60 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*

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**BM14 506: Biosensors and Transducers**

<table>
<thead>
<tr>
<th>Teaching scheme</th>
<th>Credits: 4</th>
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</thead>
<tbody>
<tr>
<td>3 hours lecture and 1 hour tutorial per week</td>
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</table>
Objectives

*To familiarise the students with*

- Various types of transducers used to measure the temperature, pressure, and flow within the body.
- Some special sensors having biomedical application

**Module I (13 hours)**

Transducers: definition, classification of transducer - active and passive, primary and secondary, Study of biological sensors in the human body and their basic mechanism action. Organization of human nervous system-neural mechanism, Chemoreceptors, Sensors for smell, touch, sound, vision, and taste.

**Module II (13 hours)**


**Module III (13 hours)**


**Module IV (13 hours)**

Flow measurement techniques- blood flow meters, positive displacement type, electromagnetic, and ultrasonic blood flow meter and Air flow measurements. Density measurement, Weight measurement, Humidity and Moisture measurement - hair hygrometer. Electrodes for ECG, EMG, EEG-electrode potential, Electrode impedance, Surface electrodes, Microelectrodes
Text Books

2. R S C Cobbold, Transducers for Biomedical Instruments, Prentice Hall

Reference Books


Internal Continuous Assessment (Maximum Marks-50)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions 8x 5 marks=40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks=60 marks

Two questions from each module with choice to answer one question.
BM14 507 (P): Medical Electronics Lab

Objectives
- To provide experience on design, testing, and analysis of some electronic circuits having application in biomedical equipment
- To familiarize the students with the operation of a few transducers having biomedical applications

(Any 12 experiments)

1. Instrumentation amplifier
2. Measurement using LVDT
3. Measurement using Strain gauge
4. AD590 temperature sensor
5. Thermistor/ RTD
6. Pacemaker circuits /heart rate meter
7. FM telemetry
8. Respiration meter
9. Optocoupler - application circuit
10. Voltage to frequency converter
11. Frequency to voltage converter
12. Astable, monostable multivibrators using 555 IC
13. Astable, monostable multivibrators using 741 IC
14. Phase Locked Loop-Application
15. ECG Simulator

Internal Continuous Assessment (Maximum Marks-50)
60%-Laboratory practical and record

30% - Test/s

10% - Regularity in the class

Semester-End Examination (*Maximum Marks-100*)

70% - Procedure, conducting experiment, results, tabulation, and inference

20% - Viva voce

10% - Fair record

**BM14 508 (P): Microprocessors and Microcontrollers Lab**

<table>
<thead>
<tr>
<th>Teaching scheme</th>
<th>Credits: 2</th>
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<tr>
<td>3 hours of Practical per week</td>
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</table>

**Objectives**

*To acquaint the students with the following skills*

- Assembly language programming based on the microprocessors 8085 and 8086
- Assembly language programming based on the microcontroller 8051
- Interfacing programs based on 8085/8086 and 8051
- ALPs using TASM/MASM
(Any 18 experiments covering all the 4 sections)

I. Assembly Language Programming Based on 8085 Kit
   1) Programs based on Arithmetic and Logic Instructions
   2) Array- Largest of arrays
   3) 8 bit Multiplication

II. Assembly language programs based on 8086 Kit
   1)
      Addition / Subtraction of 64 bit Numbers.
   2) Average of n numbers
   3) Sorting of an array
   4) Program s with lookup table
   5) Average of n numbers
   6) Square root of a 32 bit number
   7) Copy – paste of words from source to destination
   8) Numeric code conversion
   9) ADC & DAC Interfacing
  10) Stepper motor interfacing (forward & backward motion) ’
  11) Hex key pad interfacing
  12) Seven segment display interfacing

III. Assembly language programs based on 8051 Kit
   1) Arithmetic operations on 8 /16 bit numbers
   2) Parity of a number
   3) Square of a number using look-up table
   4) Largest and smallest from an array
   5) ADC & DAC Interfacing
   6) Stepper motor interfacing (forward & backward motion) ’
   7) Hex key pad interfacing
   8) Seven segment display interfacing

IV. ALPs using TASM/MASTM (DEMO Only)
   1) Simple programs listed above with usage of all assembler directives
   2) String display, changing graphics mode, array and string
      operations
   3) Downloading the assembled programs to 8086 kit

Internal Continuous Assessment(Maximum Marks-50)
   60%-Laboratory practical and record
30%- Test/s

10%- Regularity in the class

Semester-End Examination (Maximum Marks-100)

70% - Procedure, conducting experiment, results, tabulation, and inference

20% - Viva voce

10% - Fair record

SIXTH SEMESTER

BM14 601 ENGINEERING ECONOMICS AND PRINCIPLES OF MANAGEMENT
(Common for CE, EE, EC, AI and BM)

<table>
<thead>
<tr>
<th>Teaching scheme</th>
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<tbody>
<tr>
<td>3 hours lecture and 1 hour tutorial per week</td>
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</table>

Section 1: Engineering Economics

Objective

The prime objective of the Engineering Economics course is to make students familiar with the economic way of thinking. This course provides the students with the foundations of economic theory, tools and techniques for use in the process of efficient economic decision-making in their engineering and managerial profession.

**Module I (13 hours)**

**Module II (13 hours)**

**Text Books**

**Reference Books**

**Internal Continuous Assessment (Maximum Marks-25)**
60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz,
University Examination Pattern for Section 1

PART A: Analytical/problem solving SHORT questions 4x 5 marks = 20 marks

Candidates have to answer FOUR questions out of FIVE. There shall be minimum of TWO and maximum of THREE questions from each module with total FIVE questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 2 x 15 marks = 30 marks

Two questions from each module with choice to answer one question.

Maximum Total Marks: 50

University Examination Pattern for Section 1

Note: Section 1 and Section 2 are to be answered in separate answer books

Maximum 50 marks each for Section 1 and Section 2

Section 2: Principles of Management

Objective

- To provide knowledge on principles of management, decision making techniques, accounting principles and basic management streams

Module I (13 hours)

Principles of management – Evolution of management theory and functions of management.
Organizational structure – Principle and types. Decision making – Strategic, tactical & operational decisions, decision making under certainty, risk & uncertainty and multistage decisions & decision tree
Human resource management – Basic concepts of job analysis, job evaluation, merit rating, wages, incentives, recruitment, training and industrial relations

Module II (13 hours)

Basics of accounting – Principles of accounting, basic concepts of journal, ledger, trade, profit &loss account and balance sheet. Marketing management – Basic concepts of marketing environment, marketing mix, advertising and sales promotion. Project management – Phases, organisation, planning, estimating, planning using PERT & CPM

Reference Books


**Internal Continuous Assessment (Maximum Marks-25)**

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Attendance and Regularity in the class
University Examination Pattern for Section 1

**PART A:** Analytical/problem solving SHORT questions  
4x 5 marks = 20 marks

Candidates have to answer FOUR questions out of FIVE. There shall be minimum of TWO and maximum of THREE questions from each module with total FIVE questions.

**PART B:** Analytical/Problem solving DESCRIPTIVE questions  
2 x 15 marks = 30 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 50*

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University Examination Pattern for Section 2

Note: Section 1 and Section 2 are to be answered in separate answerbooks

Maximum 50 marks each for Section 1 and Section 2

BM14 602: Medical Imaging Techniques

<table>
<thead>
<tr>
<th>Teaching scheme</th>
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<tbody>
<tr>
<td>3 hours lecture and 1 hour tutorial per week</td>
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</table>

Objectives

- Imaging Fundamentals
- Tomographic Imaging Modalities
- Mathematical Framework of Image Reconstruction mechanisms

**Module I (13 hours)**


Signal Processing Fundamentals: Continuous and Discrete Functions - Fourier Representation - Discrete Fourier Transform (DFT)- Finite Fourier Transform -Two-Dimensional Finite Fourier Transform.2D Convolution

**Module II (13 hours)**


**Module III (13 hours)**

imaging: Principle- imaging systems- clinical thermography- Liquid crystal Thermography-Microwave Thermography.

Module IV (13 hours)

Text Books
3. Andrew Webb, Introduction to Biomedical Imaging, Wiley Interscience

Reference Books
2. Macovski, Medical Imaging systems, Prentice-Hall, Englewood Cliffs

Internal Continuous Assessment (Maximum Marks-50)
60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions 8x 5 marks=40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks=60 marks

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

BM14 603: Advanced Digital signal Processing

Teaching scheme

<table>
<thead>
<tr>
<th>Teaching scheme</th>
<th>Credits: 4</th>
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<tr>
<td>3 hours lecture and 1 hour tutorial per week</td>
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</table>

Objectives

To make the students familiarized with

- Conversion Requirements of biomedical signals
- Algorithms used for processing of biomedical signals (ECG, EEG, EGG)
- Fundamentals of Statistical Signal Processing
- Basics of High end signal processing techniques

Module I (13 hours)

Classification of Signals, Introduction to biomedical signals, General characteristics of biomedical signals, Bio signals acquisition: Acquisition of biomedical signals like ECG, EMG, EEG, and EGG.

Signal Conversion: Conversion requirements for biomedical signals, Sampling & Reconstruction revisited, Aliasing. Data reduction techniques: Turning point algorithm, AZTEC, CORTES, Fan, Huffman algorithms, Non Uniform Sampling Encoder.

**Module II (13 hours)**

**Module III (13 hours)**

**Module IV (13 hours)**
Text Books

Reference Books
9. Rangarajan M Rangayyan Biomedical Signal Analysis, A CASE Study Approach.

Internal Continuous Assessment (Maximum Marks-50)
60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class
University Examination Pattern

PART A: Analytical/problem solving SHORT questions 8 x 5 marks = 40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks = 60 marks

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

BM14 604: Control Systems

Teaching scheme

3 hours lecture and 1 hour tutorial per week

Credits: 4

Objectives

- To make the students familiarized with the concepts of modeling systems like linear time invariant systems and to understand the responses in time and frequency domain.
- To make the students understand how to model various biological process.

MODULE I (13 hours)

Terminology and basic structure of control system - Open loop and closed loop systems-examples. Transfer function of linear systems-Modeling of physical systems- Mechanical- translational and rotational systems- Electrical networks and transfer function of AC motors, Analogous circuits. Block diagram reduction, Signal flow graphs - Mason's gain formula.

MODULE II (13 hours)

**MODULE III (13 hours)**

**MODULE IV (13 hours)**
Difference between engineering and physiological control systems. Physiological modeling: System representation of the muscle stretch reflex, Linear model of respiratory mechanics, model of chemical regulation of ventilation, regulation of cardiac output, Urine formation and control, Pupil control systems, skeletal muscle servomechanism, and semicircular canal. Free swinging limbs, Endocrine control system.

**Text Books**
3. B. C. Kuo, and D.C. Hanselman, MATLAB Tools for Control System Analysis and Design,

**Reference Books**
Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)

30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.

10% - Regularity in the class

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University Examination Pattern

**PART A:** Analytical/problem solving SHORT questions  
8x 5 marks = 40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B:** Analytical/Problem solving DESCRIPTIVE questions  
4 x 15 marks = 60 marks

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

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**BM14 605: Digital Systems Design**

<table>
<thead>
<tr>
<th>Teaching scheme</th>
<th>Credits: 4</th>
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<tr>
<td>3 hours lecture and 1 hour tutorial per week</td>
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</table>

Objectives

*To familiarize the students with the aspects of digital design using VHDL, Verilog, concepts of FPGA and the design using FPGA.*

Module I (13 Hours)

Introduction to VHDL Entities and Architectures, Configurations, identifiers, data objects, Data types,

Module II (13 hours)
VHDL representation of combinational building blocks: Three state buffers, decoders, Multiplexers, Priority encoder, Adders, parity checker, VHDL representation of sequential circuit blocks: -latches. Flip flops, Registers, Counters, Memory, sequential multiplier, BCD to excess-3 converter, Implementation of combinational systems with ROM's and PLA's

Module III (13 hours)
Introduction to Verilog, Modules, Data types, Operators, Control Statements- If Else, Case, While, For Loop, Repeat etc, Variable assignments, Always Blocks, Tasks and functions, Concept of Test bench. State Machines design using Verilog.

Module IV (13 hours)
Design with FPGA: Concept of FPGA, Xilinx 4000 series as an example (Block diagram treatment only), Building application IC using FPGA, Introduction to simulation/synthesis software (ModelSim, Open Source GHDL etc) CPLDs. Altera 1 OK series as example. Testing: Scan testing, boundary scan testing, Built-in self test.

Text Books

Reference Books
2. Z. Navab'i, VHDL; Analysis and Modeling of Digital Systems, 2nd ed., Tata
Internal Continuous Assessment *(Maximum Marks-50)*

- **60%** - Tests (minimum 2)
- **30%** - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
- **10%** - Regularity in the class

### University Examination Pattern

**PART A:** Analytical/problem solving SHORT questions  
8x 5 marks = 40 marks  
Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B:** Analytical/Problem solving DESCRIPTIVE questions  
4 x 15 marks = 60 marks  
Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*
BM14 606: Hospital Engineering and Management

**Objectives**

*To make the students aware of the role and responsibilities of biomedical engineer in hospitals, especially in the management of medical equipments, management of electrical supply, maintenance of electrical safety, etc.*

**Module I (13 hours)**

**Module II (13 hours)**
Biomedical equipment Procurement procedure - purchase & contract procedures (CMC and AMC), selection testing and calibration and installation, Training to medical staffs - operating instructions. Management of medical equipments, Planned preventive maintenance system, preventive maintenance & repair

**Module III (13 hours)**
Hospital electrical supply & power systems - Hospital electrical systems, general power & lighting systems, Hospital wiring systems. Electrical safety, isolated power supply, line isolation monitor, IPS in patient care areas, concept of Micro and Macro shock, Earthing schemes, Generator sets, UPS & voltage stabilizers. Causes of failures of electrical supply & ways to minimize them.

Module IV (13 hours)
Basics of Air conditioning and refrigeration. Air changes filtering & sterility – Concept of Clean Room with Air Handling Unit (AHU). Hospital gas supply systems-centralized supply of air, oxygen, nitrous oxide & vacuum. Theatre lighting. Operating Tables. Requirements of inter departmental computerization. DBMS in hospital, Computerized medical record evaluation, Database approach to laboratory computerization, Case study on a hospital DBMS, Concept of DICOM. Safe management of wastes from health-care activities.

Case study: A complete design of various facilities of a Multispecialty Hospital in a Biomedical Engineering Perspective (To be submitted as an Assignment).

Text Books
1. B.M. Sakharkar, Principles of Hospital administration & planning, Medical Publisher (?) Ltd, New Delhi, 1998.

Reference Books
3. Yashpal Sharma, Hospital & Medical Gases Management, Bharat Book Centre.
4. Lucknow, 2001 Hem Chandra, Hospital Equipment Management, Bharat Book Centre, Lucknow.
7. Safety code for Medical diagnostic x-ray Equipment and installations, Atomic Energy Regulatory Board Mumbai 400 094.
Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)  
30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.  
10% - Regularity in the class

University Examination Pattern

**PART A:** Analytical/problem solving SHORT questions  
8x 5 marks=40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B:** Analytical/Problem solving DESCRIPTIVE questions  
4 x 15 marks=60 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*

BM14 607 (P): Medical Embedded & Virtual Instrumentation Lab

<table>
<thead>
<tr>
<th>Teaching scheme</th>
<th>Credits: 2</th>
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<tbody>
<tr>
<td>3 hours practical per week</td>
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</table>

Objectives

- To acquaint the students with the concepts of Embedded systems in Medical Computing  
- To familiarize students to work with Virtual Instruments and its environments.  
- To train the students to develop simple medical applications on PIC series and ARM series Processors

(Any 15 Experiments)

1. Familiarization of virtual instrumentation environment
2. VI for addition, subtraction, multiplication & division
3. VI for Logical circuits.
4. Control flow using VI
5. Design of Sub VI.
6. Arrays & Clusters in VI
7. VI for acquisition and generation of signals
8. VI for processing and analysis of signals
9. Data Acquisition and testing using NI ELVIS
12. Interfacing ADC /stepper motor with PIC16F.
13. Heart rate meter with abnormality indication
14. Room Temperature control using PIC16F
15. Automatic water pump with level indicator using PIC16F
16. Familiarization of ARM architecture and programming.
17. Acquisition and processing of PPG, temperature, and BP using ARM
18. FFT and power spectrum of ECG /EMG/EEG

Internal Continuous Assessment (Maximum Marks-50)

60% - Laboratory practical and record

30% - Test/s

10% - Regularity in the class

Semester-End Examination (Maximum Marks-100)

70% - Procedure, conducting experiment, results, tabulation, and inference

20% - Viva voce

10% - Fair record

BM14 608 (P): Mini Project

<table>
<thead>
<tr>
<th>Teaching scheme</th>
<th>Credits: 2</th>
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<tr>
<td>3 hours practical per week</td>
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</table>
Objectives

• To estimate the ability of the student in transforming the theoretical knowledge studied so far into a working model of a Biomedical/ Electronics/ Mechatronic/ Instrumentation system.

• For enabling the students to gain experience in organization and implementation of a small project and thus acquire the necessary confidence to carry out main project in the final year.

In this practical course, each group consisting of three/four members is expected to design and develop a moderately complex Biomedical/ Electronics/ Instrumentation/ Mechatronics system with practical applications; this should be a working model. The basic concepts of product design may be taken into consideration while designing the project.

A committee consisting of minimum three faculty members specialized in Biomedical/ Electronics/ Instrumentation/ Mechatronics Engineering will perform assessment of the mini project. Students have to submit a report on the mini project and demonstrate the mini project before the evaluation committee.

Internal Continuous Assessment (Maximum Marks-50)

10% - Literature Survey

30% - Design & Development

10% - Regularity in the class

Semester End Examination (Maximum Marks-100)

40% - Result & Demonstration

40% - Viva voce

20% - Final Report
SEVENTH SEMESTER

BM14 701: Digital Image Processing

<table>
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<th>Teaching scheme</th>
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<tr>
<td>3 hours lecture and 1 hour tutorial per week</td>
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</table>

Objectives

- To provide elementary knowledge about digital image processing.
- To discuss various image transforms used in digital image processing.
- To explain the algorithms adopted for image enhancement, image restoration, image segmentation & compression
- To Introduce the concept of colour Image Processing & Pattern recognition

Module I (13 hours)


Module II (13 hours)


Module III (13 hours)


Note: The End semester examination for Mini Project shall be conducted internally at Institution Level
Fundamentals- Colour models- RGB, CMY, HSI. Pseudo Colorings. **Pattern Recognition:** Basic concepts of Pattern and Pattern Classes, Pattern Matching, facial recognition algorithms.

**Module IV (13 hours)**

**Image Compression:** Fundamentals of Information theory-Redundancy-Information measurement, compression model- Lossless compression-Variable Length, LZW, Bit-plane coding, Loss less predictive-Lossy compression- Lossy predictive, Transform coding-Fundamentals of JPEG and MPEG. **Image Segmentation:** Details of Discontinuities, Edge linking and Boundary detection, Thresholding, Region based segmentation.

**Text Books**


**Reference Books**


**Internal Continuous Assessment (Maximum Marks-50)**

60% - Tests (minimum 2)

30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.

10% - Regularity in the class

University Examination Pattern

**PART A:** Analytical/problem solving SHORT questions  
8x 5 marks = 40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B:** Analytical/Problem solving DESCRIPTIVE questions  
4 x 15 marks = 60 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*

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**BM14 702: Soft Computing Techniques**

<table>
<thead>
<tr>
<th>Teaching scheme</th>
<th>Credits: 4</th>
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</thead>
<tbody>
<tr>
<td>3 hours lecture and 1 hour tutorial per week</td>
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</tbody>
</table>

**Objectives**

*To acquaint the students with important soft computing methodologies-neural networks, fuzzy Logic, genetic algorithms and genetic programming.*

**Module I (13 hours)**

Artificial intelligence systems- Neural networks, fuzzy logic, genetic algorithms. Artificial neural networks: Biological neural networks, model of an artificial neuron, Activation functions, architectures, characteristics-learning methods, brief history of ANN research-Early ANN architectures (brief study)-McCulloch & Pitts model, Perception, ADALINE, MADALINE.

**Module II (13 hours)**

Back propagation networks: architecture, multilayer perception, back propagation learning-input layer, hidden layer, output layer computations, calculation of error, training of ANN, BP algorithm, momentum
and learning rate, Selection of various parameters in BP networks. Variations in standard BP algorithms - Adaptive learning rate BP, resilient BP, Levenberg-Marquardt, and conjugate gradient BP algorithms (basic principle only) - Applications of ANN.

Module III (13 hours)

Module IV (13 hours)
Genetic algorithms - basic concepts, encoding, fitness function, reproduction-Roulette wheel, Boltzmann, tournament, rank, and steady state selections, Elitism. Inheritance operators, Crossover - different types, Mutation, Bit-wise operators, Generational cycle, Convergence of GA, Applications of GA - case studies. Introduction to Genetic programming - Basic concepts.

Text Books

2. L. Fausett, Fundamentals of Neural Networks, Prentice Hall, Upper Saddle River, N.J

Reference Books

**Internal Continuous Assessment** *(Maximum Marks-50)*

60% - Tests (minimum 2)

30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.

10% - Regularity in the class

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**University Examination Pattern**

**PART A:** Analytical/problem solving SHORT questions  
8x 5 marks = 40 marks  
Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B:** Analytical/Problem solving DESCRIPTIVE questions  
4 x 15 marks = 60 marks  
Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

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**BM14 703: Biomechanics**

<table>
<thead>
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<tbody>
<tr>
<td>3 hours lecture and 1 hour tutorial per week</td>
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</table>

**Objectives**  
*To impart knowledge on the structure of body parts like bones and their mechanical properties*

**MODULE I (13 hours)**


MODULE II (13 hours)
Mechanical properties of cartilage, diffusion properties of articular cartilage, mechanical properties of
bone, kinetics and kinematics of joints, Lubrication of joints.

MODULE III (13 hours)
Stresses related to total hip prosthesis, Maxwell’s and voight’s model, force velocity relationship,
Biomechanics associated with lifting, foot pressure measurements, Work related biomechanics, internal
stresses associated with joints, isometric, isokinetic and isotonic muscle contractions.

MODULE IV (13 hours)
Dynamics and analysis of human locomotion - Gait analysis (determination of instantaneous joint
reaction analysis), Mechanics of knee joint during standing and walking, occupant response to vehicular
vibration.

Text Books

Reference Books
2. VC Mow and W C Hayes, Basic Orthopaedic Biomechanics, Lippincott - Raven Publishers,
4. NihatOzkaya, Margareta Nordin, Fundamentals of Biomechanics: Equilibrium, Motion, and

Internal Continuous Assessment (Maximum Marks-50)
60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions \(8 \times 5 \text{ marks}=40 \text{ marks}\)
Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions \(4 \times 15 \text{ marks}=60 \text{ marks}\)
Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

BM14 704(A): Bio-Nanotechnology

<table>
<thead>
<tr>
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</table>

Objectives

To familiarize the students with the aspects of Bio-Nanotechnology

Module 1 (13 hours)
Introduction to Nanobiotechnology and Nanomedicine, Visualization and Manipulation on Nanoscale. Atomic Force Microscopy, Magnetic Resonance Force Microscopy, Scanning Probe

**Module 2 (13 hours)**
QuantumDots, Gold Nanoparticles, Lipoparticies, Assembly of Nanoparticles into Micelles, Biomedical Applications of Self-Assembly of Nanoparticles, Paramagnetic and Superparamagnetic Nanoparticles, Fluorescent Nanoparticles.

**Module 3 (13 hours)**
Bacterial Structure Relevant to Nanobiotechnology, Cubosomes, Dendrimers, DNA-Nanoparticle Conjugates, DNA Octahedron, Fullerenes, Nanoshells, Carbonnnnn Nanotubes, Nanopores, Nano structured Sillicon.

**Module 4 (13 hours)**
Molecular Motors, Nano particles for Molecular Diagnostics, Nano biosensors, Nanopharmaceuticals, Nanoparticle – Based Drug Delivery, Nanostructures for Tissue Engineering/Regenerative.Medicine, Ethical Safety, and Regulatory issues of Nanomedicine.

**Text Books**
2. Nanomaterials and Nanosystems for Biomedical Applications: M.RezaMozafari.
3. The Handbook of Nanomedicine, KewalK.Jain

**Reference Books**
1. Bio Nanotechnology, Elisabeth S.Pappazoglou, AravindParthasarathy
2. Biomedical Nanostructures, Kenneth E.Goonsalves, Craig R.Halberstadt, Cate T. Laurecin, Lakshmi S.Nair.
Internal Continuous Assessment *(Maximum Marks-50)*

60% - Tests (minimum 2)

30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.

10% - Regularity in the class

University Examination Pattern

**PART A:** Analytical/problem solving SHORT questions \[8 \times 5 \text{ marks} = 40 \text{ marks}\]

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B:** Analytical/Problem solving DESCRIPTIVE questions \[4 \times 15 \text{ marks} = 60 \text{ marks}\]

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*

**BM14 704(B): Pattern Recognition**

<table>
<thead>
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**Objectives**

- To impart a basic knowledge on pattern recognition and to give a sound idea on the topics of parameter estimation and supervised learning, linear discriminant functions and syntactic approach to PR.
- To provide a strong foundation to students to understand and design pattern recognition systems.

**Module I (13 hours)**

Introduction - introduction to statistical - syntactic and descriptive approaches - features and feature
extraction - learning - Bayes Decision theory - introduction - continuous case - 2-category classification - minimum error rate classification - classifiers - discriminant functions - and decision surfaces - error probabilities and integrals - normal density - discriminant functions for normal density

Module II (13 hours)
Parameter estimation and supervised learning - maximum likelihood estimation - the Bayes classifier - learning the mean of a normal density - general bayesian learning - nonparametric technic - density estimation - parzen windows - k-nearest neighbor estimation - estimation of posterior probabilities - nearest-neighbor rule - k-nearest neighbor rule

Module III (13 hours)
Linear discriminant functions - linear discriminant functions and decision surfaces - generalized linear discriminant functions - 2-category linearly separable case - non-separable behavior - linear programming procedures - clustering - data description and clustering - similarity measures - criterion functions for clustering

Module IV (13 hours)
Syntactic approach to PR - introduction to pattern grammars and languages - higher dimensional grammars - tree, graph, web, plex, and shape grammars - stochastic grammars - attribute grammars - parsing techniques - grammatical inference

Text Books

1. Duda & Hart P.E, *Pattern Classification And Scene Analysis*, John Wiley


Reference Books

1. Fu K.S., *Syntactic Pattern Recognition And Applications*, Prentice Hall, Eaglewood cliffs
2. Rajjan Shinghal, *Pattern Recognition: Techniques and Applications*

Internal Continuous Assessment *Maximum Marks-50*)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

**PART A:** Analytical/problem solving SHORT questions  \[8 \times 5 \text{ marks}=40 \text{ marks}\]

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B:** Analytical/Problem solving DESCRIPTIVE questions  \[4 \times 15 \text{ marks}=60 \text{ marks}\]

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*

### BM14 704(C): Advanced Medical Instrumentation

<table>
<thead>
<tr>
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</table>

**Objectives**

(This course imparts the information on the principle and working of various advanced medical instruments such as microprocessor based ECG machines, Sund stimulators, Brain mappers, Microprocessor based pulse oximeters, etc.)

**Module I (13 hours)**


**Module II (13 hours)**
Sound stimulators- Measurement of average auditory stimulators-Visually evoked potential measurement and Analysis and storage - Brain mappers (EEG)- principles and Keratometers. evoked potential - application- Photo application - Recording- Amplifiers - measurements, Computerized tonometer

Module III (13 hours)

Module IV (13 hours)

Text Books
1. John G. Webster, Medical Instrumentation Application and Design, John Wiley and Sons, New York
2. Keith H. Chiappa, Evoked potential in clinical testing. Lippincott Williams & Wilkins

Reference Books

   IEEE Medical Electronics Monograph Vol. 7 to 12
2. S. E. Sutphin, Advanced Medical Instrumentation and Equipment, Prentice Hall, 1987

Internal Continuous Assessment (Maximum Marks-50)
60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

**PART A:** Analytical/problem solving SHORT questions  
8x 5 marks=40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B:** Analytical/Problem solving DESCRIPTIVE questions  
4 x 15 marks=60 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*

**BM14 704(D): Rehabilitation Engineering**

<table>
<thead>
<tr>
<th>Teaching scheme</th>
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<tr>
<td>3 hours lecture and 1 hour tutorial per week</td>
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</table>

**Objectives**

To enlighten the students with the principles and applications of rehabilitation engineering.

**Module I (13 hours)**

Information Resources-definitions and terminology, Man-Machine Models, System Perspectives, ADA and Legislation.

**Module II (13 hours)**

Biomechanics Overview: Lower Limb Prosthetics, Elements of Design in Rehabilitation Engineering, Upper Limb Prosthetics, Orthotics (lower limb, upper limb, spinal), User-Support Interfaces & Materials.

Module III (13 hours)

Module IV (13 hours)
Introduction to Gait Analysis, Neuromuscular Electrical Stimulation, International Rehabilitation Technology & Service, Current R&D, Challenges of Technology Transfer& Future Directions.

Text Books
2. Rory A. Cooper, Rehabilitation Engineering Applied to Mobility and Manipulation. Institution of Physics Publishing

Reference Books

Internal Continuous Assessment (Maximum Marks-50)
60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class
University Examination Pattern

PART A: Analytical/problem solving SHORT questions 8x 5 marks=40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks=60 marks

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

BM14 704(E): Fundamentals of Bioacoustics

<table>
<thead>
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Objectives

To introduce the fundamentals of sound propagation, relationship to animal behavior and communication, and propagation of sound in media. Animal bioacoustics and interaction with environment, physiology of hearing and speech, representation of sound using wave equation, active control of sound and vibration, computational acoustics, sensors and techniques of sound recording and analysis, SONAR, noise and underwater acoustics in marine biology, acoustic ecology and soundscapes of Insect, Fish, Amphibians, Mammals, Birds, etc. are also covered in this subject.

Module I (13 hours)

**Module II (13 hours)**
The auditory system, Anatomy and physiology of sound in the human body, lung sounds, heart sounds, the vocal system of speech and speech production – anatomy and physiology Open-End Air Columns, Closed-End Air Columns, sound reverberation, sound reproduction. Sound based measurement- units of measurement: Decibel, sone, mel, phon, hertz. Plane Waves, Coupling Power out of a Plane Wave. Spherical waves, plane and spherical wave spectra. Sound Waveguide and Cavity Modes. Auditorium acoustics, projection of sound, soundproofing, sound clarity, bass traps and echoes, architecture of the enclosure and sound reinforcement, Active control of sound and vibration: Acoustic propagation in ducts, minimization of radiation using source coupling, sound field control in enclosures, vibration control of lumped element and distributed parameters. Acoustics in Fluid Media - Wave propagation in stationary and moving fluids; acoustic radiation and scattering; standing waves in ducts and cavities. Sound Speed Variation in the ocean with variation in temperature, depth, salinity; Geographic Variation; Acoustic bottom and surface losses; absorption losses; Typical propagation modes; surface layer; shallow channels; deep channels; convergence zones; RAP; Typical Propagation Curves.

**Module III (13 hours)**
Electroacoustic Transducers - The theory, design, and calibration of passive, linear, reciprocal electroacoustic transducers for use in both air and water media. Ultrasound applications in the human body – therapy and imaging. Sound sensors, piezoelectric crystals, accelerometers, speakers and Dolby3D surround sound, micro- phone, loudspeakers, sound baffle, SAW sensors, vibration measurement, spectral analysis of sound, hearing aids, sonobuoys, hydrophones, speakers, with woofers and tweeters, SONAR systems, speech processing, digital signal processing using sound, sound spectrogram. Examples of muffler acoustics, Helmholtz resonator, pneumatic filters- Acoustic High-Pass, Low-Pass, and Band-Stop Filters, micro- phone design. Underwater Sound Propagation - Theoretical and empirical treatment of sound propagation in the ocean, including effects of the environment, characteristics of targets, and transducers.. Sonar Engineering - Theoretical and empirical treatment of problems related to the use of underwater sound in target detection and ranging, sound localization. Sources of noise; shipping; wind generated; thermal; others; Noise spectra; ambient noise angular distribution and correlation properties; use of the spatial correlation function in system calculations.
Module IV (13 hours)
What is Bioacoustics, Sound production in animals, including anatomy and neurophysiological processes, Animal Communication & Conservation, Marine Mammals Visual and Acoustic Surveys, Bioacoustics, Acoustic Ecology and Soundscapes, Insects, Fish, Amphibians, Mammals, Birds.

Vibrational communication of insects, Biosonar or echolocation of bats and dolphins, Ultrasonic signals (>20,000 Hz) of insects, rodents, bats and dolphins, Infrasonic signals (<20 Hz) of large mammals.

Sound reception capabilities and mechanisms of animal hearing, Ethology of animal acoustic communication, Evolution, ontogeny and development of acoustic behavior, Relationships between animal sounds and their environment, Effects of man-made sounds on animals. Application of acoustic signals for taxonomic studies and for calibrating biodiversity, Practical bioacoustic applications, in wildlife monitoring and in pest control, Acoustic monitoring of threatened and endangered species in inaccessible areas, Song Sparrow acoustic interactions, Northern right whales, Finback whale behavior, Acoustic census of migrating bowhead whales.

Text Books

3 Robert D. Finch, Introduction to Acoustics
4 William S. Burdic, Underwater Acoustic System Analysis
5 Paul C. Etter, Underwater Acoustics Modelling and Simulation: Principles, Techniques and Applications

Reference Books

1 Claybourne, Anna, Sound, Edition: 2007
2 Berg, Richard E. and Stork, David G., The Physics of Sound
3 Frank J. Fahy, Foundations of Engineering Acoustics
4 F. Alton Everest, Master Handbook of Acoustics
5 Robert J. Urick, Principles of Underwater Sound 3rd Edition
6 D. Waite, Sonar for Practicing Engineers
7 Xavier Lurton, An Introduction to Underwater Acoustics
8 Mitch Gallagher, Acoustic Design for the Home Studio
9 Bob Katz, Mastering Audio, Second Edition: The art and the science
10 Jeff Cooper, Building a Recording Studio
Internal Continuous Assessment (Maximum Marks-50)

60% - Tests (minimum 2)

30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.

10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions

8x 5 marks=40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions

4 x 15 marks=60 marks

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

BM14 705(A): Human Factors in Engineering and Design

Teaching scheme

Credits: 4

3 hours lecture and 1 hour tutorial per week

Objectives

This course discusses the following topics on various human factors to be considered in engineering

• Ergonomics
• Muscle physiology
• Concepts of manual material handling
• Anthropometry.

Module I (13 hours)

Module II (13 hours)
Muscle physiology-muscle metabolism-respiratory response joint motion study-measure of physiological in-efficiency and energy consumption-work rest cycles-aspects of manual material handling (MMH). Bio-mechanical recommended limits of MMH.

Module III (13 hours)
Spatial compatibility -physical arrangement of displays and controls- movement capability - rotary controls and rotor displays movement of displays-orientation of the operator and movement relationships-control orders and control responses human limitations in tracking task.

Module IV (13 hours)
Anthropometry- anthropometric design principles-work space envelope-factors in design of workspace surfaces-principles of seat design-principles of control panel organization. Classification of human errors-dealing with human errors -theories of accident causation - reducing accidents by altering behaviour.
Text Books


Reference Books


Internal Continuous Assessment (Maximum Marks-50)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions 8x 5 marks=40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks=60 marks

Two questions from each module with choice to answer one question.

BM14 705(B): Advanced Signal Processing

Objectives
This course aims to introduce the following topics of advanced signal processing

- Multirate system fundamentals
- Multirate filter banks
- Wavelet transform and its applications

Module I (13 hours)
Multirate system fundamentals - Basic multirate operation - up-sampling and down sampling; Time domain and frequency domain analysis - Identities of multirate operations - Interpolator and decimator design - Rate conversion - Polyphase representation.

Module II (13 hours)

Module III (13 hours)

Module IV (13 hours)

Wavelet applications-Image compression - EZW algorithm - Audio compression - signal denoising techniques- different types-edge detection. Lossless compression

**Text Books**

2. K. P. Soman and K. I. Ramachandran, Insight into Wavelets, Prentice Hall of India, New Delhi, 2004

**Reference Books**


**Internal Continuous Assessment** *(Maximum Marks-50)*

60% - Tests (minimum 2)

30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.

10% - Regularity in the class

**University Examination Pattern**

*PART A: Analytical/problem solving SHORT questions*  
8x 5 marks = 40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN.
questions.

**PART B:** Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks = 60 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*

**BM14 705(C): Fundamentals of BIOMEMS and Medical Microdevices**

<table>
<thead>
<tr>
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<tr>
<td>3 hours lecture and 1 hour tutorial per week</td>
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**Objectives**

To make the students familiarized with

- Microfabrication of silicon, glass and polymer devices
- Principles of microfluidic and electrokinetic devices
- Sensors, actuators and delivery systems
- Micro total analysis systems (μTAS) and Lab-on-a-chip(LOC)
- Introduction to clinical lab medicine
- Detection and measurement devices
- Genomics and Proteomics, DNA and protein micrarrays
- Emerging MEMS technologies in medicine, research and homeland security
- Packaging, power and RF safety in MEMS

**Module I (13 hours)**

An Introduction to electromechanical devices, BioMEMS-introduction to medical microdevices, biomaterials and polymer for MEMS devices, silicon manufacturing process. Power, packaging data transmission and RF safety for MEMS. Emerging MEMS technology for medicine, research and homeland security. Biocompatibility, FDA and ISO biological evaluations

**Module II (13 hours)**

Introduction to micro fabrication-hard and soft techniques. Hard fabrication- Lithography, Etching, ion implantation, thin film technique, surface micromachining, electroplating, substrate binding. Soft fabrication techniques- soft lithography, micromolding, photopolymerization, nanomedicine and thick film techniques

Module III (13 hours)
Microfluidics-principles, sensors-optical, piezoelectric, SAW , basic and electrochemical detection, microsensors, microfluidic devices, transport phenomena and electrokinetic behaviour, micromixers, valves and pumps. Microactuators and drug delivery-activation methods and equivalent circuits, applications in medicine.

Module IV (13 hours)
Introduction to clinical laboratory medicine-chemistry, hematology, immunology, microbiology, coagulation assays, Lab-on-a-chip, μTAS, capillary electrophoresis and cell based bioassays.

Text Books
1 Fundamentals of BioMEMS and Medical Microdevices, Steven S Saliterman ,USA, 2006.

Reference Books
Internal Continuous Assessment (Maximum Marks-50)

60% - Tests (minimum 2)

30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.

10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions 8x 5 marks = 40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks = 60 marks

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

BM14 705(D): Computer Based Numerical Methods

Objective

• To impart the basic concepts of mathematical modeling of problems in science and engineering and to know procedures for solving different kinds of problems.
• To understand the various numerical techniques which provide solutions to nonlinear equations, partial differential equations etc. that describe the mathematical models of problems.

Module I (13 hours)

Module II (13 hours)

Module III (13 hours)

Module IV (13 hours)

Teaching scheme

<table>
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Statistical Computations - frequency Chart - method of least square curve fitting procedures - fitting a straight line - curve fitting by sum of exponential - data fitting with cubic splines - approximation of functions. Regression Analysis - linear and nonlinear regression - multiple regression - statistical quality control methods.

**Text Books**


**Reference Books**


**Internal Continuous Assessment (Maximum Marks-50)**

60% - Tests (minimum 2)

30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.

10% - Regularity in the class

University Examination Pattern

**PART A:** Analytical/problem solving SHORT questions  
8 x 5 marks = 40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B:** Analytical/Problem solving DESCRIPTIVE questions  
4 x 15 marks = 60 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*

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**BM14 705(E): Research Methodology**

<table>
<thead>
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<td>3 hours lecture and 1 hour tutorial per week</td>
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**Objectives**

*To give an exposure to the major aspects of research and research approaches.*

**MODULE I (13 hours)**

Introduction – meaning of research- objectives of research-motivation in research- types of research-research approaches – significance of research- research methods Vs methodology – criteria for good research

**MODULE II (13 hours)**

Defining research problem- what is a research problem- selecting the problem- necessity of defining the problem- literature review – importance of literature review in defining a problem-critical literature review – identifying gap areas from literature review

MODULE III (13 hours)
Research design–meaning of research design-need–features of good design- important concepts relating to research design- different types – developing a research plan. Method of data collection–collection of data- observation method- interview method-questionnaire method – processing and analyzing of data- processing options- types of analysis-interpretation of results

MODULE IV (13 hours)

Text Books

3  Day Ra, 1989 “How to write and publish a scientific paper”, Cambridge University Press.

Reference Books

1  Earl Babbie,1994, The practice and Social Research,Wordsworth Publishing Company,

2  J.H. Ansari, Mahavir – ITPI Reading Material on Planning Techniques

Internal Continuous Assessment(Maximum Marks-50)
60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.

University Examination Pattern

PART A: Analytical/problem solving SHORT questions 8x 5 marks=40 marks
Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks=60 marks
Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

BM14 706 (P): Biomedical and Clinical Instrumentation Lab

<table>
<thead>
<tr>
<th>Teaching scheme</th>
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<tr>
<td>3 hours practical per week</td>
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</table>

Objective

This course is intended for acquainting the students with operation and working principles of various biomedical instruments, surgical procedures and clinical instrumentation.

(Any 12 experiments)

1. Power amplifier circuit.
2. Chart Drive circuit.
3. QRS Detector circuit.
5. Time gain compensation circuit.
6. X Ray Timer circuit.
7. Practical study of Medical symbols, Medical safety, Equipment grounding and wiring procedures in Healthcare & Hospitals.
8. Study of various electrodes for data acquisition of Biosignals.
9. EMG and classification for myopathic and neuropathies diseases (Demo).
10. EEG data acquisition and classification of brain disorders (Demo).
14. Electrosurgical unit - Study & Calibration
15. Multiparameter physiological recorders – Study & Calibration
17. Study of Ultrasound Imaging System (Demo)
18. Measurement of flow velocity using Doppler Ultrasound (Demo)

Internal Continuous Assessment (Maximum Marks-50)

30% - Laboratory practical and record
10% - Tests
10% - Regularity in the class

Semester-End Examination (Maximum Marks-100)

70% - Procedure, conducting experiment, results, tabulation, and inference
20% - Viva voce
10% - Fair record

BM14 707 (P): Biomedical Signal Processing Lab

<table>
<thead>
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<tr>
<td>3 hours practical per week</td>
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</tbody>
</table>

Objective

To acquaint the students with the processing of biomedical signals using suitable software tools like Turbo C/ MATLAB/ Mathematica/ Octave/ Scilab.

(Any 12 experiments)

1. Perform (i) Addition (ii) Multiplication (iii) Convolution & (iv) Shifting operations on simulated Discrete-time signals
2. DTFT and FFT on simulated discrete-time signals
3. QRS detection and heart rate measurements
4. Correlations and template matching
5. Frequency analysis of ECG/EMG signal
6. FIR Filter Design (LP/HP/BP/Notch)
7. IIR Filter Design - Butterworth (LP/HP/BP/Notch)
8. IIR Filter Design – Chebyshev (LP/HP/BP/Notch)
9. ECG Data compression
10. Adaptive filters
11. Basic operations using STFT and wavelet transform
12. Display of Negative, binary, contrast stretching of an image.
13. Low-pass, High pass and median filtering of images
15. Histogram equalization and specification of images.
17. Image compression techniques – variable length & fixed length code.

Internal Continuous Assessment (Maximum Marks-50)

30% - Laboratory practical and record

10% - Test/s

10% - Regularity in the class

Semester-End Examination (Maximum Marks-100)

70% - Procedure, conducting experiment, results, tabulation, and inference
20% - Viva voce

10% - Fair record

BM14 708 (P): Project

<table>
<thead>
<tr>
<th>Teaching scheme</th>
<th>Credits: 4</th>
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<tbody>
<tr>
<td>4 hours practical per week</td>
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</table>

**Objectives**

To judge the capacity of the students in converting the theoretical knowledge into practical systems/investigative analysis.

Project work is for duration of two semesters and is expected to be completed in the eighth semester. Each student group consisting of not more than five members is expected to design and develop a complete system or make an investigative analysis of a technical problem in the relevant area. The project may be implemented using software, hardware, or a combination of both. The project work may be undertaken in Biomedical/Electronics/Instrumentation/Mechatronics Engg. or any allied area and must have relevance in Biomedical engineering.

Project evaluation committee consisting of the guide and three/four faculty members specialized in Biomedical/Electronics/Instrumentation/Mechatronics Engg. will perform the screening and evaluation of the projects.

Each project group should submit project synopsis within three weeks from start of seventh semester. Project evaluation committee shall study the feasibility of each project work before giving consent. Literature survey and 40% of the work has to be completed in the seventh semester.

Students should execute the project work using the facilities of the institute. However, external projects can be taken up in reputed industries, if that work solves a technical problem of the external firm. Prior sanction should be obtained from the head of department before taking up external project work and there must be an internal guide for such projects.

Each student has to submit an interim report of the project at the end of the 7th semester. Members of the group will present the project details and progress of the project before the committee at the end of the 7th semester.

50% of the marks is to be awarded by the guide and 50% by the evaluation committee.

**Internal Continuous Assessment (Maximum Marks-150)**

20% - Technical relevance of the project  
40% - Literature survey and data collection  
20% - Progress of the project and presentation  
10% - Report  
10% - Regularity in the class

---

**EIGHTH SEMESTER**

**BM14 801: Communication Systems**

<table>
<thead>
<tr>
<th>Teaching scheme</th>
<th>Credits: 4</th>
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<tr>
<td>3 hours lecture and 1 hour tutorial per week</td>
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</table>

**Objectives**

*This course introduces the various techniques used for transferring information in communication systems. Basic ideas of microwave communication, spread spectrum communication, telemetry, optical communication etc. are also covered.*

**Module I (13 hour)**

Electromagnetic spectrum-Elements of a Communication System-Classification of communications-Transmission Lines, (Brief description only)-basic types, characteristic impedance, SWR, Antennas (brief description only) - antennas operation, basic antenna types-RF wave propagation (brief description only)-modulation-AM principle, generation-SSB techniques-principle, generation-angle modulation-theory and generation of PM and FM-Comparison of AM, PM, FM

**Module II (13 hours)**

Super heterodyne receivers- Receiver parameters – AM receivers- IF and its selection, automatic gain control, AM demodulator circuits, SSB receivers, demodulation of SSB, receiver types, FM receiver-FM demodulators, FM noise suppression, Pulse modulation, Principle of PAM, PWM & PPM modulation and demodulation

---

Module III (13 hours)

Module IV (13 hours)

Text Books

Reference Books

Internal Continuous Assessment (Maximum Marks-50)
60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

Note: One of the assignments shall be simulation of continuous systems using any technical computing software
University Examination Pattern

PART A:    Analytical/problem solving SHORT questions  8x 5 marks=40 marks
Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B:    Analytical/Problem solving DESCRIPTIVE questions  4 x 15 marks=60 marks
Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

BM14 802: Advanced Biomedical Techniques & Applications

<table>
<thead>
<tr>
<th>Teaching scheme</th>
<th>Credits: 4</th>
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</thead>
<tbody>
<tr>
<td>3 hours lecture and 1 hour tutorial per week</td>
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</table>

Objectives

To Provide Information about Recent Trends in Biomedical Engineering, Applications, Scope and Research and Developments.

Module I (13 hours)

Module II (13 hours)


**Module III (13 hours)**


**Module IV (13 hours)**


---

**Text Books**


**Reference Books**

University Examination Pattern

**PART A:** Analytical/problem solving SHORT questions  
8 x 5 marks = 40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B:** Analytical/Problem solving DESCRIPTIVE questions  
4 x 15 marks = 60 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*

---

**BM14 803: Biomaterials**

<table>
<thead>
<tr>
<th>Teaching scheme</th>
<th>Credits: 4</th>
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<tbody>
<tr>
<td>3 hours lecture and 1 hour tutorial per week</td>
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</table>
Objective:

This course gives information on the nature of the materials to be used for Implantation, different structures of solids, biocompatibility of certain materials, etc.

Module I (13 hours)

Module II (13 hours)

Module III (13 hours)

Module IV (13 hours)

Text Books

Reference Books
Internal Continuous Assessment (Maximum Marks-50)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A:

Analytical/problem solving SHORT questions

8x 5 marks = 40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

BM14 804(A): Artificial Organs and Implants

Teaching scheme

3 hours lecture and 1 hour tutorial per week

Credits: 4
Objective

To introduce various artificial organs such as artificial skin, artificial heart, artificial liver, etc. and their design concepts.

Module I (13 hours)

Module II (13 hours)

Module III (13 hours)

Module IV (13 hours)
Prosthetic and Orthopedic devices. The Human Joints - Concept of Total Joint Replacement (arthroplasty), Total Knee Replacement Surgery, knee, prosthesis. Total hip prosthesis- requirements-different types of components leg replacement. Different types of models, externally powered prosthesis feedback in orthopedic system

Text Books

3. Nigg and Herzog, Biomechanics of the Musculoskeletal System, Wiley Publishers

Reference Books

3. Donald L. Wise, Encyclopedic handbook of biomaterials and bioengineering (4 Vols.),

Internal Continuous Assessment (Maximum Marks-50)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions 8x 5 marks=40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks=60 marks

Two questions from each module with choice to answer one question.

BM14 804(B): Total Quality Management

<table>
<thead>
<tr>
<th>Teaching scheme</th>
<th>Credits: 4</th>
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<tr>
<td>3 hours lecture and 1 hour tutorial per week</td>
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</table>

Objectives

To impart knowledge on the concept of quality tools for analyzing quality statistical tools in quality acceptance sampling life tests

Module I (13 hours)

Module II (13 hours)
SWOT analysis-strategic planning-customer focus-quality function deployment-customer satisfaction measurement-seven new management tools-Deming wheel-zero defect concept-bench marking-six sigma concepts-failure mode and effect analysis-poke yoke

Module III (13 hours)
Five S for quality assurance-quality circle philosophy-failure rate analysis-mean failure rate-mean time to failure (MTTF)-Mean time between failure (MTBF)-hazard models-system reliability-availability-maintenance

Module IV (13 hours)
Text Books

1. L Suganthi, Anand A Samuel, Total Quality Management, PHI

Reference Books


Internal Continuous Assessment (Maximum Marks-50)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions 8x 5 marks = 40 marks
Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks = 60 marks
Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

BM14 804(C): Reliability and Quality Control

<table>
<thead>
<tr>
<th>Teaching scheme</th>
<th>Credits: 4</th>
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<tr>
<td>3 hours lecture and 1 hour tutorial per week</td>
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</table>

**Objectives**

*The objective of this course is to provide students with a basic understanding of the approaches and techniques to assess and improve quality and reliability of process and product.*

**Module I (13 hours)**

Definition of reliability - Failure data analysis - mean failure rate - MTTF - MTVF - Bath tub curve - Hazard models - Constant, linearly increasing and weivull- system reliability - series, parallel, mixed, and 'rr' out of V configuration.

**Module II (13 hours)**


**Module III (13 hours)**

Definition of Quality - Quality control design - Product development cycle - Quality planning of manufacturing process - process selection and control - inspection and testing - quality audit - organizing for quality - quality function - Quality engineering and quality control - Typical organization for quality: small scale, medium scale and Large scale organization.

**Module IV (13 hours)**


Text Books

2. E L Grant & Levenworth, Statistical Quality Control, McGraw Hill.

Reference Books

1. Mann, R.E Schafer, N. D. Singapurvala, Methods for Statistical Analysis of Reliability and Life Date, John Wiley & Sons.

Internal Continuous Assessment (Maximum Marks-50)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions 8x 5 marks = 40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks = 60 marks

Two questions from each module with choice to answer one question.

BM14 804(D): Virtual Instrumentation

Teaching scheme

<table>
<thead>
<tr>
<th></th>
<th>Credits: 4</th>
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<tbody>
<tr>
<td>3 hours lecture and 1 hour tutorial per week</td>
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</table>

Objective

- To impart knowledge on the concepts of virtual instrumentation.
- To provide knowledge on the data acquisition

Module 1 (13 hours)

Review of Virtual Instrumentation, Historical perspective, Need of VI, Advantages of VI, Define VI, block diagram & architecture of VI, data flow techniques, graphical programming in data flow, comparison with conventional programming.

Module II (13 hours)

Programming Techniques, VIS & Sub VIS, loops & charts, arrays, clusters, graphs, case & sequence structures, formula modes, local and global variable, string & file input. Data Acquisition basics, ADC, DAC, DIO, Counters & timers, PC Hardware structure, timing, interrupts, DMA, Software and Hardware Installation

Module III (13 hours)

Common Instrument Interfaces for Current loop, Rs 232C/Rs 485, GPIB, System basics, interface basics: USB, PCMCIA, VXI, SCXI, PXI etc, networking basics for office & industrial application VISA & IVI, image acquisition & processing, Motion Control.

Module IV (13 hours)
Use of Analysis Tools, Fourier transforms, Power spectrum, Correlation methods, windowing &
flittering. Application of VI: Application in Process Control Designing of equipments like
Oscilloscope, Digital Millimeter using Lab view Software, Study of Data Acquisition & control using
Lab view. Virtual instrumentation for an Innovative Thermal Conductivity Apparatus to measure
the Thermal Conductivity Apparatus- to measure the conductivity of non Newtonian fluids white they
are subjected to sharing force.

**Text Books**


**Reference Books**


**Internal Continuous Assessment** (*Maximum Marks-50*)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey,
seminar, term-project, software exercises, etc.
10% - Regularity in the class
University Examination Pattern

PART A: Analytical/problem solving SHORT questions 8x 5 marks=40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks=60 marks

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

BM14 804(E): Mobile Communications

Teaching scheme

<table>
<thead>
<tr>
<th>Credits: 4</th>
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<tbody>
<tr>
<td>3 hours lecture and 1 hour tutorial per week</td>
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</table>

Objectives

To introduce the concepts of Mobile Communication Cellular environment

Module I (13 hours)

Introduction to Cellular Mobile Systems: A basic cellular system, performance criteria, uniqueness of mobile environment, operation of cellular systems, planning a cellular system, analog and digital cellular systems. Elements of Cellular radio system design – concept of frequency reuse channels – co – channel interference reduction factor – desired C/I from a normal case in an omni directional antenna system – cell splitting

Module II (13 hours)
**Cell coverage for Signal and Traffic:** General introduction - mobile point to point mode – radio propagation characteristics : models for path loss – shadowing and multipath fading – propagation over water or flat open area – foliage loss – propagation in near distance – long distance propagation – cell site – antenna heights and signal coverage cells – mobile to mobile propagation

**Module III (13 hours)**

**Frequency management, Channel assignment and handoff:** Frequency management – fixed channel assignment – non fixed channel assignment – traffic and channel assignment – why handoff - types of handoff and their characteristics – handoff analysis

**Module IV (13 hours)**

**Multiple access techniques:** FDMA/TDMA – CDMA, FDM/TDM Cellular systems – cellular CDMA – soft capacity – Earlang capacity comparison of FDM/TDM systems and Cellular CDMA, GSM architecture – mobile management – network signaling – frequency allocation and control

**Text Books**


**Reference Books**

1. Dr. Kamilo Feher, *Wireless and Digital Communications*, PHI

**Internal Continuous Assessment (Maximum Marks-50)**

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

**PART A:** Analytical/problem solving SHORT questions 8x 5 marks=40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B:** Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks=60 marks

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*

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**BM14 805(A): Principles of Radiography & Radiology**

<table>
<thead>
<tr>
<th>Teaching scheme</th>
<th>Credits: 4</th>
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<tbody>
<tr>
<td>3 hours lecture and 1 hour tutorial per week</td>
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</table>

**Objectives**

To introduce the concepts of Radiography & Radiology

**Module I (13 Hours)**

Production of X-rays Various components of radiographic systems Electrical circuit for X-ray unit filament circuits and mA control- IITV circuits - KV control exposure switching and control of exposure timers - types of X-ray tubes for various medical applications .. Rating charts of X-ray tubes .

Module II (13 Hours)

Module III (13 Hours)

Module IV (13 Hours)

Text Books
1. Massey & Meredith, "Fundamental Physics of Radiology", John Wright & Sons
2. Webb S, "The Physics of Medical Imaging", Adam Hilger,
3. Bristol Thomas Thompson, "A Practical Approach to Modern Imaging Equipment"

Reference Books
2. Chistrmis, "Physics of Diagnostic Radiology"

Internal Continuous Assessment (Maximum Marks-50)
60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.

10% - Regularity in the class

University Examination Pattern

**PART A:** Analytical/problem solving SHORT questions

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

**PART B:** Analytical/Problem solving DESCRIPTIVE questions

Two questions from each module with choice to answer one question.

*Maximum Total Marks: 100*

BM14 805(B): Robotics and Automation

<table>
<thead>
<tr>
<th>Teaching scheme</th>
<th>Credits: 4</th>
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<tr>
<td>3 hours lecture and 1 hour tutorial per week</td>
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</table>

**Objectives**

*To introduce the concepts of Robotics & Automation*

**Module I (13 hours)**

Basic Concepts: Definition and origin of robotics – different types of robotics – various generations of robots – degrees of freedom – Asimov’s laws of robotics – dynamic stabilization of robots.
Module II (13 hours)


Module III (13 hours)


Module IV (13 hours)


Text Books


Reference Books


Internal Continuous Assessment (Maximum Marks-50)

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions 8 x 5 marks = 40 marks
Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks = 60 marks
Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

BM14 805(C): Entrepreneurship

<table>
<thead>
<tr>
<th>Teaching scheme</th>
<th>Credits: 4</th>
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<tr>
<td>3 hours lecture and 1 hour tutorial per week</td>
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</table>

Objectives

To give an idea on entrepreneurial perspectives

Module I (13 hours)
Entrepreneurial perspectives- Understanding of entrepreneurship process- entrepreneurial decision process-entrepreneurship and economic development- characteristics of entrepreneur- entrepreneurial competencies- managerial functions for enterprise.

Module II (13 hours)
Process of business opportunity identification and evaluation - industrial policy - environment -
market survey and market assessment - project report preparation - study of feasibility and viability of
a project - assessment of risk in the industry

Module III (13 hours)
Process and strategies for starting venture - stages of small business growth - entrepreneurship in
international environment - entrepreneurship - achievement motivation - time management creativity
and innovation structure of the enterprise - planning, implementation and growth

Module IV (13 hours)
Technology acquisition for small units - formalities to be completed for setting up a small scale units -
forms of organizations for small scale units - financing of project and working capital - venture capital
and other equity assistance available - break even analysis and economic ratios technology transfer and
business incubation

Text Books
1 Harold Koontz & Heinz Weihrich, Essentials of Management, McGraw hill International
4 Donald Kurado & Hodgelts R.M., Entrepreneurship A contemporary Approach, The

Reference Books
1 Dr. Patel V.G., Seven Business Crisis, Tata McGraw hill
Internal Continuous Assessment (Maximum Marks-50)

60% - Tests (minimum 2)

30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.

10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions 8x 5 marks=40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks=60 marks

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

BM14 805(D): Probability and Random Processes

Teaching scheme

<table>
<thead>
<tr>
<th>Credit: 4</th>
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<tr>
<td>3 hours lecture and 1 hour tutorial per week</td>
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</table>

Objective

To impart knowledge on tools and skills in probability theory for solving engineering problems.

Module I (13 hours)


Module II (13 hours)

Module III (13 hours)

Module IV (13 hours)

Text Books


Reference Books

2. X. Rong Li, Probability, Random Signals, and Statistics

Internal Continuous Assessment (Maximum Marks-50)

60% - Tests (minimum 2)

30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.

10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions 8x 5 marks=40 marks

Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks=60 marks

Two questions from each module with choice to answer one question.

Maximum Total Marks: 100

BM14 805(E): Embedded System Design

Teaching scheme

<table>
<thead>
<tr>
<th>Credits: 4</th>
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<tbody>
<tr>
<td>3 hours lecture and 1 hour tutorial per week</td>
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</table>

Objectives

- To impart knowledge on the concepts of embedded systems.
- To provide knowledge on the microcontrollers 8051 and 80196, and a peripheral interface controller and thus enable students to design embedded systems.
Module I (13 hours)

Module II (13 hours)

Module III (13 hours)

Module IV (13 hours)

Text Books

Reference Books
Internal Continuous Assessment (Maximum Marks-50)
60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination Pattern

PART A: Analytical/problem solving SHORT questions 8x 5 marks=40 marks
Candidates have to answer EIGHT questions out of TEN. There shall be minimum of TWO and maximum of THREE questions from each module with total TEN questions.

PART B: Analytical/Problem solving DESCRIPTIVE questions 4 x 15 marks=60 marks
Two questions from each module with choice to answer one question.

Maximum Total Marks: 100
BM14 806(P): SEMINAR

Objectives

To assess the ability of the student to study and present a seminar on a topic of current relevance in the field of Biomedical Engineering or allied areas

It enables the students to gain knowledge in any of the technically relevant current topics and acquire the confidence in presenting the topic. The student will undertake a detailed study on the chosen topic under the supervision of a faculty member, by referring papers published in reputed journals and conferences. Each student has to submit a seminar report, based on these papers; the report must not be reproduction of any original paper. A committee consisting of three/four faculty members will evaluate the seminar.

Internal Continuous Assessment (Maximum Marks-150)

20% - Relevance of the topic and literature survey
50% - Presentation and discussion
20% - Report
10% - Regularity in the class and Participation in the seminar

BM13 807(P): PROJECT

Teaching scheme

3 hours practical per week

Credits: 2

Teaching scheme

7 hours practical per week

Credits: 4
Objectives

To estimate the ability of the student in transforming the theoretical knowledge studied so far into a working model or a system.

This project work is the continuation of the project initiated in seventh semester. The performance of the students in the project work shall be assessed on a continuous basis by the project evaluation committee through progress seminars and demonstrations conducted during the semester. Each project group should maintain a log book of activities of the project. It should have entries related to the work done, problems faced, solution evolved etc.

There shall be at least an Interim Evaluation and a final evaluation of the project in the 8th semester. Each project group has to submit an interim report in the prescribed format for the interim evaluation.

Each project group should complete the project work in the 8th semester. Each student is expected to prepare a report in the prescribed format, based on the project work. Members of the group will present the relevance, design, implementation, and results of the project before the project evaluation committee comprising of the guide, and three/four faculty members Biomedical/ Electronics/ Instrumentation/ Mechatronics etc.

50% of the mark is to be awarded by the guide/Coordinator and 50% by the evaluation committee.

<table>
<thead>
<tr>
<th>Internal Continuous Assessment (Maximum Marks - 150)</th>
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</thead>
<tbody>
<tr>
<td>40% - Design and development/Simulation and analysis</td>
</tr>
<tr>
<td>30% - Presentation &amp; demonstration of results</td>
</tr>
<tr>
<td>20% - Report</td>
</tr>
<tr>
<td>10% - Regularity in the class</td>
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</table>
BM13 808(P): VIVA VOCE

Objectives

To examine the knowledge acquired by the student during the B.Tech. Course, through an oral examination

The students shall prepare for the oral examination based on the theory and laboratory subjects studied in the B.Tech. Course, Mini project (if there is), Seminar, and Project. There is only university examination for viva-voce. University will appoint two external examiners and an internal examiner for viva-voce. These examiners shall be senior faculty members having minimum five years teaching experience at engineering degree level.

For final viva-voce, candidates should produce certified reports of Mini project, Seminar, and project. If he/she has undergone industrial training/industrial visit/ Educational tour or presented a paper in any conference, the certified report/technical paper shall also be brought for the viva-voce.

Allotment of marks for viva-voce shall be as given below.

<table>
<thead>
<tr>
<th>Assessment in Viva-voce (Maximum marks – 100)</th>
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</thead>
<tbody>
<tr>
<td>40% - Subjects</td>
</tr>
<tr>
<td>30% - Main Project and Mini Project</td>
</tr>
<tr>
<td>20% - Seminar</td>
</tr>
<tr>
<td>10% - Industrial training/industrial visit/educational tour or Paper presented at National-level</td>
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