**ANNA UNIVERSITY, CHENNAI**

**UNIVERSITY DEPARTMENTS**

**B.E. BIOMEDICAL ENGINEERING**

**REGULATIONS – 2015**

**The programme spells out Programme Educational Objectives (3 PEOs), Programme Outcomes (12 POs) with mapping and Program Specific Outcomes (3 PSOs)**

VISION

To be recognized as a benchmark and trend setter in Electronics and Communication Engineering domain keeping in pace with rapidly changing technologies through effective partnership with reputed academic institutions, research organizations, industries and community.

MISSION

- Create highly motivated, technologically competent human resource by imparting high quality technical education through flexible student centric updated curricula suited to students with diverse backgrounds.
- Adopt best teaching and learning practices and establish state-of-the-art facilities to provide quality academic ambience for innovativeness, research and developmental activities.
- Enhance collaborative activities with academic institutions and industries for evolving indigenous technological solutions to meet societal needs and nurture leadership and entrepreneurship qualities with ethical means.
- Facilitate adequate exposure to the students, faculty and staff through training in the state-of-the art technologies, efficient administration, global outreach and benchmarking against referential institutions.

ANNA UNIVERSITY, CHENNAI

UNIVERSITY DEPARTMENTS

REGULATIONS - 2015

CHOICE BASED CREDIT SYSTEM

B.E. BIO MEDICAL ENGINEERING

The programme spells out Programme Educational Objectives (3 PEOs), Programme Outcomes (12 POs) with mapping and Program Specific Outcomes (3 PSOs)

## 1. PROGRAM EDUCATIONAL OBJECTIVES (PEOs)
## THE OBJECTIVES OF THE B.E BIO MEDICAL ENGINEERING PROGRAMME IS BROADLY DEFINED ON THE FOLLOWING:

**PEO1:** The graduates will provide innovative and indigenous affordable healthcare solutions for global, industrial and societal needs through trans-disciplinary collaborations.

**PEO2:** The graduates will engage in lifelong learning and continuous self-development in Health care systems through professional development / Higher Education / Research.

**PEO3:** The graduates will demonstrate global outreach, leadership and Entrepreneurship skills in their ethical professional career involving human health and well- being.

## 2. PROGRAMME OUTCOMES (POs):

After going through the four years of study, our Biomedical Engineering Graduates will exhibit ability to:

| | |
|---|---|
| PO1 | **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and engg. specialization to the solution of complex engineering problems . |
| PO2 | **Problem analysis:** Identify, formulate, research literature, and analyze engineering problems to arrive at substantiated conclusions using first principles of mathematics, natural, and engineering sciences. |
| PO3 | **Design/development of solutions:** Design solutions for complex engineering problems and design system components, processes to meet the specifications with consideration for the public health and safety, and the cultural, societal, and environmental considerations. |
| PO4 | **Conduct investigations of complex problems:** Use research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions. |
| PO5 | **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and |

| | |
|---|---|
| | modeling to complex engineering activities with an understanding of the limitations. |
| PO6 | **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice. |
| PO7 | **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development. |
| PO8 | **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. |
| PO9 | **Individual and team work:** Function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings. |
| PO10 | **Communication:** Communicate effectively with the engineering community and with society at large. Be able to comprehend and write effective reports documentation. Make effective presentations, and give and receive clear instructions. |
| PO11 | **Project management and finance:** Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team. Manage projects in multidisciplinary environments. |
| PO12 | **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. |

**PROGRAM SPECIFIC OUTCOMES (PSOs):**

**By the completion of Bio Medical Engineering program, the student will have following Program Specific Outcomes.**

**Graduates Will be able to**

PSO 1. Apply concepts of Life Science, Mathematics, Electronics and Biomedical Engineering for medical applications.

PSO 2. Analyze healthcare systems and develop innovative solutions effectively through problem specific design and development using hardware and software tools.

PSO 3. Adopt emerging technologies in research and development to provide healthcare solutions for societal needs.

## MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVE WITH PROGRAMME OUTCOMES

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

| PROGRAMME EDUCATIONAL OBJECTIVES | PROGRAMME OUTCOMES | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| I. | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 3 | 2 | 1 |
| II. | 1 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 3 | 2 | 1 | 2 |
| III. | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 2 | 3 | 1 | 1 | 3 |

## MAPPING OF COURSE OUTCOMES WITH PROGRAMME OUTCOMES

**A broad relation between the programme outcomes and the course outcomes is given in the following table:**

| | | COURSE NAME | PROGRAMME OUTCOMES | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO 3 |
| YEAR 1 | SEMESTER 1 | Foundational English | | | | | | | | | | | | | | | |
| | | Mathematics I | | | | | | | | | | | | | | | |
| | | Engineering Physics | | | | | | | | | | | | | | | |
| | | Engineering Chemistry | | | | | | | | | | | | | | | |
| | | Engineering Graphics | | | | | | | | | | | | | | | |
| | | Basic Sciences Laboratory | | | | | | | | | | | | | | | |
| | | Engineering Practices Laboratory | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | SEMESTER 2 | Technical English | | | | | | | | | | | | | | | |
| | | Mathematics II | | | | | | | | | | | | | | | |
| | | Anatomy and Physiology | | | | | | | | | | | | | | | |
| | | Electron Devices and Circuits | - | 3 | 2.5 | 3 | 3 | - | - | - | - | - | 3 | - | 3 | | |
| | | Computing Techniques | 3 | 3 | 2 | 2 | | | | | | | | 1 | 3 | | |
| | | Circuit Theory | 3 | 2 | | | | | | | | | | | 3 | | |
| | | Devices and Circuits Laboratory | - | 3 | 2.67 | 3 | 3 | - | - | - | - | - | 3 | - | 3 | | |
| | | Computer Practices Laboratory | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| YEAR 2 | SEMESTER 3 | Transform Techniques and Partial Differential Equations | 3 | 3 | 1 | 1 | - | - | - | - | 1 | - | - | - | 3 | | |
| | | Environmental Science and Engineering | | | | | | | | | | | | | | | |
| | | Fundamentals of Biochemistry | 3 | 2 | 2 | | | | | | | | | | 3 | | |
| | | Sensors and Measurements | 3 | 3 | 3 | | 2 | | | | | | | | 3 | 2 | |
| | | Signals and Systems | 3 | 2 | 2 | 2 | | | | | | | | | 3 | | |
| | | Electrical Engineering | 3 | 3 | 2 | | 3 | | | | 3 | 3 | | 2 | 3 | | |
| | | Biochemistry and Human Physiology Laboratory | 3 | 2 | | | | | | | 3 | 3 | | 2 | 3 | | |
| | | Sensors and Measurements Laboratory | | | | | | | | | | | | | | | |
| | SEMESTER IV | Probability and Random processes | 3 | 3 | 2 | | | | | | | 2 | | 2 | 3 | | |
| | | Biomedical Instrumentation and Measurements | 3 | 3 | 3 | | 2 | | | | | | | | 3 | | |
| | | Analog and Digital Communication | | | | | | | | | | | | | | | |
| | | Digital Electronics and System Design | 3 | 3 | 3 | 3 | 2 | | | | | | | | 3 | | |
| | | Operational Amplifiers and Analog Integrated circuits | 3 | 3 | 3 | | | | | | | 2 | | | 3 | 2 | |
| | | Control System for Bio Medical Engg. | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Biomedical Instrumentation Laboratory | 3 | 3 | 3 | | | | | 3 | 3 | 3 | | 3 | 3 | | |
| | | Digital and Integrated Circuits Laboratory | 3 | 3 | 2 | | | | | | 3 | 3 | | 2 | 3 | | |
| YEAR 3 | SEMESTER 5 | Hospital Management | 3 | 2 | | | | | | | | | | | 3 | 3 | |
| | | Diagnostic and Therapeutic Equipment I | 3 | 3 | 3 | 3 | | | | | | | | | 3 | 3 | |
| | | Microprocessors and Microcontrollers | 3 | 3 | | | | | | 3 | 3 | 3 | | 3 | 3 | | |
| | | Discrete Time Signal Processing | 3 | | | | | 3 | 3 | 3 | | | | 2 | 3 | | |
| | | Data structures and Object Oriented Programming in C++ | | | | | | | | | | | | | | | |
| | | Professional Elective – I | | | | | | | | | | | | | | | |
| | | Microcontroller and Interfacing laboratory | 3 | 2 | 2 | | 3 | | | | 3 | 3 | | 2 | 3 | | |
| | | Discrete Time Signal Processing Laboratory | 3 | 3 | 3 | | | | | | 3 | 3 | | 3 | 3 | 3 | |
| | SEMESTER 6 | Bio Mechanics | 3 | 2 | | | | | | | | | | | 3 | 3 | |
| | | Diagnostic and Therapeutic Equipment –II | 3 | 2 | | | | 2 | | 2 | | | | | 3 | | 2 |
| | | Pathology and Microbiology | 3 | 3 | 2 | | | | | | | | | | 3 | | |
| | | Radiological Equipment | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Professional Elective - II | | | | | | | | | | | | | | | |
| | | Professional Elective –III | | | | | | | | | | | | | | | |
| | | Diagnostic and Therapeutic Equipment Laboratory | 3 | 3 | | | 3 | | | | 3 | 3 | | 3 | 3 | 3 | |
| | | Pathology and Microbiology Laboratory | 3 | 3 | 2 | | | | | | 3 | 3 | | 2 | 3 | | |
| YEAR 4 | SEMESTER 7 | Medical Informatics | 3 | 3 | 2 | | 2 | | | | | | | | 3 | | |
| | | Pattern Recognition and Neural Networks | 3 | 3 | 3 | | 2 | | | | | | | | 3 | 3 | |
| | | Principles of Digital Image Processing | | | | | | | | | | | | | | | |
| | | Professional Elective - IV | | | | | | | | | | | | | | | |
| | | Professional Elective - V | | | | | | | | | | | | | | | |
| | | Open Elective-I | 3 | 3 | | | 3 | | | | 3 | 3 | | 3 | | 3 | |
| | | Medical Image Processing Laboratory | 3 | 2 | | | | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | |
| | | Mini Project | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| | | Hospital Training | | | | | | | | | | | | | | | |
| | SEMESTER 8 | Professional Elective - VI | | | | | | | | | | | | | | | |
| | | Professional Elective – VII | | | | | | | | | | | | | | | |
| | | Open Elective-II | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Project Work | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| | | AVERAGE PO | 3.000 | 2.742 | 2.465 | 2.600 | 2.643 | 2.833 | 3.000 | 2.875 | 2.867 | 2.875 | 3.000 | 2.471 | 3.000 | 2.800 | 2.750 |
| | | ESTIMATED PO | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

**ANNA UNIVERSITY, CHENNAI UNIVERSITY DEPARTMENTS**
**B.E. BIOMEDICAL ENGINEERING**
**REGULATIONS – 2015**
**CHOICE BASED CREDIT SYSTEM**
**CURRICULA AND SYLLABI FOR I – VIII SEMESTER**
**SEMESTER I**

| S.NO | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | HS7151 | Foundational English | HS | 4 | 4 | 0 | 0 | 4 |
| 2. | MA7151 | Mathematics –I | BS | 4 | 4 | 0 | 0 | 4 |
| 3. | PH7151 | Engineering Physics | BS | 3 | 3 | 0 | 0 | 3 |
| 4. | CY7151 | EngineeringChemistry | BS | 3 | 3 | 0 | 0 | 3 |
| 5. | GE7152 | Engineering Graphics | ES | 5 | 3 | 2 | 0 | 4 |
| **PRACTICALS** | | | | | | | | |
| 6. | BS7161 | Basic Sciences Laboratory | BS | 4 | 0 | 0 | 4 | 2 |
| 7. | GE7162 | Engineering Practices Laboratory | ES | 4 | 0 | 0 | 4 | 2 |
| **TOTAL** | | | | **27** | **17** | **2** | **8** | **22** |

**SEMESTER II**

| S.NO | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | HS7251 | Technical English | HS | 4 | 4 | 0 | 0 | 4 |
| 2. | MA7251 | Mathematics –II | BS | 4 | 4 | 0 | 0 | 4 |
| 3. | BM7201 | Anatomy andPhysiology | PC | 3 | 3 | 0 | 0 | 3 |
| 4. | EC7252 | Electron Devicesand Circuits | ES | 3 | 3 | 0 | 0 | 3 |
| 5. | GE7151 | Computing Techniques | ES | 3 | 3 | 0 | 0 | 3 |
| 6. | EC7251 | Circuit Theory | ES | 4 | 2 | 2 | 0 | 3 |
| **PRACTICALS** | | | | | | | | |
| 7. | EC7261 | Devices and Circuits Laboratory | ES | 4 | 0 | 0 | 4 | 2 |
| 8. | GE7161 | Computer Practices Laboratory | ES | 4 | 0 | 0 | 4 | 2 |
| | | **TOTAL** | | **29** | **19** | **2** | **8** | **24** |

**SEMESTER III**

| S.NO | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | BM7301 | Fundamentals ofBiochemistry | PC | 3 | 3 | 0 | 0 | 3 |
| 2. | BM7302 | Sensors and Measurements | PC | 3 | 3 | 0 | 0 | 3 |
| 3. | EC7355 | Signals and Systems | ES | 4 | 2 | 2 | 0 | 3 |
| 4. | EE7305 | Electrical Engineering | ES | 3 | 3 | 0 | 0 | 3 |
| 5. | GE7251 | Environmental Science and Engineering | HS | 3 | 3 | 0 | 0 | 3 |
| 6. | MA7358 | Transform Techniquesand Partial Differential Equations | BS | 4 | 4 | 0 | 0 | 4 |
| **PRACTICALS** | | | | | | | | |
| 7. | BM7311 | Biochemistry and Human Physiology Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| 8. | BM7312 | Sensors and Measurements Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| **TOTAL** | | | | **28** | **18** | **2** | **8** | **23** |

**SEMESTER IV**

| S.NO | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | BM7401 | Analog and Digital Communication | ES | 3 | 3 | 0 | 0 | 3 |
| 2. | BM7402 | Biomedical Instrumentation and Measurements | PC | 3 | 3 | 0 | 0 | 3 |
| 3. | BM7403 | Control System forBio Medical Engineering. | PC | 3 | 3 | 0 | 0 | 3 |
| 4. | EC7353 | Digital Electronics and System Design | PC | 3 | 3 | 0 | 0 | 3 |
| 5. | EC7452 | Operational Amplifiers and Analog Integrated Circuits | PC | 3 | 3 | 0 | 0 | 3 |
| 6. | MA7356 | Probability and Random Processes | BS | 4 | 4 | 0 | 0 | 4 |
| **PRACTICALS** | | | | | | | | |
| 7. | BM7411 | Bio Medical Instrumentation Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| 8. | BM7412 | Digital and Integrated Circuits Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| | | **TOTAL** | | **27** | **19** | **0** | **8** | **23** |

**SEMESTER V**

| S.NO | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | BM7501 | Diagnostic and Therapeutic EquipmentI | PC | 3 | 3 | 0 | 0 | 3 |
| 2. | BM7502 | Hospital Management | HS | 3 | 3 | 0 | 0 | 3 |
| 3. | EC7352 | Data structures and Object Oriented Programming In C++ | ES | 5 | 3 | 2 | 0 | 4 |
| 4. | EC7451 | Microprocessors and Microcontrollers | PC | 3 | 3 | 0 | 0 | 3 |
| 5. | EC7552 | Discrete Time Signal Processing | PC | 3 | 3 | 0 | 0 | 3 |
| 6. | | Professional Elective – I | PE | 3 | 3 | 0 | 0 | 3 |
| **PRACTICALS** | | | | | | | | |
| 7. | BM7511 | Microcontroller and Interfacing laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| 8. | EC7561 | Discrete Time Signal Processing Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| | | | **TOTAL** | **28** | **18** | **2** | **8** | **23** |

**SEMESTER VI**

| S. NO. | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | BM7601 | Bio Mechanics | PC | 3 | 3 | 0 | 0 | 3 |
| 2. | BM7602 | Diagnostic and Therapeutic Equipment –II | PC | 3 | 3 | 0 | 0 | 3 |
| 3. | BM7603 | Pathology and Microbiology | PC | 3 | 3 | 0 | 0 | 3 |
| 4. | BM7604 | Radiological Equipment | PC | 3 | 3 | 0 | 0 | 3 |
| 5. | | Professional Elective-II | PE | 3 | 3 | 0 | 0 | 3 |
| 6. | | Professional Elective-III | PE | 3 | 3 | 0 | 0 | 3 |
| **PRACTICALS** | | | | | | | | |
| 7. | BM7611 | Diagnostic and Therapeutic Equipment Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| 8. | BM7612 | Pathology and Microbiology Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| | | | **TOTAL** | **26** | **18** | **0** | **8** | **22** |

**SEMESTER VII**

| S.NO | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | BM7701 | Medical Informatics | PC | 3 | 3 | 0 | 0 | 3 |
| 2. | BM7702 | Pattern Recognitionand Neural Networks | PC | 3 | 3 | 0 | 0 | 3 |
| 3. | EC7751 | Principles of DigitalImage Processing | PC | 3 | 3 | 0 | 0 | 3 |
| 4. | | Professional Elective -IV | PE | 3 | 3 | 0 | 0 | 3 |
| 5. | | Professional Elective -V | PE | 3 | 3 | 0 | 0 | 3 |
| 6. | | Open Elective - I * | OE | 3 | 3 | 0 | 0 | 3 |
| **PRACTICALS** | | | | | | | | |
| 7. | BM7711 | Hospital Training # | EEC | 4 | 0 | 0 | 4 | 2 |
| 8. | BM7712 | Medical Image Processing Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| 9. | BM7713 | Mini Project # | EEC | 6 | 0 | 0 | 6 | 3 |
| | | | **TOTAL** | **32** | **18** | **0** | **14** | **25** |

**SEMESTER VIII**

| S.NO | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | | Professional Elective -VI | PE | 3 | 3 | 0 | 0 | 3 |
| 2. | | Professional Elective -VII | PE | 3 | 3 | 0 | 0 | 3 |
| 3. | | Open Elective -II * | OE | 3 | 3 | 0 | 0 | 3 |
| **PRACTICALS** | | | | | | | | |
| 4. | BM7811 | Project Work | EEC | 20 | 0 | 0 | 20 | 10 |
| | | | **TOTAL** | **29** | **9** | **0** | **20** | **19** |

**TOTAL NO. OF CREDITS:181**

*** Course from the curriculum of other UG programmes**

**# The Contact periods will not appear in the slot time table**

## HUMANITIES AND SOCIAL SCIENCES (HS)

| S.NO | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| 1. | HS7151 | Foundational English | HS | 4 | 4 | 0 | 0 | 4 |
| 2. | HS7251 | Technical English | HS | 4 | 4 | 0 | 0 | 4 |
| 3. | GE7251 | Environmental Science and Engineering | HS | 3 | 3 | 0 | 0 | 3 |
| 4. | BM7502 | Hospital Management | HS | 3 | 3 | 0 | 0 | 3 |

## BASIC SCIENCES (BS)

| S.NO | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| 1. | MA7151 | Mathematics –I | BS | 4 | 4 | 0 | 0 | 4 |
| 2. | PH7151 | Engineering Physics | BS | 3 | 3 | 0 | 0 | 3 |
| 3. | CY7151 | Engineering Chemistry | BS | 3 | 3 | 0 | 0 | 3 |
| 4. | BS7161 | Basic Sciences Laboratory | BS | 4 | 0 | 0 | 4 | 2 |
| 5. | MA7251 | Mathematics-II | BS | 4 | 4 | 0 | 0 | 4 |
| 6. | MA7358 | Transform Techniques and Partial Differential Equations | BS | 4 | 4 | 0 | 0 | 4 |
| 7. | MA7356 | Probability and Random processes | BS | 4 | 4 | 0 | 0 | 4 |

## ENGINEERING SCIENCES (ES)

| S.NO | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| 1. | GE7152 | Engineering Graphics | ES | 5 | 3 | 2 | 0 | 4 |
| 2. | GE7162 | Engineering Practices Laboratory | ES | 4 | 0 | 0 | 4 | 2 |
| 3. | EC7252 | Electron Devices and Circuits | ES | 3 | 3 | 0 | 0 | 3 |
| 4. | GE7151 | Computing Techniques | ES | 3 | 3 | 0 | 0 | 3 |
| 5. | EC7251 | Circuit Theory | ES | 4 | 2 | 2 | 0 | 3 |
| 6. | EC7261 | Devices and Circuits Laboratory | ES | 4 | 0 | 0 | 4 | 2 |
| 7. | GE7161 | Computer Practices Laboratory | ES | 4 | 0 | 0 | 4 | 2 |
| 8. | EC7355 | Signals and Systems | ES | 4 | 2 | 2 | 0 | 3 |
| 9. | EE7305 | Electrical Engineering | ES | 3 | 3 | 0 | 0 | 3 |
| 10. | BM7401 | Analog and Digital Communication | ES | 3 | 3 | 0 | 0 | 3 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 11. | EC7352 | Data structures and Object Oriented Programming In C++ | ES | 5 | 3 | 2 | 0 | 4 |

**PROFESSIONAL CORE (PC)**

| S.NO | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| 1. | BM7201 | Anatomy and Physiology | PC | 3 | 3 | 0 | 0 | 3 |
| 2. | BM7301 | Fundamentals of Biochemistry | PC | 3 | 3 | 0 | 0 | 3 |
| 3. | BM7302 | Sensors and Measurements | PC | 3 | 3 | 0 | 0 | 3 |
| 4. | BM7311 | Biochemistry and Human Physiology Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| 5. | BM7312 | Sensors and Measurements Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| 6. | BM7402 | Bio Medical Instrumentation and Measurements | PC | 3 | 3 | 0 | 0 | 3 |
| 7. | EC7353 | Digital Electronics and System design | PC | 3 | 3 | 0 | 0 | 3 |
| 8. | EC7452 | Operational Amplifiers and Analog Integrated Circuits | PC | 3 | 3 | 0 | 0 | 3 |
| 9. | BM7403 | Control System for Bio Medical Engineering. | PC | 3 | 3 | 0 | 0 | 3 |
| 10. | BM7411 | Bio Medical Instrumentation Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| 11. | BM7412 | Digital and Integrated Circuits Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| 12. | BM7501 | Diagnostic and Therapeutic Equipment –I | PC | 3 | 3 | 0 | 0 | 3 |
| 13. | EC7451 | Microprocessors and Microcontrollers | PC | 3 | 3 | 0 | 0 | 3 |
| 14. | EC7552 | Discrete Time Signal Processing | PC | 3 | 3 | 0 | 0 | 3 |
| 15. | BM7511 | Microcontroller And Interfacing Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| 16. | EC7561 | Discrete Time Signal Processing Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| 17. | BM7601 | Biomechanics | PC | 3 | 3 | 0 | 0 | 3 |
| 18. | BM7602 | Diagnostic and Therapeutic Equipment –II | PC | 3 | 3 | 0 | 0 | 3 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 19. | BM7603 | Pathology and Microbiology | PC | 3 | 3 | 0 | 0 | 3 |
| 20. | BM7604 | Radiological Equipment | PC | 3 | 3 | 0 | 0 | 3 |
| 21. | BM7611 | Diagnostic and Therapeutic Equipment Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| 22. | BM7612 | Pathology and Microbiology Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| 23. | BM7701 | Medical Informatics | PC | 3 | 3 | 0 | 0 | 3 |
| 24. | BM7702 | Pattern Recognition and Neural Networks | PC | 3 | 3 | 0 | 0 | 3 |
| 25. | EC7751 | Principles of Digital Image Processing | PC | 3 | 3 | 0 | 0 | 3 |
| 26. | BM7712 | Medical Image Processing Laboratory | PC | 4 | 0 | 0 | 4 | 2 |

**PROFESSIONAL ELECTIVES (PE)**

| S.NO | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| 1. | BM7001 | Advanced Bio Analytical And Therapeutic Techniques | PE | 3 | 3 | 0 | 0 | 3 |
| 2. | BM7002 | Bio Signal Processing | PE | 3 | 3 | 0 | 0 | 3 |
| 3. | BM7003 | Biomaterials and Artificial Organs | PE | 3 | 3 | 0 | 0 | 3 |
| 4. | BM7004 | Biomaterials and Characterisation | PE | 3 | 3 | 0 | 0 | 3 |
| 5. | BM7005 | Biometric Systems | PE | 3 | 3 | 0 | 0 | 3 |
| 6. | BM7006 | Body Area Networks | PE | 3 | 3 | 0 | 0 | 3 |
| 7. | BM7007 | Brain Computer Interface and Applications | PE | 3 | 3 | 0 | 0 | 3 |
| 8. | BM7008 | Computer Hardware and Interfacing | PE | 3 | 3 | 0 | 0 | 3 |
| 9. | BM7009 | Medical Optics | PE | 3 | 3 | 0 | 0 | 3 |
| 10. | BM7010 | Medical Physics | PE | 3 | 3 | 0 | 0 | 3 |
| 11. | BM7011 | MEMS and its Biomedical Applications | PE | 3 | 3 | 0 | 0 | 3 |
| 12. | BM7012 | Neural Engineering | PE | 3 | 3 | 0 | 0 | 3 |
| 13. | BM7013 | Physiological Modeling | PE | 3 | 3 | 0 | 0 | 3 |
| 14. | BM7014 | Principles of Tissue Engineering | PE | 3 | 3 | 0 | 0 | 3 |
| 15. | BM7015 | Rehabilitation Engineering | PE | 3 | 3 | 0 | 0 | 3 |
| 16. | BM7016 | Virtual Reality | PE | 3 | 3 | 0 | 0 | 3 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 17. | BM7017 | Wearable Systems | PE | 3 | 3 | 0 | 0 | 3 |
| 18. | EC7022 | Internet and Java | PE | 3 | 3 | 0 | 0 | 3 |
| 19. | EC7071 | Advanced Microcontrollers | PE | 3 | 3 | 0 | 0 | 3 |
| 20. | EC7072 | Cryptography and Network Security | PE | 3 | 3 | 0 | 0 | 3 |
| 21. | EC7073 | Electro Magnetic Interference and Compatibility | PE | 3 | 3 | 0 | 0 | 3 |
| 22. | EC7074 | Foundations for Nano Electronics | PE | 3 | 3 | 0 | 0 | 3 |
| 23. | EC7075 | Multimedia Compression and Networks | PE | 3 | 3 | 0 | 0 | 3 |
| 24. | EC7076 | Real Time and Embedded Systems | PE | 3 | 3 | 0 | 0 | 3 |
| 25. | EC7077 | Robotics | PE | 3 | 3 | 0 | 0 | 3 |
| 26. | EC7078 | Soft Computing and Applications | PE | 3 | 3 | 0 | 0 | 3 |
| 27. | EC7079 | Speech Processing | PE | 3 | 3 | 0 | 0 | 3 |
| 28. | EC7551 | Computer Architecture and Organization | PE | 3 | 3 | 0 | 0 | 3 |
| 29. | EC7651 | VLSI Design | PE | 3 | 3 | 0 | 0 | 3 |
| 30. | GE7071 | Disaster Management | PE | 3 | 3 | 0 | 0 | 3 |
| 31. | GE7072 | Foundation Skills In Integrated Product Development | PE | 3 | 3 | 0 | 0 | 3 |
| 32. | GE7074 | Human Rights | PE | 3 | 3 | 0 | 0 | 3 |
| 33. | GE7351 | Engineering Ethics and Human Values | PE | 3 | 3 | 0 | 0 | 3 |
| 34. | GE7652 | Total Quality Management | PE | 3 | 3 | 0 | 0 | 3 |

**EMPLOYABILITY ENHANCEMENT COURSES (EEC)**

| S.NO | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| 1. | BM7713 | Mini Project | EEC | 6 | 0 | 0 | 6 | 3 |
| 2. | BM7711 | Hospital Training | EEC | 4 | 0 | 0 | 4 | 2 |
| 3. | BM7811 | Project Work | EEC | 20 | 0 | 0 | 20 | 10 |

**SUMMARY**

| S.NO. | SUBJECT AREA | CREDITS AS PER SEMESTER | | | | | | | | CREDITS TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|
| | | I | II | III | IV | V | VI | VII | VII I | |
| 1. | HS | 4 | 4 | 3 | - | 3 | - | - | - | 14 |
| 2. | BS | 12 | 4 | 4 | 4 | - | - | - | - | 24 |
| 3. | ES | 6 | 13 | 6 | 3 | - | - | - | - | 28 |
| 4. | PC | - | 3 | 10 | 16 | 13 | 16 | 11 | - | 69 |
| 5. | PE | - | - | - | - | 3 | 6 | 6 | 6 | 21 |
| 6. | OE | - | - | - | - | - | - | 3 | 3 | 6 |
| 7. | EEC | - | - | - | - | 4 | - | 5 | 10 | 19 |
| | Total | 22 | 24 | 23 | 23 | 23 | 22 | 25 | 19 | 181 |
| 8. | Non Credit / Mandatory | | | | | | | | | |

**HS7151 FOUNDATIONAL ENGLISH L T P C**

**4 0 0 4**

**COURSE DESCRIPTION:**

This course aims at developing the language skills necessary for the first year students of Engineering and Technology.

**OBJECTIVES:**

- To develop the four language skills – Listening, Speaking, Reading and Writing.
- To improve the students‘ communicative competence in English.
- To teach students the various aspects of English language usage.

**CONTENTS:**

**UNIT I GREETING AND INTRODUCING ONESELF 12**

**Listening**- Types of listening — Listening to short talks, conversations; **Speaking** — Speaking about one‘s place, important festivals etc. — Introducing oneself, one‘s family/ friend; **Reading** –Skimming a passage– Scanning for specific information; **Writing**- Guided writing - Free writing on any given topic (My favourite place/ Hobbies/ School life, writing about one‘s leisure time activities, hometown, etc); **Grammar** – Tenses (present and present continuous) -Question types - Regular and irregular verbs; **Vocabulary** – Synonyms and Antonyms.

**UNIT II GIVING INSTRUCTIONS AND DIRECTIONS 12**

**Listening** – Listening and responding to instructions; **Speaking** – Telephone etiquette - Giving oral instructions/ Describing a process – Asking and answering questions; **Reading** – Reading and finding key information in a given text - Critical reading - **Writing –**Process description( non- technical)- **Grammar** – Tense (simple past& past continuous) - Use of imperatives – Subject – verb agreement – Active and passive voice; - **Vocabulary** – Compound words – Word formation –Word expansion (root words).

**UNIT III READING AND UNDERSTANDING VISUAL MATERIAL 12**

**Listening**- Listening to lectures/ talks and completing a task; **Speaking** –Role play/ Simulation –Group interaction; **Reading** – Reading and interpreting visual material; **Writing**- Jumbled sentences — Discourse markers and Cohesive devices — Essay writing (cause & effect/ narrative);**Grammar** – Tenses (perfect), Conditional clauses –Modal verbs; **Vocabulary** –Causeand effect words; Phrasal verbs in context.

**UNIT IV CRITICAL READING AND WRITING 12**

**Listening**- Watching videos/ documentaries and responding to questions based on them; **Speaking** Informal and formal conversation; **Reading** –Critical reading (prediction & inference);**Writing**– Essay writing ( compare & contrast/ analytical) – Interpretation of visual materials; **Grammar** – Tenses (future time reference);**Vocabulary** – One word substitutes (withmeanings) – Use of abbreviations & acronyms – Idioms in sentences.

**UNIT V LETTER WRITING AND SENDING E-MAILS 12**

**Listening**- Listening to programmes/broadcast/ telecast/ podcast; **Speaking** – Giving impromptu talks, Making presentations on given topics- Discussion on the presentation; **Reading**–Extensive reading; **Writing**- Poster making – Letter writing (Formal and E-mail) ;**Grammar** – Direct and Indirect speech – Combining sentences using connectives; **Vocabulary** –Collocation;

**TEACHING METHODS:**

Interactive sessions for the speaking module.
Use of audio – visual aids for the various listening activities.Contextual Grammar Teaching.

**EVALUATION PATTERN:**

Internals – 50%
End Semester – 50%

**TOTAL: 60 PERIODS**

**OUTCOMES:**

- Students will improve their reading and writing skills
- Students will become fluent and proficient in communicative English
- Students will be able to improve their interpersonal communication

**TEXTBOOK:**

1. Richards, Jack.C with Jonathan Hull and Susan Proctor **New Interchange: English for International Communication. (level2, Student's Book)** Cambridge University Press, New Delhi: 2010.

**REFERENCES:**

1. Bailey, Stephen. **Academic Writing: A practical guide for students**. New York: Rutledge, 2011.
2. Morgan, David and Nicholas Regan. **Take-Off: Technical English for Engineering**. London:Garnet Publishing Limited, 2008.
3. Redston, Chris & Gillies Cunningham **Face2Face** (Pre-intermediate Student's Book&Workbook) Cambridge University Press, New Delhi: 2005
4. Comfort, Jeremy, et al. **Speaking Effectively: Developing Speaking Skills for BusinessEnglish.** Cambridge University Press, Cambridge: Reprint 2011.

| MA7151 | MATHEMATICS – I | L | T | P | C |
|---|---|---|---|---|---|
| | **(Common to all branches of B.E. / B.Tech. Programmes in I Semester)** | **4** | **0** | **0** | **4** |

**OBJECTIVES:**

- The goal of this course is for students to gain proficiency in calculus computations.In calculus, we use three main tools for analyzing and describing the behavior of functions: limits, derivatives, and integrals. Students will use these tools to solve application problems in a variety of settings ranging from physics and biology to business and economics.
- To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.

**UNIT I DIFFERENTIAL CALCULUS 12**

Representation of functions - New functions from old functions - Limit of a function - Limits at infinity - Continuity - Derivatives - Differentiation rules - Polar coordinate system - Differentiation in polar coordinates - Maxima and Minima of functions of one variable.

**UNIT II FUNCTIONS OF SEVERAL VARIABLES 12**

Partial derivatives – Homogeneous functions and Euler‘s theorem – Total derivative – Differentiation of implicit functions – Change of variables – Jacobians – Partial differentiationof implicit functions — Taylor‘s series for functions of two variables — Errors and approximations – Maxima and minima of functions of two variables – Lagrange‘s method of undetermined multipliers.

**UNIT III INTEGRAL CALCULUS 12**

Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals.

**UNIT IV MULTIPLE INTEGRALS 12**

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables indouble and triple integrals.

**UNIT V DIFFERENTIAL EQUATIONS 12**

Method of variation of parameters – Method of undetermined coefficients – Homogenous equation of Euler‘s and Legendre‘s type – System of simultaneous linear differential equations with constant coefficients.



**TOTAL: 60 PERIODS**

**OUTCOMES:**

- Understanding of the ideas of limits and continuity and an ability to calculate withthem and apply them.
- Improved facility in algebraic manipulation.
- Fluency in differentiation.
- Fluency in integration using standard methods, including the ability to find anappropriate method for a given integral.
- Understanding the ideas of differential equations and facility in solving simplestandard examples.

**TEXTBOOKS:**

**1.** James Stewart, "Calculus with Early Transcendental Functions", Cengage Learning,New Delhi, 2008.

2. Narayanan S. and Manicavachagom Pillai T. K., ―Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2007.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 9th Edition,New Delhi, 2014.
4. Grewal B.S., ―Higher Engineering Mathematics‖, Khanna Publishers, New Delhi, 43rdEdition, 2014.

**REFERENCES:**

1. Ramana B.V., ―Higher Engineering Mathematics‖, Tata McGraw Hill Co. Ltd., New Delhi, 11th Reprint, 2010.
2. Jain R.K. and Iyengar S.R.K., ―Advanced Engineering Mathematics‖, Narosa Publications, New Delhi, 3rd Edition, 2007.
3. Bali N., Goyal M. and Watkins C., ―Advanced Engineering Mathematics‖, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
4. Greenberg M.D., ―Advanced Engineering Mathematics‖, Pearson Education, New Delhi,2nd Edition, 5th Reprint, 2009.
5. Peter V.O'Neil, ―Advanced Engineering Mathematics‖, Cengage Learning India Pvt., Ltd,New Delhi, 2007.

**PH7151 ENGINEERING PHYSICS L T P C**

(Common to all branches of B.E / B.Tech programmes) **3 0 0 3**

**OBJECTIVE:**

- To introduce the concept and different ways to determine moduli of elasticity and applications.
- To instill the concept of sound, reverberation, noise cancellation, and ultrasonic generation,detection and applications
- To inculcate an idea of thermal properties of materials, heat flow through materials andquantum physics
- To promote the basic understanding of interferometers, principles and applications of lasers,optical fibers and sensors
- To establish a sound grasp of knowledge on the basics, significance and growth of singlecrystals

**UNIT I PROPERTIES OF MATTER 9**

Elasticity — Poisson's ratio and relationship between moduli (qualitative) - stress-strain diagram for ductile and brittle materials, uses - factors affecting elastic modulus and tensile strength - bending of beams - cantilever - bending moment - Young's modulus determination - theory and experiment
- uniform and non-uniform bending - I shaped girders - twisting couple - hollow cylinder - shaft - torsion pendulum - determination of rigidity modulus- moment of inertia of a body (regular and irregular).

**UNIT II ACOUSTICS AND ULTRASONICS 9**

Classification of sound - loudness and intensity - Weber-Fechner Law - standard intensity and intensity level - decibel - reverberation - reverberation time - calculation of reverberation time fordifferent types of buildings – sound absorbing materials - factors affecting acoustics of buildings :focusing, interference, echo, echelon effect, resonance - noise and their remedies. Ultrasonics:production - magnetostriction and piezoelectric methods - detection of ultrasound - acoustic grating — ultrasonic interferometer - industrial applications — Non-destructive testing - ultrasonicmethod: scan modes and practice.

**UNIT III THERMAL AND MODERN PHYSICS 9**

Thermal expansion - thermal stress - expansion joints - bimetallic strips - thermal conductivity-heat conductions in solids – flow of heat through compound media - Forbe's and Lee's disc method: theory and experiment- Black body radiation – Planck's theory (derivation) – Compton effect – wave model of radiation and matter – Schrödinger's wave equation – time dependent andindependent equations – Physical significance of wave function – particle in a one dimensional box.

**UNIT IV APPLIED OPTICS 9**

Interference - Michelson interferometer: construction, working, determination of wave length and thickness -

anti-reflection coating - air wedge and its applications - Lasers — principle and applications — Einstein's coefficients — $CO_2$ and Nd:YAG laser - semiconductor lasers: homo junction and hero junction - construction and working – applications. Optical fibres - classification(index & mode based) - principle and propagation of light in optical fibres - acceptance angle andnumerical aperture - fibre optic communication system - active and passive sensors.

**UNIT V CRYSTAL PHYSICS 9**

Single crystalline, polycrystalline and amorphous materials — Single crystals: unit cell, crystal systems, Bravais lattices, detections and planes in a crystal, Miller indices - interplanar distancefor a cubic crystal - coordination number and packing factor for SC, BCC, FCC, HCP and diamond structures - structure and significance of NaCl, CsCl, ZnS and graphite - crystal imperfections:point defects, line defects — Burger vectors, dislocations and stacking faults — Growth of single crystals: Bridgman and Czochralski methods.

**TOTAL: 45 PERIODS**

**OUTCOME:**

- The students will understand different moduli of elasticity, their determination and applications.
- The students will gain knowledge on the properties of sound, noise cancellation, andproduction, detection and applications of ultrasonics
- The students will acquire sound knowledge on thermal expansion and thermal conductivity of materials. Further they will gain an idea of quantum physics.
- The students will gain knowledge on interferometers, lasers and fiber optics
- The students will secure knowledge on the basics of crystal structures and their significance.Further they gain basic ideas of growing single crystals.

**TEXT BOOKS:**


1. Gaur R.K. and Gupta S.L., ―Engineering Physics‖, Dhanpat Rai Publications (2013)
2. Palanisamy P.K., ―Engineering Physics‖, Scitech Publications (P) Ltd. (2006).
2. Arumugam M., ―Engineering Physics‖, Anuradha Publications (2000)


**REFERENCES:**


1. Serway R.A. and Jewett, J.W. ―Physics for Scientists and Engineers with Modern Physics‖. Brooks/cole Publishing Co. 2010.
2. Tipler P.A. and Mosca, G.P., ―Physics for Scientists and Engineers with Modern Physics‖. W.H.Freeman, 2007.
3. Markert J.T.,Ohanian, H. and Ohanian, M. ―Physics for Engineers and Scientists‖. W.W.Norton& Co. 2007.


**CY7151 ENGINEERING CHEMISTRY L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To develop an understanding about fundamentals of polymer chemistry.
- Brief elucidation on surface chemistry and catalysis.
- To develop sound knowledge photochemistry and spectroscopy.
- To impart basic knowledge on chemical thermodynamics.
- To understand the basic concepts of nano chemistry.

**UNIT I POLYMER CHEMISTRY 9**

Introduction: Functionality-degree of polymerization. Classification of polymers- natural and synthetic, thermoplastic and thermosetting. Types and mechanism of polymerization: addition (free radical, cationic, anionic and living); condensation and copolymerization. Properties of polymers: Tg, tacticity, molecular weight-weight average, number average and polydispersity index. Techniques of polymerization: Bulk, emulsion, solution and suspension.

**UNIT II SURFACE CHEMISTRYAND CATALYSIS 9**

Adsorption-Types of adsorption-adsorption of gases on solids- adsorption from solutions- Types of isotherms — Frendlich adsorption isotherm, Langmuir adsorption isotherm. Industrial applications of adsorption. Catalysis: Characteristics and types of catalysts-homogeneous and heterogeneous, auto catalysis. Enzyme catalysis -factors affecting enzyme catalysis, Michaelis - Menton equation. Industrial applications of catalysts.

**UNIT III PHOTOCHEMISTRY AND SPECTROSCOPY 9**

Photochemistry: Laws of photochemistry-Grotthuss-Draper law, Stark-Einstein law and Lambert-Beer Law. Photo processes-internal conversion, inter-system crossing, fluorescence, phosphorescence, chemiluminescence09 and photo-sensitization. Spectroscopy: Electromagnetic spectrum-absorption of radiation-electronic, vibrational and rotational transitions. Width and intensities of spectral lines. Spectrophotometric estimation of iron.UV-Vis and IR spectroscopy- principles, instrumentation (Block diagram) and applications.

**UNIT IV CHEMICAL THERMODYNAMICS 9**

Second law: Entropy-entropy change for an ideal gas, reversible and irreversible processes; entropy of phase transitions; Free energy and work function: Helmholtz and Gibbs freeenergy functions; Criteria of spontaneity; Gibbs-Helmholtz equation; Clausius Clapeyron equation; Maxwell relations-Van't Hoff isotherm and isochore. Chemical potential; Gibbs- Duhem equation- variation of chemical potential with temperature and pressure.

**UNIT V NANOCHEMISTRY 9**

Basics-distinction between molecules, nanoparticles and bulk materials; size-dependent properties.Preparation of nanoparticles — sol-gel and solvothermal.Preparation of carbon nanotube by chemical vapour deposition and laser ablation.Preparation of nanowires by VLS growth, electrochemical deposition and electro spinning.Properties and uses of nanoparticles, nanoclusters, nanorods, nanotubes and nanowires.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Will be familiar with polymer chemistry, surface chemistry and catalysis.
- Will know the photochemistry, spectroscopy and chemical thermodynamics.
- Will know the fundamentals of nano chemistry.

**TEXT BOOKS:**


1. Jain P. C. & Monica Jain., ―Engineering Chemistry‖, DhanpatRai Publishing Company (P) Ltd, New Delhi, 2014.
2. Kannan P., Ravikrishnan A., ―Engineering Chemistry‖, Sri Krishna Hitech Publishing Company Pvt. Ltd. Chennai, 2014


**REFERENCES:**


1. Pahari A., Chauhan B., ―Engineering Chemistry‖, Firewall Media, New Delhi, 2012.
2. Sivasankar B., ―Engineering Chemistry‖, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2012.
3. AshimaSrivastava. Janhavi N N, Concepts of Engineering Chemistry‖, ACME Learning Private Limited., New Delhi., 2010.
4. Vairam S., Kalyani P., Suba Ramesh., ―Engineering Chemistry‖, Wiley India Pvt Ltd.,New Delhi., 2011.

**GE7152 ENGINEERING GRAPHICS L T P C**
**3 2 0 4**

**OBJECTIVES**

- To develop in students, graphic skills for communication of concepts, ideas and design of engineering products and expose them to existing national standards related to technicaldrawings.

**CONCEPTS AND CONVENTIONS (NOT FOR EXAMINATION) 1**

Importance of graphics in engineering applications — Use of drafting instruments — BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

**UNIT I PLANE CURVES AND FREE HANDSKETCHING 14**

Basic Geometrical constructions, Curves used in engineering practices-Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – constructionof involutes of square and circle — Drawing of tangents and normal to the above curves. Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three Dimensional objects — Layout of views- Free hand sketching of multiple views from pictorial views of objects

**UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES 14**

Orthographic projection- principles-Principal planes-First angle projection-Projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes- Determination of true lengths and true inclinations by rotating line method and trapezoidal method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

**UNIT III PROJECTION OF SOLIDS 14**

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when theaxis is inclined to both the principal planes by rotating object method and auxiliary plane method.

**UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 14**

Sectioning of solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids — Prisms, pyramids cylinders and cones. Development of lateral surfaces of solids with cut-outs and holes.

**UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 15**

Principles of isometric projection — isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions and miscellaneous problems.

Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method and vanishing point method.

**COMPUTER AIDED DRAFTING (DEMONSTRATION ONLY) 3**

Introduction to drafting packages and demonstration of their use.

**L=45+T=30, TOTAL: 75 PERIODS**

**OUTCOMES:**

**On Completion of the course the student will be able to**

- Perform free hand sketching of basic geometrical shapes and multiple views of objects.
- Draw orthographic projections of lines, planes and solids
- Obtain development of surfaces.
- Prepare isometric and perspective views of simple solids.

**TEXT BOOK:**

1. N.D.Bhatt and V.M.Panchal, ―Engineering Drawing‖, Charotar Publishing House, 50thEdition, 2010.

**REFERENCES:**

1. K.R.Gopalakrishna., ―Engineering Drawing‖ (Vol I&II combined) SubhasStores, Bangalore,2007.
2. Luzzader, Warren.J., and Duff,John M.,,‘‘ Fundamentals of Engineering Drawingwith an introduction to Interactive Computer Graphics for Design and Production‖,Eastern Economy Edition, Prentice Hall of India Pvt Ltd, New Delhi, 2005
3. M.B.Shah and B.C.Rana, ―Engineering Drawing‖, Pearson, 2nd Edition, 2009.
4. K.Venugopal and V.Prabhu Raja, ―Engineering Graphics‖, New Age International (P)Limited, 2008.
5. K. V.Natarajan, ―A text book of Engineering Graphics‖, 28th Edition, Dhanalakshmi Publishers, Chennai, 2015.
6. BasantAgarwal and Agarwal C.M., ―Engineering Drawing‖, Tata McGraw Hill PublishingCompany Limited, New Delhi, 2008.
7. N.S Parthasarathy and Vela Murali, ― Engineering Drawing‖, Oxford University Press, 2015.

**Publication of Bureau of Indian Standards**:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

**Special points applicable to University Examinations on Engineering Graphics:**

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be Permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day.

| BS7161 | BASIC SCIENCES LABORATORY | L | T | P | C |
|---|---|---|---|---|---|
| | **(Common to all branches of B.E. / B.Tech Programmes)** | **0** | **0** | **4** | **2** |

**OBJECTIVE:**

- To inculcate experimental skills to test basic understanding of physics of materials including properties of matter, thermal and optical properties.
- To induce the students to familiarize with experimental determination of velocity of ultrasonic waves, band gap determination and viscosity of liquids.

**PHYSICS LABORATORY: (Any Seven Experiments)**

1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertiaof disc
2. Non-uniform bending - Determination of young‘s modulus
3. Uniform bending – Determination of young‘s modulus
4. Lee‘s disc Determination of thermal conductivity of a bad conductor
5. Potentiometer-Determination of thermo e.m.f of a thermocouple
6. Laser- Determination of the wave length of the laser using grating
7. Air wedge - Determination of thickness of a thin sheet/wire
8. a) Optical fibre -Determination of Numerical Aperture and acceptance angle
   b) Compact disc- Determination of width of the groove using laser.
9. Acoustic grating- Determination of velocity of ultrasonic waves in liquids.
10. Ultrasonic interferometer – determination of the velocity of sound and compressibilityof liquids
11. Post office box -Determination of Band gap of a semiconductor.
12. Spectrometer- Determination of wavelength using gating.
13. Viscosity of liquids - Determination of co-efficient of viscosity of a liquid by Poiseuille‟s flow

**TOTAL: 30 PERIODS**

**OUTCOME:**

Upon completion of the course, the students will be able

- To determine various moduli of elasticity and also various thermal and optical properties of materials.
- To determine the velocity of ultrasonic waves, band gap determination and viscosity ofliquids.

**(CHEMISTRY LABORATORY) (Minimum of 8 experiments to be conducted)**

1. Estimation of HCl using $Na_2CO_3$ as primary standard and Determination of alkalinity in watersample.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler‘s method.
4. Determination of chloride content of water sample by argentometric method.
5. Estimation of copper content of the given solution by Iodometry.
6. Determination of strength of given hydrochloric acid using pH meter.
7. Determination of strength of acids in a mixture of acids using conductivity meter.
8. Estimation of iron content of the given solution using potentiometer.
9. Estimation of iron content of the water sample using spectrophotometer (1, 10-Phenanthroline/thiocyanate method).
10. Estimation of sodium and potassium present in water using flame photometer.
11. Determination of molecular weight of poly vinyl alcohol using Ostwald viscometer.
12. Pseudo first order kinetics-ester hydrolysis.
13. Corrosion experiment-weight loss method.
14. Determination of CMC.
15. Phase change in a solid.

**TOTAL: 30 PERIODS**

**TEXT BOOKS:**

1. Vogel‘s Textbook of Quantitative Chemical Analysis $8^{TH}$ edition, 2014
2. Laboratory Manual- Department of Chemistry, CEGC, Anna University 2014.
3.

| GE7162 | ENGINEERING PRACTICES LABORATORY | L | T | P | C |
|---|---|---|---|---|---|
| | (Common to all Branches of B.E. / B.Tech. Programmes) | 0 | 0 | 4 | 2 |

**OBJECTIVES**

- To provide exposure to the students with hands-on experience on various Basic EngineeringPractices in Civil, Mechanical, Electrical and Electronics Engineering.
-

**GROUP – A (CIVIL & ELECTRICAL)**

**1. CIVIL ENGINEERING PRACTICES** **15**

**PLUMBING**

Basic pipe connections involving the fittings like valves, taps, coupling, unions, reducers,elbows and other components used in household fittings. Preparation of plumbing line sketches.

- Laying pipe connection to the suction side of a pump.
- Laying pipe connection to the delivery side of a pump.
- Practice in connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

**WOOD WORK**

- Sawing, planning and making joints like T-Joint, Mortise and Tenon joint and DovetailJoint.

**STUDY**

- Study of joints in door panels and wooden furniture
- Study of common industrial trusses using models.

**2. ELECTRICAL ENGINEERING PRACTICES** **15**

- Basic household wiring using Switches, Fuse, Indicator and Lamp etc.,
- Stair case light wiring
- Tube – light wiring
- Preparation of wiring diagrams for a given situation.
- Study of Iron-Box, Fan Regulator and Emergency Lamp

**GROUP – B (MECHANICAL AND ELECTRONICS)** **15**

**3.MECHANICAL ENGINEERING PRACTICES WELDING**

- Arc welding of Butt Joints, Lap Joints, and Tee Joints
- Gas welding Practice.
- Basic Machining - Simple turning, drilling and tapping operations.
- Study and assembling of the following:
    a. Centrifugal pump
    b. Mixie
    c. Air Conditioner.

**DEMONSTRATION ON FOUNDRY OPERATIONS.**

**4. ELECTRONIC ENGINEERING PRACTICES** **15**

- Soldering simple electronic circuits and checking continuity.
- Assembling electronic components on a small PCB and Testing.
- Study of Telephone, FM radio and Low Voltage Power supplies.

**TOTAL: 60 PERIODS**

**OUTCOMES:**

- Ability to fabricate carpentry components and to lay pipe connections including plumbing Works.
- Ability to use welding equipments to join the structures
- Ability to do wiring for electrical connections and to fabricate electronics circuits.

**HS7251** **TECHNICAL ENGLISH** **L T P C**
**4 0 0 4**

**OBJECTIVES:**

- To enable students acquire proficiency in technical communication.
- To enhance their reading and writing skills in a technical context.
- To teach various languages learning strategies needed in a professional environment.

**CONTENTS:**

**UNIT I ANALYTICAL READING** **12**

**Listening**- Listening to informal and formal conversations; **Speaking** — Conversation Skills(opening, turn taking, closing )-explaining how something works-describing technical functions and applications; **Reading** –Analytical reading, Deductive and inductive reasoning; **Writing**- vision statement–structuring paragraphs.

**UNIT II SUMMARISING** **12**

**Listening**- Listening to lectures/ talks on Science &Technology; **Speaking** –Summarizing/ Oral Reporting, **Reading** – Reading Scientific and Technical articles; **Writing**- Extended definition –Lab Reports — Summary writing.

**UNIT III DESCRIBING VISUAL MATERIAL** **12**

**Listening**- Listening to a panel discussion; **Speaking** – Speaking at formal situations; **Reading** –Reading journal articles - Speed reading; **Writing**-data commentary-describing visual material- writing problem-process- solution-the structure of problem-solution texts- writing critiques

**UNIT IV WRITING/ E-MAILING THE JOB APPLICATION** **12**

**Listening**- Listening to/ Viewing model interviews; **Speaking** –Speaking at different types of interviews — Role play practice ( mock interview); **Reading** — Reading job advertisements and profile of the company concerned; **Writing**- job application – cover letter –Résumé preparation.

**UNIT V REPORT WRITING** **12**

**Listening**- Viewing a model group discussion; **Speaking** –Participating in a discussion - Presentation; **Reading**– Case study - analyse -evaluate — arrive at a solution; **Writing**–Recommendations- Types of reports (feasibility report)- designing and reporting surveys- – Report format.- writing discursive essays.

**TEACHING METHODS:**

Practice writing
Conduct model and mock interview and group discussion.
Use of audio – visual aids to facilitate understanding of various forms of technical communication.Interactive sessions.

**EVALUATION PATTERN:**

Internals – 50%
End Semester – 50%

**TOTAL: 60 PERIODS**

**OUTCOMES:**

- Students will learn the structure and organization of various forms of technical communication.
- Students will be able to listen and respond to technical content.
- Students will be able to use different forms of communication in their respective fields.

**TEXT BOOK:**

1. Craig, Thaine**. Cambridge Academic English: An integrated skills course for EAP(Student's Book)Level: Intermediate** Cambridge University Press, New Delhi: 2012

**REFERENCES:**

1. Laws, Anne. **Presentations.** Hyderabad: Orient Blackswan, 2011.
2. Ibbotson, Mark. **Cambridge English for Engineering**. Cambridge University Press,Cambridge,New Delhi: 2008
3. Naterop, Jean B. and Rod Revell. **Telephoning in English**. Cambridge: Cambridge UniversityPress, 2004.
4. Rutherford, Andrea J. **Basic Communication Skills for Technology**. New Delhi: PearsonEducation, 2001.
5. Bailey, Stephen. **Academic Writing A practical Guide for Students**. Routledge, London:2004
6. Hewings, Martin**. Cambridge Academic English: An integrated skills course forEAP(Student's Book)Level: Intermediate** Cambridge University Press, New Delhi: 2012.

| MA7251 | MATHEMATICS – II (Common to all branches of B.E. / B.Tech. Programmes in II Semester) | L | T | P | C |
|---|---|---|---|---|---|
| | | 4 | 0 | 0 | 4 |

**OBJECTIVES:**

- To develop the use of matrix algebra techniques that is needed by engineers forpractical applications.
- To acquaint the student with the concepts of vector calculus needed for problems inall engineering disciplines.
- To develop an understanding of the standard techniques of complex variable theoryso as to enable the student to apply them with confidence, in application areas suchas heat conduction, elasticity, fluid dynamics and flow of the electric current.
- To make the student appreciate the purpose of using transforms to create a newdomain in which it is easier to handle the problem that is being investigated.

**UNIT I MATRICES** **12**

Eigen values and Eigenvectors of a real matrix – Characteristic equation – Properties of eigenvalues and eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.



**UNIT II VECTOR CALCULUS** **12**

Gradient and directional derivative – Divergence and Curl – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Area of a curved surface -Volume integral - Green's, Gauss divergence and Stoke's theorems – Verification and application in evaluating line, surface and volume integrals.

**UNIT III ANALYTIC FUNCTION** **12**

Analytic functions – Necessary and sufficient conditions for analyticity - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by Functions $w = z + c$, $az$, $\frac{1}{z}$, $z^2$ - Bilinear transformation.

**UNIT IV COMPLEX INTEGRATION** **12**

Line integral - Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour with no pole on real axis.

**UNIT V LAPLACE TRANSFORMS** **12**

Existence conditions – Transforms of elementary functions – Transform of unit step functionand unit impulse function – Basic properties – Shifting theorems -Transforms of derivativesand integrals – Initial and final value theorems – Inverse transforms – Convolution theorem – – Transform of periodic functions – Application to solution of linear ordinary differential equations with constant coefficients.

**TOTAL: 60 PERIODS**

**OUTCOMES:**

Upon successful completion of the course, students should be able to:

- Evaluate real and complex integrals using the Cauchy integral formula and theresidue Theorem
- Appreciate how complex methods can be used to prove some important theoreticalresults.
- Evaluate line, surface and volume integrals in simple coordinate systems
- Calculate grad, div and curl in Cartesian and other simple coordinate systems, andestablish identities connecting these quantities
- Use Gauss, Stokes and Greens theorems to simplify calculations of integrals andprove simple results.

**TEXT BOOKS:**

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 9th Edition, New Delhi, 2014.
2. Grewal B.S., ―Higher Engineering Mathematics‖, Khanna Publishers, New Delhi, 43rdEdition, 2014.

**REFERENCES:**

1. Ramana, B.V. ―Higher Engineering Mathematics‖, Tata McGraw Hill, New Delhi, 2010.
2. Glyn James, ―Advanced Modern Engineering Mathematics‖, Pearson Education, New Delhi, 2007.
3. Jain R.K. and Iyengar S.R.K., ―Advanced Engineering Mathematics‖, Narosa Publications, New Delhi, 3rd Edition, 2007.
4. Bali N., Goyal M. and Watkins C., ―Advanced Engineering Mathematics‖, Firewall Media(An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
5. Peter V. O'Neil , ―Advanced Engineering Mathematics‖, Cengage Learning India Pvt.,Ltd, New Delhi, 2007.



**BM7201 ANATOMY AND PHYSIOLOGY** **L T P C**
**3 0 0 3**

**OBJECTIVES:**

**The student should be made to:**

- Know basic structural and functional elements of human body.
- Learn organs and structures involving in system formation and functions.
- Understand all systems in the human body.

**UNIT I BASIC ELEMENTS OF HUMAN BODY** **8**

Cell: Structure and organelles - Functions of each component in the cell. Cell membrane – transport across membrane – origin of cell membrane potential – Action potential Tissue: Types –Specialized tissues – functions, Types of glands.

**UNIT II SKELETAL AND RESPIRATORY SYSTEM** **9**

Skeletal system: Bone types and functions — Joint - Types of Joint - Cartilage and functions Respiratory System: Components of respiratory system — Respiratory Mechanism. Types of respiration - Oxygen and carbon dioxide transport and acid base regulation.

**UNIT III CIRCULATORY SYSTEM** **10**

Blood composition - functions of blood – functions of RBC. WBC types and their functions Bloodgroups – importance of blood groups – identification of blood groups. Blood vessels - Structure of heart – Properties of Cardiac muscle – Conducting system of heart – Cardiac cycle – ECG - Heartsound - Volume and pressure changes and regulation of heart rate –Coronary Circulation. Factors regulating Blood flow.

**UNIT IV URINARY AND SPECIAL SENSORY SYSTEM** **9**

Urinary system: Structure of Kidney and Nephron. Mechanism of Urine formation and acid baseregulation — Urinary reflex — Homeostasis and blood pressure regulation by urinary system. Special senses: Eye and Ear.

**UNIT V NERVOUS SYSTEM** **9**

Structure of a Neuron – Types of Neuron. Synapses and types. Conduction of action potential inneuron Brain – Divisions of brain lobes - Cortical localizations and functions - EEG. Spinal cord –Tracts of spinal cord - Reflex mechanism — Types of reflex. Autonomic nervous system and its functions.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

The student will have knowledge to:
CO1: Describe basic structural and functional elements of human body.
CO2: Explain gaseous exchange and fluid maintenance in the human body.
CO3: Enlighten organs and structures involving in system formation and functions.
CO4: Identify all systems in the human body.
CO5: Elucidate special senses in the human body.

**TEXT BOOKS:**


1. Elaine.N. Marieb, “Essential of Human Anatomy and Physiology”, Pearson Education New Delhi, 8th Edition, 2007.
2. Gillian Pocock, Christopher D. Richards, "The Human Body An introduction for Biomedical and Health Sciences", Oxford University Press, USA, 2009.


**REFERENCES:**


1. William F. Ganong,"Review of Medical Physiology”, Mc Graw Hill, New Delhi, 25th Edition, 2015.
2. Eldra Pearl Solomon. "Introduction to Human Anatomy and Physiology",W.B.Saunders Company, 2003.
3. Arthur C. Guyton, "Text book of Medical Physiology", Elsevier Saunders, 11th Edition, 2006.


| COURSE OUTCOMES | PROGRAMME OUTCOMES | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO10 | PO11 | PO12 | PSO 1 | PSO 2 | PSO 3 |
| CO1 | 3 | 2 | | | | | | | | | | | 3 | | |
| CO2 | 3 | 2 | | | | | | | | | | | 3 | | |
| CO3 | 3 | 2 | | | | | | | | | | | 3 | | |
| CO4 | 3 | 2 | | | | | | | | | | | 3 | | |
| CO5 | 3 | 2 | | | | | | | | | | | 3 | | |
| Avg | 3 | 2 | | | | | | | | | | | 3 | | |

| GE7151 | COMPUTING TECHNIQUES | L | T | P | C |
|---|---|---|---|---|---|
| | (Common to all branches of Engineering and Technology) | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To learn programming using a structured programming language.
- To provide C programming exposure.
- To introduce foundational concepts of computer programming to students of differentbranches of Engineering and Technology.

**UNIT I INTRODUCTION** **9**

Introduction to Computers – Computer Software – Computer Networks and Internet - Need forlogical thinking – Problem formulation and development of simple programs - Pseudo code -Flow Chart and Algorithms.

**UNIT II C PROGRAMMING BASICS** **9**

Introduction to C programming – Fundamentals – Structure of a C program – Compilation andlinking processes - Constants, Variables – Data Types – Expressions - Operators –Decision Making and Branching – Looping statements – Solving Simple Scientific and Statistical Problems.

**UNIT III ARRAYS AND STRINGS** **9**

Arrays – Initialization – Declaration – One dimensional and two dimensional arrays - Strings-String operations – String Arrays - simple programs- sorting- searching – matrix operations.

**UNIT IV POINTERS** **9**

Macros - Storage classes –Basic concepts of Pointers– Pointer arithmetic - Example Problems - Basic file operations.

**UNIT V FUNCTIONS AND USER DEFINED DATA TYPES** **9**

Function – definition of function – Declaration of function – Pass by value – Pass by reference – Recursion –Enumerators – Structures – Unions

**TOTAL :45 PERIODS**

**OUTCOMES**

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

- Write C program for simple applications
- Formulate algorithm for simple problems
- Analyze different data types and arrays
- Perform simple search and sort**.**
- Use programming language to solve problems.



**TEXTBOOKS:**

1. Pradip Dey, Manas Ghosh, ―Computer Fundamentals and Programming in C‖, SecondEdition, Oxford University Press, 2013
2. Ashok N. Kamthane, ―Computer programming‖, Pearson Education, 2007.
3. Yashavant P. Kanetkar. ―Let Us C‖, BPB Publications, 2011.

**REFERENCES:**

1. Kernighan,B.W and Ritchie,D.M, ―The C Programming language‖, Second Edition,Pearson Education, 2006
2. Byron S Gottfried, ―Programming with C‖, Schaums Outlines, Second Edition, Tata McGraw-Hill, 2006.
3. R.G. Dromey, ―How to Solve it by Computer‖, Pearson Education, Fourth Reprint, 2007

**EC7251** **CIRCUIT THEORY** **L T P C**
**2 2 0 3**

**OBJECTIVES:**

- To introduce the basic concepts of DC and AC circuits behavior
- To study the transient and steady state response of the circuits subjected to step andsinusoidal excitations.
- To introduce different methods of circuit analysis using Network theorems, duality andtopology.

**UNIT I DC CIRCUIT ANALYSIS** **6+6**

Basic Components of electric Circuits, Charge, current, Voltage and Power, Voltage and Current Sources, Ohms Law, Kirchoff‟s Current Law, Kirchoff‟s voltage law, The single Node — Pair Circuit, series and Parallel Connected Independent Sources, Resistors in Series and Parallel, voltage and current division, Nodal analysis, Mesh analysis.

**UNIT II NETWORK THEOREM AND DUALITY** **4+4**

Useful Circuit Analysis techniques - Linearity and superposition, Thevenin and Norton Equivalent Circuits, Maximum Power Transfer, Delta-Wye Conversion. Duals, Dual circuits.

**UNIT III SINUSOIDAL STEADY STATE ANALYSIS** **8+8**

Sinusoidal Steady — State analysis , Characteristics of Sinusoids, The Complex Forcing Function, The Phasor, Phasor relationship for R, L, and C, impedance and Admittance, Nodal and Mesh Analysis, Phasor Diagrams, AC Circuit Power Analysis, Instantaneous Power, Average Power, apparent Power and Power Factor, Complex Power.

**UNIT IV TRANSIENTS AND RESONANCE IN RLC CIRCUITS** **6+6**

Basic RL and RC Circuits, The Source- Free RL Circuit, The Source-Free RC Circuit, The Unit- Step Function, Driven RL Circuits, Driven RC Circuits, RLC Circuits, Frequency Response, Parallel Resonance, Series Resonance, Quality Factor.

**UNIT V COUPLED CIRCUITS AND TOPOLOGY** **6+6**

Magnetically Coupled Circuits, mutual Inductance, the Linear Transformer, the Ideal Transformer, An introduction to Network Topology, Trees and General Nodal analysis, Links and Loop analysis.

**TOTAL: 30 +30 : 60 PERIODS**

**COURSE OUTCOMES:**

CO1: Ability to comprehend and design ac/dc circuits.

CO2 : Develop and understand ac/dc circuits.

CO3 : To be capable of evaluating ac/dc circuits.

CO4 : Ability to analyze electrical circuits.

CO5 : To inherit the ability to apply circuit theorems in real time.

**TEXT BOOKS:**


1. Hayt Jack Kemmerly, Steven Durbin, "Engineering Circuit Analysis", Mc Graw Hill education, 9th Edition, 2018.
2. Robert.L. Boylestead, "Introductory Circuit Analysis", Pearson Education India, 12th Edition, 2014.


**REFERENCES:**


1. Charles K. Alexander & Mathew N.O.Sadiku, "Fundamentals of Electric Circuits", Mc Graw- Hill, 2nd Edition, 2003.
2. D.R.Cunningham, J.A. Stuller, "Basic Circuit Analysis", Jaico Publishing House, 2005.
3. David Bell, "Fundamentals of Electric Circuits", Oxford University press, 7th Edition, 2009.
4. Charles.K.Alexander, Mathew N.O.Sadiku,"Fundamentals of Electric Circuits", McGraw Hill, 5th Edition, 2012.

5. John O Mallay, Schaum's Outlines "Basic Circuit Analysis", The Mc Graw Hill companies, 2nd Edition, 2011.

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 2 | 2 | | | | | | | | 1 | 3 | | |
| **CO2** | 3 | 3 | 2 | 2 | | | | | | | | 1 | 3 | | |
| **CO3** | 3 | 3 | 2 | 2 | | | | | | | | 1 | 3 | | |
| **CO4** | 3 | 3 | 2 | 2 | | | | | | | | | 3 | | |
| **CO5** | 3 | 3 | 2 | 2 | | | | | | | | | 3 | | |
| **Average** | 3 | 3 | 2 | 2 | | | | | | | | 1 | 3 | | |

**EC7261 DEVICES AND CIRCUITS LABORATORY L T P C**

**0 0 4 2**

**OBJECTIVES:**

**The student should be made to:**

- Be exposed to RL and RC circuits
- Be familiar with Thevenin & Norton theorem KVL & KCL, and Super Position Theorems
- Know series and parallel resonance circuits.
- Learn the characteristics of basic electronic devices.
- Understand the characteristics of Amplifiers.

**LIST OF EXPERIMENTS**

1. Verification of ohm's law, Kirchhoff's law, and Thevenin's theorem
2. Verification of superposition theorem and Maximum power transfer theorem
3. Frequency response of series resonance and parallel resonance circuits
4. Transient analysis of RL and RC circuits.
5. PN Junction Diode Characteristics and application as half wave and full wave rectifiers
6. Zener Diode Characteristics and application as voltage regulator
7. FET Characteristics
8. Characteristics of Thyristor and UJT
9. Frequency Response of CE Amplifier
10. Design and Analysis of Feedback Amplifiers
11. Design and Analysis of Differential Amplifier
12. Design of RC Oscillators and LC Oscillators

**OUTCOMES:**

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

CO1: Prepare a theoretical Experimental model for the Electronics devices and circuit using the design specifications.

CO2: Setting up an experiment and verifying the circuit connections.

CO3: Practically conduct the experiment as a team and verifying its characteristics.

CO4: Mathematical and graphical analysis of results.

CO5: Record Writing, Presentation and interpretation.
CO6: Demonstrate the experiments individually and defend the outcomes.

| | PO 1 | PO 2 | PO 3 | PO 4 | PO5 | PO 6 | PO7 | PO8 | PO9 | PO10 | PO1 1 | PO1 2 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 2 | | 3 | | | | 3 | 3 | | 2 | 3 | | |
| **CO2** | 3 | 3 | 2 | | 3 | | | | 3 | 3 | | 2 | 3 | | |
| **CO3** | 3 | 3 | 2 | | 3 | | | | 3 | 3 | | 2 | 3 | | |
| **C O4** | 3 | 3 | 2 | | 3 | | | | 3 | 3 | | 2 | 3 | | |
| **CO5** | 3 | 3 | 2 | | 3 | | | | 3 | 3 | | 2 | 3 | | |
| **CO6** | 3 | 3 | 2 | | 3 | | | | 3 | 3 | | 2 | 3 | | |
| **Aver age** | 3 | 3 | 2 | | 3 | | | | 3 | 3 | | 2 | 3 | | |

**GE7161 COMPUTER PRACTICES LABORATORY L T P C**
**0 0 4 2**

**OBJECTIVES:**

- To understand the basic programming constructs and articulate how they are used todevelop a program with a desired runtime execution flow.
- To articulate where computer programs fit in the provision of computer-based solutionsto real world problems.
- To learn to use user defined data structures.

**LIST OF EXPERIMENTS**

1. Search, generate, manipulate data using MS office/ Open Office
2. Presentation and Visualization – graphs, charts, 2D, 3D
3. Problem formulation, Problem Solving and Flowcharts
4. C Programming using Simple statements and expressions
5. Scientific problem solving using decision making and looping.
6. Simple programming for one dimensional and two dimensional arrays.
7. Solving problems using String functions
8. Programs with user defined functions
9. Program using Recursive Function
10. Program using structures and unions.

**TOTAL: 60 PERIODS**

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

- Write and compile programs using C programs.
- Write program with the concept of Structured Programming
- Identify suitable data structure for solving a problem
- Demonstrate the use of conditional statement.

**LABORATORY REQUIREMENTS FOR BATCH OF 30 STUDENTS**

30 Systems with C compiler

**BM7301 FUNDAMENTALS OF BIOCHEMISTRY L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/internationalpolicies with a futuristic

vision along with socio-economic impact and issues

- To get a clear idea of biomolecules and their functions.
- To know the significance of biomolecules in biological systems.
- To understand the metabolic pathways in normal and pathological conditions.
-

**UNIT I INTRODUCTION TO BIOCHEMISTRY 9**

Introduction to Biochemistry, water as a biological solvent, weak acid and bases, pH, buffers, Handerson - Hasselbalch equation, physiological buffers, fitness of the aqueous environmentfor living organism . Principle of viscosity, surface tension, adsorption, diffusion, osmosis and their applications in biological systems.

**UNIT II CARBOHYDRATES 9**

Classification of carbohydrates mono, di, oligo and polysaccharides.Isomerism, racemisation and mutarotation. Structure, physical and chemical properties of carbohydrates. Metabolic pathways and bioenergetics — Glycolysis, glycogenesis, glycogenolysis and its hormonal regulation. TCA cycle and electron transport chain. Oxidative phosphorylation.

**UNIT III LIPIDS 9**

Classification of lipids- simple, compound and derived lipids. Nomenclature of fatty acid, physical and chemical properties of fat. Saponification number, Reichert- Meissl number andiodine number. Metabolic pathways: synthesis and degradation of fatty acid (beta oxidation), hormonal regulation of fatty acid metabolism, ketogenesis, structural architecture and significance of biological membrane.

**UNIT IV NUCLEIC ACID & PROTEIN 9**

Structure of purines and pyrimidines, nucleoside, nucleotide, DNA act as a genetic material,chargaffs rule. Watson and crick model of DNA. Structure of RNA and its type. Classification, structure and properties of proteins, structural organization of proteins, classification and properties of aminoacids. Separation of protein: gel filtration, electrophoresis and ultracentrifugation.

**UNIT V ENZYME AND ITS KINETICS 9**

Classification of enzymes, apoenzyme, coenzyme, holoenzyme and cofactors.Kinetics of enzymes - Michaelis - Menten equation. Factors affecting enzymatic activity: temperature, pH, substrate concentration and enzyme concentration. Inhibitors of enzyme action: Competitive, non-competitive, irreversible. Enzyme: Mode of action, allosteric and covalent regulation. Clinical significance of enzymes. Measurement of enzyme activity and interpretation of units.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

**At the end of the course the student is able to**

CO1: Describe the surface properties involved in biological systems.
CO2: Explain about bio molecules such as Carbohydrates, Lipids, Nucleic Acid & Protein
CO3: Explain functions of bio molecules
CO4: Assess the significance of biomolecules in biological systems.
CO5: Analyze the etiology and biological parameters in metabolic diseases.

**TEXT BOOKS:**


1. David L.Nelson, Michael M.Cox, Lehninger "Principles of Biochemistry Macmillan", 6th Edition 2013.
2. Keith Wilson and John Walker, "Practical Biochemistry– Principles &Techniques", Oxford University press, 7th Edition, 2010.


**REFERENCES:**


1. Trevorpalmer, "Understanding Enzymes", Ellis Horwood LTD, 4th Edition, 1995.
2. Pamela. C. Champe and Richard. A. Harvey, "Biochemistry Lippincott's Illustrated Reviews. Lippincott" Raven publishers, 6th Edition, 2013.

| COURSE OUTCOMES | PROGRAMME OUTCOMES | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
| CO1 | 3 | 3 | | | | | | | | | | | 3 | | |
| CO2 | 3 | 3 | 2 | | | | | | | | | | 3 | | |
| CO3 | 3 | - | 2 | | | | | | | | | | 3 | | |
| CO4 | 3 | 3 | 2 | | | | | | | 2 | | 2 | 3 | | |
| CO5 | 3 | 3 | 2 | | | | | | | 2 | | 2 | 3 | | |
| Avg | 3 | 3 | 2 | | | | | | | 2 | | 2 | 3 | | |

**BM7302 SENSORS AND MEASUREMENTS L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To understand the purpose of measurement, the methods of measurements, errorsassociated with measurements.
- To know the principle of transduction, classifications and the characteristics of different transducers and study its biomedical applications.
- To know the different display and recording devices.

**UNIT I SCIENCE OF MEASUREMENT 7**

Measurement System – Instrumentation – Classification and Characteristics of Transducers – Static and Dynamic – Errors in Measurements – Calibration – Primary and secondary standards.

**UNIT II DISPLACEMENT, PRESSURE, TEMPERATURE SENSORS 11**

Resistive Transducers: Strain Gauge: Gauge factor, sensing elements, configuration, biomedical applications; strain gauge as displacement & pressure transducers, RTD materials & range, Characteristics, thermistor characteristics, biomedical applications of Temperature sensors Capacitive transducer, Inductive transducer, LVDT, Active type: Thermocouple — characteristics.

**UNIT III PHOTOELECTRIC AND PIEZO ELECTRIC SENSORS 9**

Phototube, scintillation counter, Photo Multiplier Tube (PMT), photovoltaic, Photo conductive cells, photo diodes, phototransistor, comparison of photoelectric transducers, spectrophotometric applications of photo electric transducers. Piezoelectric active transducer and biomedical applications as pressure & Ultrasound transducer.

**UNIT IV SIGNAL CONDITIONING & SIGNAL ANALYSER 9**

AC and DC Bridges –wheat stone bridge, Kelvin, Maxwell, Hay, Schering – Concepts of filters, Pre-amplifier – impedance matching circuits – isolation amplifier. Spectrum analyzer.

**UNIT V DISPLAY AND RECORDING DEVICES 9**

Digital voltmeter – Multi meter – CRO – block diagram, CRT – vertical & horizontal deflection system, DSO, LCD monitor, PMMC writing systems, servo recorders, photographic recorder, magnetic tape recorder, Inkjet recorder, thermal recorder. Demonstration of the display and recording devices.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

**Upon completion of the course, the student will be able to:**

CO1: Describe the purpose and methods of measurements.
CO2: Explain the principle of different sensors and its applications.
CO3: Analyze the characteristics of different transducers.
CO4: Describe the need and function of various signal conditioning circuits.
CO5: Explain different display and recording devices for various applications.

**TEXT BOOKS:**

1. Doebelin E.O. and Manik D.N., "Measurement Systems", Tata McGraw-Hill Education Pvt. Ltd., 6th Edition, 2011.
2. L.A Geddes and L.E.Baker , "Principles of Applied Biomedical Instrumentation", – John Wiley and sons, 3rd Edition, Reprint 2008.
3. Albert D.Helfrick and William D.Cooper, "Modern Electronic Instrumentation and Measurement Techniques", Prentice Hall of India, 2007.

**REFERENCES:**

1. A.K.Sawhney, "Electrical & Electronics Measurement and Instrumentation", Dhanpat Rai&Co, New Delhi, 17th Edition, 2004.
2. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, 3rd Edition, 2014.
3. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, "Biomedical Instrumentation and Measurement", Prentice Hall India Pvt. Ltd, New Delhi, 2nd Edition, Reprint, 2013.

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | | | | | | | | | | | 3 | | |
| **CO2** | 3 | 2 | | | | | | | | | | | 3 | | |
| **CO3** | 3 | 2 | 2 | | | | | | | | | | 3 | | |
| **CO4** | 3 | 2 | | | | | | | | | | | 3 | | |
| **CO5** | 3 | | | | | | | | | | | | 3 | | |
| **Avg** | 3 | 2 | 2 | | | | | | | | | | 3 | | |

**EC7355 SIGNALS AND SYSTEMS L T P C**

**2 2 0 3**

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To introduce visualization and mathematical representation of continuous-time and discrete-time signals
- To teach the applications of Laplace and Fourier transforms in the analysis of continuous-timesignals
- To teach the applications of Z- and Fourier transforms in the analysis of discrete – time signals

**UNIT I CLASSIFICATION OF SIGNALS AND SYSTEMS 6+6**

Continuous time signals (CT signals)- Discrete time signals (DT signals) — Step, Ramp, Pulse, Impulse, Exponential - classification of CT and DT signals — periodic and a periodic signals, random signals, Energy & Power signals - CT systems and DT systems, Classification of systems.

**UNIT II ANALYSIS OF CONTINUOUS TIME SIGNALS 6+6**

Fourier series analysis- Spectrum of Continuous Time (CT) signals- Fourier and Laplace transforms in Signal Analysis.

**UNIT III LINEAR TIME INVARIANT –CONTINUOUS TIME SYSTEMS 6+6**

Differential Equation-Block diagram representation-impulse response, convolution integrals- Fourier and Laplace transforms in Analysis.

**UNIT IV ANALYSIS OF DISCRETE TIME SIGNALS 6+6**

Baseband Sampling of CT signals- Aliasing, Reconstruction of CT signal from DT signal DTFT andproperties, Z-transform & properties.

**UNIT V LINEAR TIME INVARIANT –DISCRETE TIME SYSTEMS 6+6**

Difference Equations-Block diagram representation-Impulse response-Convolution sum-DTFT and Z Transform analysis of Recursive & Non-Recursive systems.

**TOTAL: 30L + 30T: 60 PERIODS**

**COURSE OUTCOMES:**

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

CO1: Describe the continuous time and discrete time signals and systems.
CO2: Analyze the signals in both continuous time and discrete time
CO3: Compute the spectrum of any signal
CO4: Design IIR filter to process real world signals
CO5: Design FIR filter to process real world signals

**TEXT BOOKS:**


1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, “Signals and Systems”, Pearson, Indian Reprint, 2nd Edition, 2015.
2. S. Haykin and B. Van Veen, "Signals and Systems", Wiley, 2nd Edition, 2007.
3. John G Proakis and Manolakis, “Digital Signal Processing Principles, Algorithms and Applications”, Pearson, 4th Edition, 2014
4. A.V.Oppenheim, R.W. Schafer and J.R. Buck, “Discrete-Time Signal Processing”, Indian Reprint, Pearson, 3rd Edition, 2014.


**REFERENCES:**


1. H P Hsu, “Signals and Systems, Schaum‘s Outlines”, Tata McGraw Hill, 3rd Edition, 2013.
2. B. P. Lathi, “Principles of Linear Systems and Signals”, Oxford, 2nd Edition, 2009.
3. John Alan Stuller, “An Introduction to Signals and Systems”, Cengage Learning, 2007
4. Emmanuel Ifeachor, Barrie Jervis, “Digital Signal Processing- A practical approach”, Pearson, 2nd Edition, 2002.
5. M. H. Hayes, “Digital Signal Processing, Schaum’s outlines”, Tata McGraw Hill, 2nd Edition, 2011.
6. Sanjit K. Mitra, “Digital Signal Processing: A Computer-Based Approach”, McGraw Hill Education, 4th Edition, 2013.


| COURSE OUTCOMES | PROGRAMME OUTCOMES | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
| CO1 | 3 | 3 | | | | | | | | | | | 3 | 3 | |
| CO2 | 3 | 3 | | | | | | | | | | | 3 | 3 | |
| CO3 | 3 | 3 | | | | | | | | | | | 3 | 3 | |
| CO4 | 3 | 3 | 3 | 3 | | | | | | | | | 3 | 3 | |
| CO5 | 3 | 3 | 3 | 3 | | | | | | | | | 3 | 3 | |
| Avg | 3 | 3 | 3 | 3 | | | | | | | | | 3 | 3 | |

**EE7305 ELECTRICAL ENGINEERING L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To understand magnetic circuits, principle and application of transformers
- To know the Principle of operation of DC motors and AC Machines

**UNIT I INDUCTION THEORY 9**

Magnetic effects of electric current- Magnetic circuits- Magnetic materials and B-H relationship-Energy and co energy– Electromagnetic induction and force – Hysteresis and eddy current losses

**UNIT II TRANSFORMER 9**

Introduction – Single phase transformer construction and principle of operation – EMF equationof transformer-Transformer no–load phasor diagram — Transformer on–load phasor diagram —– Equivalent circuit of transformer — Regulation of transformer –Transformer losses and efficiency-All day efficiency –auto transformers.

**UNIT III DC MACHINES 9**

Construction of DC machines – theory of operation of DC generators- EMF and torque equations– characteristics of DC generators-Applications. Operating principle of DC motors –types of DC motors and their characteristics — speed control of DC motors-Applications, Stepper motor and Applications.

**UNIT IV INDUCTION MACHINES AND SYNCHRONOUS MACHINES 9**

Principle of operation of three-phase induction motors – Construction –Types – Equivalent circuit – Construction of single-phase induction motors – Double revolving field theory – starting methods Principles of alternator – Construction details – Types – Equation of induced EMF – Voltage regulation. Methods of starting of synchronous motors – Torque equation – V curves – Synchronous motors.

**UNIT V SPECIAL ELECTRIC MACHINES 9**

Switched reluctance motor, stepper motor, servo motor, BL DC motor- working principles, speed- torque characteristics and applications.

**OUTCOMES:**

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

- Comprehend and appreciate the significance and role of this course in the presentcontemporary world
- Describe principles and applications of transformers.
- Explain the working of DC Motors, fractional kW motors, AC machines.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**


1. D P Kothari and I J Nagrath, ―Basic Electrical Engineering‖, TMH, 2ed, 2002
2. P. C Sen, ―Principles of Electric machines and power electronics‖, John- Wiley & Sons,2nd edition, 2007.


**REFERENCES:**


1. Stephen J. Chapman, ― Electric Machinery fundamentals‖, ― Mc Graw Hill Intl. Edition, New Delhi, Fourth Edition, 2005.
2. Fitzgerald, A.E.Charles Kingsley Jr.Stephen D. Umans, ― Electric Machinery‖, Mc Graw HillBook Compny, sixth Edition 2003.
3. T. Kenjo and S.Nagomari, ―Permanent magnet and brushless DC motors, Clarendon 125Press, London, 1988.

**BM7311** **BIOCHEMISTRY AND HUMAN PHYSIOLOGY LABORATORY** **L T P C 0 0 4 2**

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with afuturistic vision along with socio-economic impact and issues
- To provide practice on
- Estimation and quantification of bio molecules.
- Separation of macromolecules.
- Interpreting the metabolic changes in pathological conditions

**LIST OF EXPERIMENTS:**

1. Study of Human anatomy with A.D.A.M interactive online software
2. General tests for carbohydrates, proteins and lipids.
3. Preparation of serum and plasma from blood.
4. Estimation of blood glucose.
5. Estimation of creatinine
6. Estimation of urea
7. Estimation of cholesterol
8. Assay of SGOT/SGPT
9. Separation of proteins by SDS electrophoresis
10. Separation of amino acids by thin layer chromatography
11. Separation of DNA by agarose gel electrophoresis
12. ESR, PCV, MCH, MCV, MCHC, total count of RBCs and hemoglobin estimation.
13. Differential count of different WBCs and blood group identification.
14. Measurement of pH of solutions using pH meter.
15. Ishihara chart for color blindness and Snellen‟s chart for myopia and hyperopia - byletters reading and ophthalmoscope to view retina
16. Weber‟s and Rinne ―s test for auditory conduction.

**TOTAL: 60 PERIODS**

**COURSE OUTCOMES:**

**Upon completion of the course, students will be able to:**

CO1: Prepare a theoretical Experimental model related to macro molecules and blood parameters in consultation with team members.
CO2: Preparation of chemical solutions, setting up an experiment and verifying its accuracy.
CO3: Practically conduct the experiment as a team and verify its underlying concepts.
CO4: Experimental observation and graphical analysis of results.
CO5: Report Writing, Presentation and Interpretation.
CO6: Demonstrate the experiments individually and defend the outcomes.

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO1 0 | PO1 1 | PO1 2 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | | | | | | 3 | 3 | | | 3 | | |
| **CO2** | 3 | 3 | 3 | | | | | | 3 | 3 | | | 3 | | |
| **CO3** | 3 | | 3 | | | | | | 3 | 3 | | | 3 | | |
| **CO4** | 3 | 3 | | | | | | | 3 | 3 | | 3 | 3 | | |
| **CO5** | 3 | | | | | | | 3 | 3 | 3 | | 3 | 3 | | |
| **CO6** | 3 | 3 | 3 | | | | | 3 | 3 | 3 | | 3 | 3 | | |
| **Average** | 3 | 3 | 3 | | | | | 3 | 3 | 3 | | 3 | 3 | | |

**BM7312 SENSORS AND MEASUREMENTS LABORATORY L T P C**
**0 0 4 2**

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To study the characteristics of sensors, signal conditioning circuits and display devices

**LIST OF EXPERIMENTS:**

1. Characteristics of strain guages.
2. Displacement measurement using LVDT.
3. Characteristics of temperature sensor-thermistor
4. Characteristics of temperature sensor -RTD.
5. Characteristics of thermocouple
6. Characteristics of Light sensors-LDR, PhotoDiode, Photo Transistor
7. Characteristics of Piezoelectric Transducer.
8. Wheatstone Bridge and Kelvin's Bridge for Measurement of Resistance.
9. Measurement of capacitance using bridge circuits.
10. Measurement of inductance using bridge circuits.
11. Study of Medical Oscilloscope.
12. Study of Input / Output characteristics using X – Y oscilloscope.

**OUTCOMES:**

**Upon completion of the course, students will be able to:**

CO1: Prepare a theoretical Experimental model in consultation with team members to study the characteristics of transducers.
CO2: Setting up an experiment and verifying its connections.
CO3: Practically conduct the experiment as a team and obtain the transducer characteristics.
CO4: Mathematical and graphical analysis of results.
CO5: Report Writing, Presentation and interpretation of results.
CO6: Demonstrate the experiments individually and defend the outcomes.

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO1 0 | PO1 1 | PO1 2 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | | | | | | | 3 | 3 | | 2 | 3 | | |
| **CO2** | 3 | 2 | | | | | | | 3 | 3 | | 2 | 3 | | |
| **CO3** | 3 | 2 | | | | | | | 3 | 3 | | 2 | 3 | | |
| **CO4** | 3 | 2 | | | | | | | 3 | 3 | | 2 | 3 | | |
| **CO5** | 3 | 2 | | | | | | | 3 | 3 | | 2 | 3 | | |
| **CO6** | 3 | 2 | | | | | | | 3 | 3 | | 2 | 3 | | |
| **Average** | 3 | 2 | | | | | | | 3 | 3 | | 2 | 3 | | |

**BM7401 ANALOG AND DIGITAL COMMUNICATION L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with afuturistic vision along with socio-economic impact and issues
- To study the various analog and digital modulation techniques
- To study the principles behind information theory and coding
- To study the various digital communication techniques

**UNIT I ANALOG MODULATION 9**

Amplitude Modulation – AM, DSBSC, SSBSC, VSB – PSD, modulators and demodulators – Angle modulation – PM and FM – PSD, modulators and demodulators – Superheterodyne receivers.

**UNITII PULSE MODULATION 9**

Low pass sampling theorem — Quantization — PAM — Line coding — PCM, DPCM, DM, and ADPCM And ADM, Channel Vocoder - Time Division Multiplexing, Frequency Division Multiplexing.

**UNIT III DIGITAL MODULATION AND TRANSMISSION 9**

Phase shift keying – BPSK, DPSK, QPSK – Principles of M-ary signaling M-ary PSK & QAM – Comparison, ISI – Pulse shaping – Duo binary encoding – Cosine filters – Eye pattern, equalizers.

**UNIT IV INFORMATION THEORY AND CODING 9**

Measure of information – Entropy – Source coding theorem – Shannon–Fano coding, Huffman Coding, LZ Coding – Channel capacity – Shannon-Hartley law – Shannon's limit – Error control codes – Cyclic codes, Syndrome calculation – Convolution Coding, Sequential and Viterbi decoding.

**UNIT V SPREAD SPECTRUM AND MULTIPLE ACCESS 9**

PN sequences — properties — m-sequence — DSSS — Processing gain, Jamming — FHSS — Synchronisation and tracking – Multiple Access – FDMA, TDMA, CDMA.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

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

- Ability to comprehend and appreciate the significance and role of this course in the present contemporary world
- Apply analog and digital communication techniques.
- Use data and pulse communication techniques.
- Analyze Source and Error control coding.

**TEXT BOOKS:**

1. H Taub, D L Schilling, G Saha, ―Principles of Communication Systems‖ 3/e, TMH 2007
2. S. Haykin ―Digital Communications‖ John Wiley 2005

**REFERENCES:**

1. B.P.Lathi, ―Modern Digital and Analog Communication Systems‖, 3rd edition, Oxford University Press, 2007
2. H P Hsu, Schaum Outline Series – ―Analog and Digital Communications‖ TMH 2006
3. B.Sklar, Digital Communications Fundamentals and Applications‖ 2/e PearsonEducation 2007.

**BM7402 BIOMEDICAL INSTRUMENTATION AND MEASUREMENTS L T P C**
**3 0 0 3**

**OBJECTIVES:**

**The student should be made to:**

- Introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- Study the basic theory of Bio potential Electrodes and Bio potential measurement.
- Understand the design of Bio potential amplifiers.
- Study the various non-electrical physiological measurement and bio chemical measurements.

**UNIT I BIOPOTENTIAL ELECTRODES 9**

Origin of bio potential and its propagation. Electrode-electrolyte interface, electrode– skin interface, half cell potential, impedance, polarization effects of electrode — nonpolarizable electrodes. Types of electrodes -

surface, needle and micro electrodes and their equivalent circuits. Recording problems - measurement with two electrodes.

**UNIT II BIOPOTENTIAL MEASUREMENT 9**

Biosignal characteristics– frequency and amplitude ranges. ECG – Einthoven's triangle, standard 12 lead system. EEG – 10-20 electrode system, unipolar, bipolar and average mode, Functionalblock diagram. EMG – unipolar and bipolar mode, block diagram.

**UNIT III BIOPOTENTIAL AMPLIFIER 8**

Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier – right leg driven ECG amplifier. Band pass filtering, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier. Power line interference.

**UNIT IV NON ELECTRICAL PHYSIOLOGICAL PARAMETER MEASUREMENT 10**

Temperature, respiration rate and pulse rate measurements. Blood Pressure: indirect methods - auscultatory method, oscillometric method, direct methods: electronic manometer, Pressure amplifiers - systolic, diastolic, mean detector circuit. Blood flow and cardiac output measurement: Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurement, Measurements of heart sounds - PCG.

**UNIT V BIOCHEMICAL MEASUREMENT 9**

Biochemical sensors - pH, Po2 and Pco2, Ion selective Field Effect Transistor (ISFET), Immunologically sensitive FET (IMFET), Blood glucose sensors - Blood gas analyzers, colorimeter, flame photometer, spectrophotometer, blood cell counter, auto analyzer (simplified schematic description).

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

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

CO1: Describe the electrode behavior and circuit models.
CO2: Describe the fundamentals of Bio potential recording.
CO3: Design various bio amplifiers.
CO4: Measure various nonelectrical physiological parameters.
CO5: Measure various biochemical parameters.

**TEXT BOOKS:**


1. Joseph J. Carr and John M. Brown, "Introduction to Biomedical equipment technology", Pearson Education, 4th Edition, 2014.
2. John G.Webster, "Medical Instrumentation Application and Design", John Wiley and Sons, New York, 4th Edition, 2009.




**REFERENCES:**


1. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, 3rd Edition, 2014.
2. L.A Geddes and L.E.Baker, "Principles of Applied Biomedical Instrumentation", John Wiley and Sons, 3rd Edition, Reprint 2008.
3. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, Biomedical Instrumentation and Measurements, Pearson Education India, 2nd Edition, 2015.
4. Myer Kutz, "Standard Handbook of Biomedical Engineering & Design", McGraw-Hill Publisher, 2003.

| COURSE OUTCOMES | PROGRAMME OUTCOMES | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 3 | | | | | | | | | | | 3 | | |
| CO2 | 3 | 3 | | | | | | | | | | | 3 | | |
| CO3 | 3 | 3 | 3 | | | | | | | | | | 3 | 2 | |
| CO4 | 3 | 3 | | | | | | | | 2 | | | 3 | | |
| CO5 | 3 | 3 | | | | | | | | 2 | | | 3 | | |
| Avg | 3 | 3 | 3 | | | | | | | 2 | | | 3 | 2 | |

**BM7403 CONTROL SYSTEM FOR BIO MEDICAL ENGINEERING L T P C**

**3 0 0 3**

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To study the mathematical techniques for analysis of given system
- To study the given system in time domain and frequency domain analysis.
- To study the stability analysis of the given system
- To study the concept of physiological control system

**UNIT I CONTROL SYSTEM MODELING 9**

Terminology and basic structure of control system, example of a closed loop system, transfer function, modeling of electrical systems, translational and rotational mechanical systems, and electromechanical systems, block diagram and signal flow graph representation of systems, reduction of block diagram and signal flow graph, conversion of block diagram to signal flow graph.Need for modeling physiological system.

**UNIT II TIME RESPONSE ANALYSIS 9**

Step and impulse responses of first order and second order systems, determination of time domain specifications of first and second order systems from its output responses, definition of steady state error constants and its computations.

**UNIT III STABILITY ANALYSIS 9**

Definition of stability, Routh- Hurwitz criteria of stability, root locus technique, construction of root locus and study of stability, definition of dominant poles and relative stability.

**UNIT IV FREQUENCY RESPONSE ANALYSIS 9**

Frequency response, Nyquist stability criterion, Nyquist plot and determination of closed loop stability, definition of gain margin and phase margin, Bode plot, determination of gain margin and phase margin using Bode plot, use of Nichol's chart to compute frequency and bandwidth.

**UNIT V PHYSIOLOGICAL CONTROL SYSTEM 9**

Example of physiological control system, difference between engineering and physiological control systems, generalized system properties, models with combination of system elements, linearmodels of physiological systems-Examples, introduction to simulation. Illustration with real time applications.

**TOTAL: 45 PERIODS.**

**COURSE OUTCOMES:**

**The students will be able to:**

CO1: Develop mathematical model for a given system.
CO2: Determine and analyze the time domain specifications of different systems.
CO3: Perform stability analysis of the given system using various techniques.
CO4: Determine and Analyze the frequency domain specifications of the different systems.

CO5: Explain the concept and model of physiological control systems.

**TEXT BOOKS:**


1. J.Nagrath and M.Gopal, "Control System Engineering", New Age International Publishers, 6th Edition, 2008.
2. Michael C K Khoo, "Physiological control systems", IEEE Press, Prentice Hall of India, 2005.


**REFERENCES:**


1. Farid Golnaraghi, Benjamin C. Kuo, "Automatic Control Systems", Wiley, 9th Edition, 2014.
2. M. Gopal, "Control System, Principles and Design", McGraw-Hill, 2012.
3. Constantine H.Houpis, Stuart N. Sheldon, "Linear Control System Analysis and Design with MATLAB", CRC Press, 6th Edition, 2013.
4. Richard C.Dorf & Robert H. Bishop, "Modern Control Systems", Prentice Hall, 12th Edition, 2010.
5. Joseph J.DiStefano, Allen R.Stubberud, Schaum's, "Outline of Feedback and Control Systems", McGraw-Hill Education, 2nd Edition, 2013.


| COURSE OUTCOMES | PROGRAMME OUTCOMES | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 3 | 3 | | | | | | | | | | 3 | | |
| CO2 | 3 | 3 | 3 | | | | | | | | | | 3 | | |
| CO3 | 3 | 3 | 3 | | | | | | | | | | 3 | | |
| CO4 | 3 | 3 | 3 | 3 | | | | | | | | | 3 | | |
| CO5 | 3 | 3 | 3 | 3 | 2 | | | | | | | | 3 | | |
| Avg | 3 | 3 | 3 | 3 | 2 | | | | | | | | 3 | | |

**EC7353 DIGITAL ELECTRONICS AND SYSTEM DESIGN L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To introduce Boolean algebra and its applications in digital systems
- To introduce the design of various combinational digital circuits using logic gates
- To bring out the analysis and design procedures for synchronous and asynchronous Sequential circuits
- To introduce the electronic circuits involved in the making of logic gates
- To introduce semiconductor memories and related technology

**UNIT I BASIC CONCEPTS AND COMBINATIONAL CIRCUITS 9**

Number Systems — Decimal, Binary, Octal, Hexadecimal, 1's and 2's complements, Codes — Binary, BCD, 84-2-1, 2421, Excess 3, Biquinary, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Minterms and Maxterms, Karnaugh map and Tabulation methods.

**UNIT II MSI CIRCUITS 9**

Problem formulation and design of combinational circuits - Code-Converters, Half and Full Adders, Binary Parallel Adder — Carry lookahead Adder, BCD Adder, Magnitude Comparator, Decoder, Encoder, Priority Encoder, Mux/Demux, Case study: Digital transreciver / 8 bit Arithmetic andlogic unit

**UNIT III SYNCRONOUS SEQUENTIAL CIRCUITS 9**

Flip flops — SR, JK, T, D, Master/Slave FF, Triggering of FF, Analysis and design of clocked sequential circuits – Design - Moore/Mealy models, state minimization, state assignment, circuitimplementation - Counters, Ripple Counters, Ring Counters, Shift registers, Universal Shift Register. Model Development: Designing of rolling display/real time clock

**UNIT III ASYNHRONOUS SEQUENTIAL CIRCUITS 9**

Stable and Unstable states, output specifications, cycles and races, state reduction, race free assignments, Hazards, Essential Hazards, Pulse mode sequential circuits, Design of Hazard free circuits.

**UNIT V LOGIC FAMILIES AND PROGRAMMABLE LOGIC DEVICES 9**

Logic families- TTL, MOS, CMOS, BiCMOS - Comparison of Logic families - Implementation of combinational logic/sequential logic design using standard ICs, ROM, PLA and PAL.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Ability to comprehend and appreciate the significance and role of this course in the present contemporary world
- Use Boolean algebra and apply it to digital systems.
- Design various combinational digital circuits using logic gates.
- Bring out the analysis and design procedures for synchronous and asynchronoussequential circuits.
- Use electronic circuits involved in the design of logic gates.
- Ability to use the semiconductor memories and related technology.

**TEXT BOOKS:**

1. M. Morris Mano and Michael D. Ciletti, ―Digital Design‖, 5th Edition, Pearson, 2013.
2. Charles H. Roth, Jr, ―Fundamentals of Logic Design‖, Fourth edition, Jaico Books, 2002.

**REFERENCES:**

1. William I. Fletcher, ―An Engineering Approach to Digital Design‖, Prentice- Hall of India, 1980.
2. Floyd T.L., ―Digital Fundamentals‖, Charles E. Merril publishing company,1982.
3. John. F. Wakerly, ―Digital design principles and practices‖, Pearson Education, Fourth Edition,2007.

**EC7452 OPERATIONAL AMPLIFIERS AND ANALOG INTEGRATED CIRCUITS L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To study the circuit configuration of linear integrated circuits.
- To introduce practical applications of linear integrated circuits.
- To introduce the concept of analog multiplier and Phase Locked Loop with applications.
- To study the application of ADC and DAC in real time systems.
- To introduce special function ICs and its construction.

**UNIT I CIRCUIT CONFIGURATION FOR LINEAR ICS 9**

Current sources, Analysis of difference amplifiers with active loads, supply and temperature independent biasing, Band gap references, Monolithic IC operational amplifiers, specifications, frequency compensation, slew rate and methods of improving slew rate. Interpretation of TL082 datasheet.

**UNIT II APPLICATION OF OPERATIONAL AMPLIFIERS 9**

Linear and Nonlinear Circuits using operational amplifiers and their analysis, Inverting and Noninverting Amplifiers, Differentiator, Integrator, Voltage to Currency converter, Instrumentation amplifier, Sine wave Oscillators, Low pass and band pass filters, Comparator, Multivibrator and Schmitt trigger, Triangle wave

generator, Precision rectifier, Log and Antilog amplifiers, Non-linear function generator.

**UNIT III ANALOG MULTIPLIER AND PLL 9**

Analysis of four quadrants and variable Transconductance multipliers, Analog multiplier MPY634 features, Voltage controlled oscillator, Closed loop analysis of PLL, AM, PM and FSK modulators and demodulators, AVC using op-AMP, Frequency synthesizers, Compander ICs.

**UNIT IV ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTORS 9**

Analog switches, High speed sample and hold circuit and IC‘s, Types of D/A converter, Current driven DAC, Switches for DAC, A/D converter - Flash, Single slope, Dual slope, Successive approximation, DM and ADM, Voltage to Time and Voltage to Frequency converters.

**UNIT V SPECIAL FUNCTION ICS 9**

Timers, Voltage regulators - linear and switched mode types, Switched capacitor filter, SMPS, Features of TPS40200, TPS40210 buck and boost controller, Frequency to Voltage converters, Tuned amplifiers, Power amplifiers and Isolation Amplifiers, Video amplifiers, Fiber optics ICs and Opto couplers, Sources for Noises, Op Amp noise analysis and Low noise OP-Amps.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

CO1: Ability to design new analog linear circuits and develop linear IC based Systems.
CO2: Understand the concept of application of ADC and DAC in real time systems and Phase Locked Loop with applications.
CO3: Use Boolean algebra and apply it to digital systems.
CO4: Design various combinational digital circuits using logic gates.
CO5: Bring out the analysis and design procedures for synchronous and asynchronous sequential circuits.

**TEXT BOOKS:**


1. Sergio Franco, “Design with operational amplifiers and analog integrated circuits”, Mc Graw Hill Education, 3rd Edition, 2017.
2. M. Morris Mano and Michael D.Ciletti, “Digital Design”, Pearson, 5th Edition, 2013.
3. Charles H.Roth, Jr, “Fundamentals of Logic Design”, Jaico Books, 7th Edition, 2013.


**REFERENCES:**


1. Gray and Meyer, “Analysis and Design of Analog Integrated Circuits”, Wiley International, 2009.
2. Michael Jacob J., “Applications and Design with Analog Integrated Circuits”, Prentice Hall of India, 2nd Edition, 2008.
3. Ramakant A. Gayakwad, “OP - AMP and Linear IC‘s”, Prentice Hall, 2012.
4. Taub and Schilling, “Digital Integrated Electronics”, Mc Graw Hill, 2017.
5. Coughlin and Driscoll, “Operational amplifiers and Linear Integrated Circuits”, Prentice Hall, 6th Edition, 2001.
6. Floyd T.L., “Digital Fundamentals”, Charles E.Merril publishing company, 8th Edition, 2005.
7. John.F.Wakerly, “ Digital design principles and practices”, Pearson Education, 5th Edition, 2018.


| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO10 | PO11 | PO12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | | 2 | | | | | | | | 3 | | |
| **CO2** | 3 | 3 | 3 | | 2 | | | | | | | | 3 | | |
| **CO3** | 3 | 3 | 3 | | 2 | | | | | | | | 3 | | |
| **CO4** | 3 | 3 | 3 | | 2 | | | | | | | | 3 | | |
| **CO5** | 3 | 3 | 3 | | 2 | | | | | | | | 3 | | |
| **Average** | 3 | 3 | 3 | | 2 | | | | | | | | 3 | | |

**BM7411 BIO MEDICAL INSTRUMENTATION LABORATORY L T P C**
**0 0 4 2**

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To study and design Bio amplifiers.
- To provide hands on training on Measurement of physiological parameters.

**LIST OF EXPERIMENTS:**

1. Design of low noise pre-amplifier.
2. Design of ECG amplifier.
3. Design of EMG amplifier.
4. Measurement of heart sounds using PCG.
5. Study of effect of offset potential in Bio potential recording.
6. Study of effect of contact impedance in Bio potential recording.
7. Measurement of pulse-rate using Photo transducer.
8. Measurement of respiration rate.
9. Measurement of blood flow velocity using ultrasound transducer.10.Measurement of heart rate using F-V converter. 11.Measurement of blood pressure using sphygmomanometer. 12.Study of characteristics of optical Isolation amplifiers.

**TOTAL: 60 PERIODS.**

**OUTCOMES:**

**Upon completion of the course, students will be able to:**

CO1: Prepare a theoretical Experimental model in consultation with team members and design modalities.
CO2: Setting up an experiment and verifying its appropriateness.
CO3: Practically conduct the experiment as a team and verify its underlying principles.
CO4: Mathematical and graphical analysis of results.
CO5: Report Writing, Presentation and interactions and updation.
CO6: Demonstrate the experiments individually and defend the outcomes.

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO10 | PO11 | PO12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | | | | | | 3 | 3 | | 3 | 3 | 3 | |
| **CO2** | 3 | 3 | 3 | | | | | | 3 | 3 | | 3 | 3 | 3 | |
| **CO3** | 3 | 3 | 3 | | | | | | 3 | 3 | | 3 | 3 | 3 | |
| **CO4** | 3 | 3 | 3 | | | | | | 3 | 3 | | 3 | 3 | 3 | |
| **CO5** | 3 | 3 | 3 | | | | | | 3 | 3 | | 3 | 3 | 3 | |
| **CO6** | 3 | 3 | 3 | | | | | | 3 | 3 | | 3 | 3 | 3 | |
| **Average** | 3 | 3 | 3 | | | | | | 3 | 3 | | 3 | 3 | 3 | |

**BM7412 DIGITAL AND INTEGRATED CIRCUITS LABORATORY L T P C**
**0 0 4 2**

**OBJECTIVES:**

- To Introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To design digital logic and circuits
- To learn the function of different ICs
- To understand the applications of operation amplifier.
- To learn the working of multivibrators
- To design circuits for generating waveforms using ICs.

**LIST OF EXPERIMENTS:**

1. Inverting, non-inverting amplifier and comparator

2. Integrator and Differentiator
3. Active filter – first order and second order LPF and HPF
4. Schmitt trigger using operational amplifier
5. Instrumentation amplifier using operational amplifier
6. RC and LC oscillators
7. Multivibrators using IC555 Timer

**TOTAL: 60 PERIODS**

**COURSE OUTCOMES:**

**Upon completion of the course, students will be able to:**

CO1: Prepare a theoretical Experimental model for the Integrated circuits using the design specifications.
CO2: Setting up an experiment and verifying the circuit connections.
CO3: Practically conduct the experiment as a team and verifying its underlying principles.
CO4: Mathematical and graphical analysis of results.
CO5: Record Writing, Presentation and interpretation.
CO6: Demonstrate the experiments individually and defend the outcomes.

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO10 | PO11 | PO12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 2 | | | | | | 3 | 3 | | 2 | 3 | | |
| **CO2** | 3 | 3 | 2 | | | | | | 3 | 3 | | 2 | 3 | | |
| **CO3** | 3 | 3 | 2 | | | | | | 3 | 3 | | 2 | 3 | | |
| **CO4** | 3 | 3 | 2 | | | | | | 3 | 3 | | 2 | 3 | | |
| **CO5** | 3 | 3 | 2 | | | | | | 3 | 3 | | 2 | 3 | | |
| **CO6** | 3 | 3 | 2 | | | | | | 3 | 3 | | 2 | 3 | | |
| **Average** | 3 | 3 | 2 | | | | | | 3 | 3 | | 2 | 3 | | |

**BM7501 DIAGNOSTIC AND THERAPEUTIC EQUIPMENT - I L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with afuturistic vision along with socio-economic impact and issues
- To understand the medical devices applied in measurement of parameters related to cardiology, neurology and the methods of continuous monitoring and transmitting them.
- To learn some of the cardiac assist devices.
- To learn to measure the signals generated by muscles.
- To understand the need and use of some of the extracorporeal devices.

**UNIT I CARDIAC EQUIPMENT 9**

Electrocardiograph, Normal and Abnormal Waves, Heart rate monitor, Holter Monitor, Phonocardiography, Plethysmography. Cardiac Pacemaker- Internal and External Pacemaker–Batteries, AC and DC Defibrillator- Internal and External.

**UNIT II NEUROLOGICAL EQUIPMENT 9**

Multi channel EEG recording system, Clinical significance of EEG- Epilepsy, Evoked Potential —Visual, Auditory and Somatosensory, EEG Bio Feedback Instrumentation, MEG (Magneto Encephalo Graph) - sensing principle and instrumentation (Block diagram)

**UNIT III SKELETAL MUSCULAR EQUIPMENT 9**

Generation of EMG, recording and analysis of EMG waveforms, fatigue characteristics, Muscle stimulators, nerve stimulators, Nerve conduction velocity measurement, EMG Bio Feedback Instrumentation.

**UNIT IV PATIENT MONITORING AND BIOTELEMETRY 9**

Patient monitoring systems, ICU/CCU Equipments, Infusion pumps, bed side monitors, Central consoling controls. Radio Telemetry (single, multi), Portable and Landline Telemetry unit, Applications in ECG and EEG Transmission.

**UNIT V EXTRA CORPOREAL DEVICES AND SPECIAL DIAGNOSTIC TECHNIQUES 9**

Need for heart lung machine, functioning of bubble, disc type and membrane type oxygenators, finger pump, roller pump, electronic monitoring of functional parameters. HemoDialyser unit, Lithotripsy, Principles of Cryogenic technique and application, Endoscopy,Laparoscopy. Thermography — Recording and clinical application.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

**At the end of the course, the student will be able to**

CO1: Apply different medical devices in the measurement of parameters related to cardiology, neurology.
CO2: Use various cardiac assist devices.
CO3: Measure and analyse signals generated by muscles.
CO4: Perform continuous monitoring and transmission of vital parameters.
CO5: Comprehend the need for special diagnostic and therapeutic devices and extra-corporeal devices.

**TEXT BOOKS:**


1. Joseph J. Carr and John M. Brown, "Introduction to Biomedical equipment technology", Pearson Education, 4th Edition, 2014.
2. John G.Webster, "Medical Instrumentation Application and Design", John Wiley and Sons, New York, 4th Edition, 2009.


**REFERENCES:**


1. Myer Kutz, "Biomedical Engineering & Design Handbook: Volume 2", McGraw-Hill Publisher, 2nd Edition, 2009.
2. L.A Geddes and L.E.Baker, "Principles of Applied Biomedical Instrumentation", John Wiley and Sons, 3rd Edition, Reprint 2008.
3. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, "Biomedical Instrumentation and Measurements", Pearson Education India; 2nd Edition, 2015.
4. Antony Y.K.Chan, "Biomedical Device technology, Principles and design", Charles Thomas Publisher Ltd, Illinois, USA, 2008


| COURSE OUTCOMES | PROGRAMME OUTCOMES | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 2 | | | | | | | | | | | 3 | 3 | |
| CO2 | 3 | 2 | | | | | | | | | | | 3 | 3 | |
| CO3 | 3 | 2 | | | | | | | | | | | 3 | 3 | |
| CO4 | 3 | 2 | | | | | | | | | | | 3 | 3 | |
| CO5 | 3 | 2 | | | | | | | | | | | 3 | 3 | |
| Avg | 3 | 2 | | | | | | | | | | | 3 | 3 | |

**BM7502 HOSPITAL MANAGEMENT L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case

studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues

- The student should be made to understand the principles, practices and areas of application in Hospital management.

**UNIT I OVERVIEW OF HOSPITAL ADMINISTRATION 7**

Distinction between Hospital and Industry, Challenges in Hospital Administration –Hospital Planning – Equipment Planning – Functional Planning - Current Issues in Hospital Management -Telemedicine - Bio-Medical Waste Management

**UNIT II HUMAN RESOURCE MANAGEMENT ON HOSPITAL 9**

Principles of HRM — Functions of HRM — Profile of HRD Manager — Tools of HRD –Human Resource Inventory – Manpower Planning. Different Departments of Hospital, Recruitment, Selection, Training Guidelines –Methods of Training – Evaluation of Training – Leadership grooming and Training, Promotion – Transfer.

**UNIT III MARKETING RESEARCH & CONSUMER BEHAVIOUR 10**

Marketing information systems - assessing information needs, developing & disseminating information - Market Research process - Other market research considerations - Consumer Markets & Consumer Buyer Behaviour - Model of consumer behaviour - Types of buying decision behaviour - The buyer decision process - Model of business buyer behaviour - Major types of buying situations - global marketing in the medical sector - WTO and its implications.

**UNIT IV HOSPITAL INFORMATION SYSTEMS & SUPPORTIVE SERVICES 10**

Management Decisions and Related Information Requirement - Clinical Information Systems - Administrative Information Systems - Support Service Technical Information Systems – Medical Transcription, Medical Records Department — Central Sterilization and Supply Department — Pharmacy– Food Services - Laundry Services.

**UNIT V QUALITY AND SAFETY ASPECTS IN HOSPITAL 9**

Quality system – Elements, implementation of quality system, Documentation, Quality auditing, International Standards ISO 9000 – 9004 – Features of ISO 9001 – ISO 14000 – ISO 13485, Environment Management Systems. NABA, JCI, NABL, NABH. Security – Loss Prevention – Fire Safety – Alarm System – Safety Rules. Health Insurance & Managing Health Care - Medical Audit – Hazard and Safety in a hospital Setup.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

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

CO1: Explain the principles, practices and areas of application in Hospital Management.
CO2: Understand the biomedical waste disposal concept.
CO3: Explain the importance of supportive services.
CO4: Comprehend the quality aspect specified by the international standards.
CO5: Knowledge on Hospital safety.

**TEXT BOOKS:**

1. R.C.Goyal, "Hospital Administration and Human Resource Management", PHI–4th Edition,2006.

2. G.D.Kunders, "Hospitals – Facilities Planning and Management", TMH, New Delhi – 5th edition Reprint 2007.

**REFERENCES:**

1. Cesar A.Caceres and Albert Zara, "The Practice of Clinical Engineering", Academic Press, New York,1977.
2. Norman Metzger , "Handbook of Health Care Human Resources Management", Aspen Publication Inc. Rockville, Maryland, USA, 2nd Edition 1990.
3. Peter Berman, "Health Sector Reform in Developing Countries", Harvard University Press, 1995.
4. William A.Reinke, "Health Planning For Effective Management", Oxford University Press, 1988.
5. Blane, David, Brunner, Eric , "Health and Social organization: Towards a health policy for the 21st century", Calrendon Press, 1994.
6. Arnold D. Kalcizony & Stephen M.Shortell, "Health Care Management", 6th Edition, 2011.

| COURSE OUTCOMES | PROGRAMME OUTCOMES | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | | | | | 3 | | | | | | 2 | 3 | | |
| CO2 | 3 | | | | | 3 | 3 | 3 | | | | 2 | 3 | | |
| CO3 | 3 | | | | | 3 | | | | | | 2 | 3 | | |
| CO4 | 3 | | | | | 3 | 3 | 3 | | | | 2 | 3 | | |
| CO5 | 3 | | | | | 3 | 3 | 3 | | | | 2 | 3 | | |
| Avg | 3 | | | | | 3 | 3 | 3 | | | | 2 | 3 | | |

**EC7352 DATA STRUCTURES AND OBJECT ORIENTED PROGRAMMING IN C++** **L T P C 3 2 0 4**

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- This course comprehends the fundamentals of object oriented programming, particularly in C++, which are then used to implement data structures. This also gives an idea of linear and non-linear data structures and their applications.

**UNIT I DATA ABSTRACTION & OVERLOADING** **9+6**

Overview of C++ – Structures – Class Scope and Accessing Class Members – Reference Variables – Initialization – Constructors – Destructors – Member Functions and Classes – Friend Function – Dynamic Memory Allocation – Static Class Members – Container Classes and Integrators – Proxy Classes – Overloading: Function overloading and Operator Overloading.

**UNIT II INHERITANCE & POLYMORPHISM** **9+6**

Base Classes and Derived Classes – Protected Members – Casting Class pointers and MemberFunctions

– Overriding – Public, Protected and Private Inheritance – Constructors and Destructorsin derived Classes — Implicit Derived — Class Object To Base — Class Object Conversion — Composition Vs. Inheritance – Virtual functions – This Pointer – Abstract Base Classes and Concrete Classes – Virtual Destructors – Dynamic Binding.

**UNIT III LINEAR DATA STRUCTURES 11+6**

Asymptotic Notations: Big-Oh, Omega and Theta – Best, Worst and Average case Analysis: Definition and an example – Arrays and its representations – Stacks and Queues – Linked lists –Linked list based implementation of Stacks and Queues – Evaluation of Expressions – Linked list based polynomial addition.

**UNIT IV NON-LINEAR DATA STRUCTURES 9+6**

Trees – Binary Trees – Binary tree representation and traversals – Threaded binary trees – Binarytree representation of trees – Application of trees: Set representation and Union-Find operations – Graph and its representations – Graph Traversals – Connected components.

**UNIT V SORTING & SEARCHING 7+6**

Insertion sort – Merge sort – Quick sort – Heap sort – Linear Search – Binary Search.

**TOTAL: 45 L+30 T = 75 PERIODS**

**OUTCOMES:**

- Ability to comprehend and appreciate the significance and role of this course in the present contemporary world
- Select suitable data structure for specific Application.
- Compare Linear and nonlinear data structures for different application.
- Perform different searching and sorting techniques.
- Identify connected components in trees.
- Analyze asymptotic notations

**TEXT BOOKS:**


1. Deitel and Deitel, ―C++, How To Program‖, Fifth Edition, Pearson Education, 2005.
2. Ellis Horowitz, Sartaj Sahni and Dinesh Mehta, Fundamentals of Data Structures in C++, Galgotia, New Delhi, 1995.


**REFERENCES:**


1. Mark Allen Weiss, ―Data Structures and Algorithm Analysis in C++‖, Third Edition, Addison-Wesley, 2007.
2. Bhushan Trivedi, ―Programming with ANSI C++, A Step-By-Step approach‖, Oxford UniversityPress, 2010.
3. Goodrich, Michael T., Roberto Tamassia, ―David Mount. Data Structures and Algorithms inC++‖, 7th ed, Wiley. 2004.


**EC7451 MICROPROCESSOR AND MICROCONTROLLERS L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To study the architecture of 8085, 8086 and 8051

- To study the addressing modes and instruction set of 8085, 8086 and 8051
- To introduce the need and use of interrupt structure in 8085 and 8051.
- To develop skill in simple program writing for 8085 and 8051 applications.
- To introduce commonly used peripheral / interfacing ICs.

**UNIT I 8- BIT MICROPROCESSOR. 9**

8085 Architecture, Pin configuration, Instruction set, Addressing modes, Interrupts, Timing diagrams Memory and I/O interfacing.

**UNIT II 16- BIT MICROPROCESSOR. 9**

8086 Architecture, Instruction set, Addressing modes, Minimum and Maximum mode configuration, Assembler Directives, Assembly Language Programming, Interrupts. Features of 80186, 80286, 80386, and 80486.

**UNIT III PERIPHERALS AND INTERFACING 9**

Programmable Peripheral Interface (8255), Keyboard display controller (8279), ADC0808 and DAC0808 Interface, Programmable Timer Controller (8254), Programmable interrupt controller (8259), Serial Communication Interface (8251).

**UNIT IV MICROCONTROLLER 9**

8051 — Architecture, Special Function Registers (SFRs), Instruction set, Addressing modes, Assembly language programming, I/O Ports, Timers / counters, Interrupts and serial communication.

**UNIT V MICROCONTROLLER BASED SYSTEM DESIGN. 9**

Interfacing to: matrix display, (16x2) LCD, high power devices, optical motor shaft encoder, Stepper Motor, DC Motor speed Control using PWM, RTC and EEPROM interface using I2C protocol.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

CO1: Ability to relate any architecture and assembly language for a processor.
CO2: Ability to comprehend the architectural and pipelining concepts for Microprocessors.
CO3: Ability to design and deploy the Interfacing peripherals in real time scenario.
CO4: Ability to discriminate different microprocessor and microcontroller and its special function registers.
CO5: Ability to design, develop and trouble shoot microcontroller based system.

**TEXT BOOKS:**


1. Ramesh S. Gaonkar, "Microprocessor Architecture, Programming and Applications with 8085". Penram International Publishing reprint, 6th Edition, 2017.
2. Douglas V. Hall, "Microprocessor and Interfacing, Programming and Hardware", Tata McGraw Hill, Revised 2nd Edition 2006, 11th reprint 2015.


**REFERENCES:**


1. Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin D. McKinley, "The 8051 Microcontroller and Embedded Systems", Pearson Education, 2nd Edition, 2008, 12th impression 2018.
2. Krishna Kant, “Microprocessor and Microcontroller Architecture, programming and system design using 8085, 8086, 8051 and 8096”, PHI, 2007, 7th Reprint, 2015.
3. Kenneth J. Ayala., “The 8051 Microcontroller, Thompson Delmar Learning”, 3rd Edition, 2012.
4. A.K. Ray, K.M. Bhurchandi, “Advanced Microprocessor and Peripherals”, Tata McGraw-Hill, 2nd Edition, 2010.
5. Barry B. Brey, “The Intel Microprocessors Architecture, Programming and Interfacing”, Pearson Education, 2007, 2nd impression, 2010.

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 2 | | | | | | | | | | 3 | | |
| **CO2** | 3 | 3 | 2 | | | | | | | | | | 3 | | |
| **CO3** | 3 | 3 | 2 | | | | | | | | | | 3 | | |
| **CO4** | 3 | 3 | 2 | | | | | | | | | | 3 | | |
| **CO5** | 3 | 3 | 2 | | | | | | | | | | 3 | | |
| **Avg** | 3 | 3 | 2 | | | | | | | | | | 3 | | |

**EC7552 DISCRETE TIME SIGNAL PROCESSING L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/internationalpolicies with a futuristic vision along with socio-economic impact and issues
- To understand computation of spectrum and to analyze systems
- To understand filters for spectrum shaping
- To understand implementation issues in a Digital Signal Processor

**UNIT I DISCRETE FOURIER TRANSFORM 9**

Review of discrete-time signals & systems - DFT and its properties, FFT algorithms & its applications, Overlap-add & overlap-save methods.

**UNIT II DESIGN OF INFINITE IMPULSE RESPONSE FILTERS 9**

Analog filters — Butterworth filters, Chebyshev Type I filters (upto 3 rd order), Analog Transformation of prototype LPF to BPF /BSF/ HPF. Transformation of analog filters into equivalent digital filters using Impulse invariant method and Bilinear Z transform method - Realization structures for IIR filters – direct, cascade, parallel forms.

**UNIT III DESIGN OF FINITE IMPULSE RESPONSE FILTERS 9**

Design of linear phase FIR filters windowing and Frequency sampling methods - Realization structures for FIR filters – Transversal and Linear phase structures, Comparison of FIR & IIR.

**UNIT IV FINITE WORDLENGTH FFECTS 9**

Representation of numbers-ADC Quantization noise-Coefficient Quantization error, Product Quantization error-truncation & rounding errors -Limit cycle due to product round-off error- Round- off noise power

**UNIT V INTRODUCTION TO DIGITAL SIGNAL PROCESSORS 9**

DSP functionalities - circular buffering – DSP architecture – Fixed and Floating point architecture principles – Programming – Application examples.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

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

CO1: Describe the continuous time and discrete time signals and systems.
CO2: Analyze the signals in both continuous time and discrete time
CO3: Compute the spectrum of any signal
CO4: Design IIR filter to process real world signals
CO5: Design FIR filter to process real world signals

**TEXT BOOKS:**

1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, "Signals and Systems", Pearson, Indian Reprint, 2nd Edition, 2015.
2. S. Haykin and B. Van Veen, "Signals and Systems", Wiley, 2nd Edition, 2007.
3. John G Proakis and Manolakis, "Digital Signal Processing Principles, Algorithms and Applications", Pearson, 4th Edition, 2014
4. A.V.Oppenheim, R.W. Schafer and J.R. Buck, "Discrete-Time Signal Processing", Indian Reprint, Pearson, 3rd Edition, 2014.

**REFERENCES:**

1. H P Hsu, "Signals and Systems, Schaum's Outlines", Tata McGraw Hill, 3rd Edition, 2013.
2. B. P. Lathi, "Principles of Linear Systems and Signals", Oxford, 2nd Edition, 2009.
3. John Alan Stuller, "An Introduction to Signals and Systems", Cengage Learning, 2007
4. Emmanuel Ifeachor, Barrie Jervis, "Digital Signal Processing- A practical approach", Pearson, 2nd Edition, 2002.
5. M. H. Hayes, "Digital Signal Processing, Schaum's outlines", Tata McGraw Hill, 2nd Edition, 2011.
6. Sanjit K. Mitra, "Digital Signal Processing: A Computer-Based Approach", McGraw Hill Education, 4th Edition, 2013.

| COURSE OUTCOMES | PROGRAMME OUTCOMES | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO1 0 | PO1 1 | PO1 2 | PSO 1 | PSO 2 | PSO 3 |
| CO1 | 3 | 3 | | | | | | | | | | | 3 | 3 | |
| CO2 | 3 | 3 | | | | | | | | | | | 3 | 3 | |
| CO3 | 3 | 3 | | | | | | | | | | | 3 | 3 | |
| CO4 | 3 | 3 | 3 | 3 | | | | | | | | | 3 | 3 | |
| CO5 | 3 | 3 | 3 | 3 | | | | | | | | | 3 | 3 | |
| Avg | 3 | 3 | 3 | 3 | | | | | | | | | 3 | 3 | |

**BM7511 MICROCONTROLLER AND INTERFACING LABORATORY L T P C**
**0 0 4 2**

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/internationalpolicies with a futuristic vision along with socio-economic impact and issues
- To study introduce the programming language of 8085, 8086 and 805.
- To develop skill in program writing for microprocessors and controllers.
- To introduce microprocessor and microcontroller based system design.
- To impart knowledge on embedded S/W development.

**8085 based experiments:**

1. Assembly Language Programming of 8085.

**8086 based experiments:**

2. Programs for 16 bit Arithmetic, Sorting, Searching and String operations,
3. Programs for Digital clock, Interfacing ADC and DAC
4. Interfacing and programming 8279, 8259, and 8253.
5. Serial Communication between two microprocessors kits using 8251.
6. Interfacing Stepper Motor, Speed control of DC Motor

7. Parallel communication between two microprocessors kits using Mode 1 and Mode 2 of 8255.
8. Macro assembler Programming for 8086

**8051 based experiments using assembly language and C programming:**

9. Programming using Arithmetic, Logical and Bit Manipulation instructions of the 8051 microcontroller.
10. Programming and verifying Timer, Interrupts and UART operations in 8051 microcontroller.
11. Interfacing – DAC and ADC and 8051 based temperature measurement
12. Interfacing – LED and LCD
13. Interfacing – Stepper motor and traffic light control system
14. Communication between 8051 Microcontroller kit and PC.

**TOTAL: 60 PERIODS**

**OUTCOMES:**

- Ability to comprehend and appreciate the significance and role of this course in the present contemporary world
- Ability to design and develop microprocessor based system for real time application.
- Ability to develop microprocessor and microcontroller systems for entertainment,communication and medical applications.
- Ability to troubleshoot microprocessor and microcontroller systems.

| | PO | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 2 | | | | | | 3 | 3 | | 2 | 3 | | |
| **CO2** | 3 | 3 | 2 | | | | | | 3 | 3 | | 2 | 3 | | |
| **CO3** | 3 | 3 | 2 | | | | | | 3 | 3 | | 2 | 3 | | |
| **CO4** | 3 | 3 | 2 | | | | | | 3 | 3 | | 2 | 3 | | |
| **CO5** | 3 | 3 | 2 | | | | | | 3 | 3 | | 2 | 3 | | |
| **Avg** | 3 | 3 | 2 | | | | | | 3 | 3 | | 2 | 3 | | |

**EC7561 DISCRETE TIME SIGNAL PROCESSING LABORATORY L T P C**

**0 0 4 2**

**OBJECTIVES:**

- To implement Linear and Circular Convolution
- To implement FIR and IIR filters
- To study the architecture of DSP processor
- To demonstrate Finite word length effect

**DSP Processor Implementation**

1. Study of architecture of Digital Signal Processor
2. MAC operation using various addressing modes
3. Implementation of difference equations
4. Linear Convolution
5. Circular Convolution
6. Waveform generation

**MATLAB / Equivalent Software package**

7. Generation of sequences
8. Linear and Circular Convolutions
9. DFT

10. FIR filter design
11. IIR filter design
12. Decimation and Interpolation

**TOTAL: 60 PERIODS**

**OUTCOMES:**

- Ability to comprehend and appreciate the significance and role of this course in the present contemporary world
- Carry out simulation of DSP systems
- Demonstrate their abilities towards DSP processor based implementation of DSP systems
- Analyze Finite word length effect on DSP systems
- Demonstrate the applications of FFT to DSP
- Implement adaptive filters for various applications of DSP.

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | | 3 | | | | 3 | 3 | | 2 | 3 | | |
| **CO2** | 3 | 2 | 2 | | 3 | | | | 3 | 3 | | 2 | 3 | | |
| **CO3** | 3 | 2 | 2 | | 3 | | | | 3 | 3 | | 2 | 3 | | |
| **CO4** | 3 | 2 | 2 | | 3 | | | | 3 | 3 | | 2 | 3 | | |
| **CO5** | 3 | 2 | 2 | | 3 | | | | 3 | 3 | | 2 | 3 | | |
| **CO6** | 3 | 2 | 2 | | 3 | | | | 3 | 3 | | 2 | 3 | | |
| **Average** | 3 | 2 | 2 | | 3 | | | | 3 | 3 | | 2 | 3 | | |

**BM7601** **BIOMECHANICS** **L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To study about the mechanics involved with various physiological systems.
- To gain knowledge in deriving the mathematical models related to blood vessels.

**UNIT I INTRODUCTION** **9**

Scope of mechanics in medicine, mechanics of bone structure, determination of in-vivo elastic modulus. Biofluid mechanics, flow properties of blood.

**UNIT II MECHANICS OF PHYSIOLOGICAL SYSTEMS** **9**

Heart valves, power developed by the heart, prosthetic valves. Constitutive equations for soft tissues, dynamics of fluid flow in cardiovascular system and effect of vibration - shear stresses in extra-corporeal circuits.

**UNIT III ORTHOPAEDIC MECHANICS** **9**

Mechanical properties of cartilage, diffusion properties of articular cartilage, mechanical properties of bone, kinetics and kinematics of joints, Lubrication of joints.

**UNIT IV MATHEMATICAL MODELS** **9**

Introduction to Finite Element Analysis, Mathematical models - pulse wave velocities in arteries, determination of in-vivo elasticity of blood vessel, dynamics of fluid filled catheters.

**UNIT V ORTHOPAEDIC APPLICATIONS** **9**

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

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

**At the end of the course, the student will be able to**

CO1: Understand the use of mechanics in medicine.
CO2: Understand the mechanics of physiological systems.
CO3: Distinguish the reason for abnormal patterns.
CO4: Analyze the biomechanical systems using mathematical models.
CO5: Design and develop the models specific to orthopedic applications.

**TEXT BOOKS:**


1. Y.C.Fung,―Bio-Mechanics, "Mechanical Properties ofTissues'',Springer-Verilog,1998.
2. C. Ross Ether and Craig A.Simmons, "Introductory Biomechanics from cells to organisms", Cambridge University Press, New Delhi, 2009.


**REFERENCES:**


1. Susan J Hall, "Basics of Biomechanics'', Mc Graw Hill Publishing.co. New York, 5th Edition, 2007.
2. Dhanjoo N.Ghista, "Orthopaedic Mechanics", Academic Press, 1990.
3. Joseph D.Bronzino, "Biomedical Engineering Fundamentals", Taylor& Francis, 2006.
4. John Enderle, Susanblanchard, Joseph Bronzino, "Introduction to Biomedical Engineering'', Elsevier, 2005.
5. B.H.Brown, PV Lawford, RH Small wood, DR Hose, Dc Barber,"Medical Physics and Biomedical Engineering'', CRC Press, 1999.
6. Dhanjoo N.Ghista, "Bio-mechanics of Medical ic ", Marcel Dekker, 1980.
7. Haufred Clynes, "Bio-medical Engineering Systems'', McGrawHill,1998.


| COURSE OUTCOMES | PROGRAMME OUTCOMES | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 3 | | | | | | | | | | | 3 | | |
| CO2 | 3 | 3 | | | | | | | | | | | 3 | | |
| CO3 | 3 | 3 | 2 | | | | | | | | | | 3 | | |
| CO4 | 3 | 3 | | | 2 | | | | | | | | 3 | | |
| CO5 | 3 | 3 | 2 | | | | | | | | | | 3 | | |
| Avg | 3 | 3 | 2 | | 2 | | | | | | | | 3 | | |



**BM7602 DIAGNOSTIC AND THERAPEUTIC EQUIPMENT – II** **L T P C**

**3 0 0 3**

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues

**The student should be made to:**

- Gain knowledge about measurements of parameters related to respiratory system
- Learn measurement techniques of sensory responses
- Understand different types and uses of diathermy units.

- Know ultrasound imaging technique and its use in diagnosis
- Know the importance of patient safety against electrical hazard

**UNIT I RESPIRATORY MEASUREMENT STSTEM 10**

Instrumentation for measuring the mechanics of breathing – Spiro meter-Lung Volume and vital capacity, measurements of residual volume, pneumotachometer — Airway resistance measurement, Whole body plethysmography, Intra-Alveolar and Thoracic pressure measurements, Apnea Monitor. Types of Ventilators — Pressure, Volume, and Time controlled. Flow, Patient Cycle Ventilators, Humidifiers, Nebulizers, Inhalators.

**UNIT II SENSORY MEASUREMENT 8**

Psycho Physiological Measurements-for testing sensory Responses, Electro occulograph, Electro retinograph, Audiometer-Pure tone, Speech. EGG (Electrogastrograph), galvanic skin resistance (GSR), polygraph.

**UNIT III DIATHERMY 9**

IR and UV lamp - application. Need for different diathermy units, Short wave diathermy, ultrasonic diathermy, Microwave diathermy. Electro surgery machine - Current waveforms, Tissue Responses, Electro surgical current level, Hazards and safety procedures.

**UNIT IV ULTRASONIC TECHNIQUE 9**

Diagnosis: Tissue Reaction, Basic principles of Echo technique, display techniques A, Band M mode, B Scan, Application of ultrasound as diagnostic tool — Echocardiogram, Echoencephalogram, abdomen, obstetrics and gynecology, ophthalmology.

**UNIT V PATIENT SAFETY 9**

Physiological effects of electricity — important susceptibility parameters — Macro shock, Micro shock hazards, Patient‘s electrical environment. Electrical safety codes and standards, Basic Approaches to protection against shock, Protection equipment design, Electrical safety analyzer – Testing the Electrical safety of medical equipment.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

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

CO1: Explain about measurements of parameters related to respiratory system .
CO2: Appreciate the use of advanced laser technology in diagnosis and minimally invasive therapies.
CO3: Analyze different types of diathermy units.
CO4: Understand the concepts of ultrasound equipment.
CO5: Identify the electrical hazards and Implement methods of patient safety.

**TEXT BOOKS:**


1. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, “Biomedical Instrumentation and Measurements”, Pearson Education India; 2nd Edition, 2015.
2. Joseph J. Carr and John M. Brown, “Introduction to Biomedical equipment technology”, Pearson Education, 4th Edition, 2014.
3. Leon Goldman, “The Biomedical Laser: Technology and Clinical applications”, Springer – Verlag Newyork Inc., 2013.

**REFERENCES:**


1. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, 3rd Edition, 2014.
2. Richard Aston, "Principles of Biomedical Instrumentation and Measurement" Merril Publishing Company, 1990.
3. L.A Geddes and L.E.Baker, "Principles of Applied Biomedical Instrumentation", 3rd Edition, John Wiley and Sons, Reprint 2008.
4. John G.Webster, "Medical Instrumentation Application and Design", John Wiley and Sons, New York, 4th edition, 2009.
5. Myer Kutz, "Standard Handbook of Biomedical Engineering & Design" – McGraw-Hill Publisher, 2003.
6. Antony Y.K.Chan, "Biomedical Device technology, Principles and design'', Charles Thomas Publisher Ltd, Illinois, USA, 2008.


| COURSE OUTCOMES | PROGRAMME OUTCOMES | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 2 | | | | | | | | | | | 3 | 3 | |
| CO2 | 3 | 2 | | | | | | | | | | | 3 | 3 | |
| CO3 | 3 | 2 | | | | | | | | | | | 3 | 3 | |
| CO4 | 3 | 2 | | | | | | | | | | | 3 | 3 | |
| CO5 | 3 | 2 | | | | | | | | | | | 3 | 3 | |
| Avg | 3 | 2 | | | | | | | | | | | 3 | 3 | |

**BM7603 PATHOLOGY AND MICROBIOLOGY L T P C**

**3 0 0 3**

**OBJECTIVES:**

To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues

- To understand the structural and functional aspects of living organisms.
- To know the etiology and remedy in treating the pathological diseases.
- To empower the importance of public health.

**UNIT I CELL DEGENERATION, REPAIR AND NEOPLASIA 9**

Cell injury and Necrosis, Apoptosis, Intracellular accumulations, Pathological calcification, cellular adaptations of growth and differentiation, Inflammation and Repair including fracture healing, Neoplasia, Classification, Benign and Malignant tumours, carcinogenesis, spread of tumours. Autopsy and biopsy.

**UNIT II FLUID AND HEMODYNAMIC DERRANGEMENTS 9**

Edema, normal hemostasis, thrombosis, disseminated intravascular coagulation, embolism, infarction, shock. Hematological disorders-Bleeding disorders, Leukaemias, Lymphomas.

**UNIT III MICROSCOPES 9**

Light microscope – bright field, dark field, phase contrast, fluorescence, Electron microscope (TEM& SEM). Preparation of samples for electron microscope. Staining methods – simple, gram staining and AFB staining.

**UNIT IV MICROBIAL CULTURES 9**

Morphological features and structural organization of bacteria, growth curve, Sterilization techniques –

physical and chemical methods, identification of bacteria, culture media and its types, culture techniques and observation of culture.

**UNIT V IMMUNOLOGY** **9**

Natural and artificial immunity, opsonization, phagocytosis, inflammation, Immune deficiency syndrome, antibodies and its types, antigen and antibody reactions, immunological techniques: immunodiffusion, immuno electrophoresis, radioimmunoassay and enzyme linked immune sorbent assay, monoclonal antibodies. Disease caused by bacteria, fungi, protozoal, virus and helminthes.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

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

CO1: Analyze structural and functional aspects of living organisms.

CO2: Explain the function of microscopes.

CO3: Discuss the importance of public health.

CO4: Describe treatment methods involved in curing the pathological diseases.

CO5: Perform practical experiments on tissue processing, sterilization techniques and staining processes.

**TEXT BOOKS:**


1. Ramzi S Cotran, Vinay Kumar & Stanley L Robbins, "Pathologic Basis of diseases", WB Saunders Co. 7th Edition, 2005.
2. Harsh Mohan, "Text book of Pathology". Jaypee Brothers Medical publishers private Limited, 7th Edition, 2014.


**REFERENCES:**


1. Underwood JCE, "General and Systematic Pathology", Churchill Livingstone, 3rd, Edition, 2000.
2. Ananthanarayanan, "Microbiology", Panicker University press. 9th Edition, 2013.
3. Dubey RC and Maheswari DK , "Microbiology", S Chand Publications, 3th Edition, 2010
4. Prescott, Harley,Klein, "Microbiology", Mc Graw Hill, 9th Edition, 2013.


| COURSE OUTCOMES | PROGRAMME OUTCOMES | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 3 | | | | | | | 3 | 3 | | | 3 | | |
| CO2 | 3 | 3 | | | | | | | 3 | 3 | | | 3 | | |
| CO3 | 3 | 3 | | | | | | 3 | 3 | 3 | | 3 | 3 | | |
| CO4 | 3 | 3 | | | | | | 3 | 3 | 3 | | 3 | 3 | | |
| CO5 | 3 | 3 | | | | | | 3 | 3 | 3 | | 3 | 3 | | |
| AVG | 3 | 3 | | | | | | 3 | 3 | 3 | | 3 | 3 | | |

**BM7604** **RADIOLOGICAL EQUIPMENT** **L T P C**

**3 0 0 3**

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues

- To understand generation of x-rays and its applications in imaging.
- To learn different types of radio diagnostic techniques.
- To know techniques used for visualizing different sections of the body
- To learn radiation therapy methodologies and the radiation safety.

**UNIT I MEDICAL X-RAY EQUIPMENT 9**

Nature of X-rays- X-Ray absorption – Tissue contrast. X- Ray Equipment (Block Diagram) – X-Ray Tube, the collimator, Bucky Grid, power supply, Digital Radiography- discrete digital detectors, storage phosphor and film scanning, X-ray Image Intensifier tubes — Fluoroscopy — Digital Fluoroscopy. Angiography, cine Angiography. Digital subtraction Angiography. Mammography.

**UNIT II COMPUTED TOMOGRAPHY 9**

Principles of tomography, CT Generations, X- Ray sources- collimation- X- Ray detectors- Viewing systems- spiral CT scanning — Ultra fast CT scanners. Image reconstruction techniques- back projection and iterative method.

**UNIT III MAGNETIC RESONANCE IMAGING 9**

Fundamentals of magnetic resonance- Interaction of Nuclei with static magnetic field and Radiofrequency wave- rotation and precession — Induction of magnetic resonance signals — bulk Magnetization — Relaxation processes T1 and T2. Block Diagram approach of MRI system- system Magnet (Permanent, Electromagnet and Super conductors), generations of gradient magnetic fields, Radio Frequency coils (sending and receiving), shim coils, Electronic components, fMRI.

**UNIT IV NUCLEAR MEDICINE SYSTEM 9**

Radio Isotopes- alpha, beta, and gamma radiations. Radio Pharmaceuticals. Radiation detectors — gas filled, ionization chambers, proportional counter, GM counter and scintillation Detectors, Gamma camera- Principle of operation, collimator, photo multiplier tube, X-Y positioning circuit, pulse height Analyzer. Principles of SPECT and PET.

**UNIT V RADIATION THERAPY AND RADIATION SAFETY 9**

Radiation therapy – linear accelerator, Telegamma Machine. SRS –SRT,-Recent Techiniques inradiation therapy - 3DCRT — IMRT — IGRT and Cyberknife- radiation measuring instruments- Dosimeter, film Badges, Thermo Luminescent dosimeters- electronic dosimeter- Radiation protection in medicine- radiation protection principles.

**TOTAL: 45 PERIODS.**

**OUTCOMES:**

**At the end of the course, student will be able to**

CO1: Discuss the principle and working of various radiography equipment.
CO2: Explain the tomography concept and image reconstruction techniques.
CO3: Describe the basic principle and working of Magnetic resonance imaging technique.
CO4: Explain the concept of nuclear imaging techniques and radiation detectors.
CO5: Demonstrate the effects of radiation, radiation safety and the principle of Radio therapy techniques.

**TEXT BOOKS:**


1. Steve Webb, "The Physics of Medical Imaging", Adam Hilger,Philadelpia, 1988.
2. Jerrold T.Bushberg, J.Anthony Seibert, Edwin M.Leidholdt,Jr, John M.Boone, 'The Essential Physics of Medical Imaging'', Lippincott Williams and Wilkins, 3rd Edition, 2012.
3. R.Hendee and Russell Ritenour, "Medical Imaging Physics", William,Wiley- Liss, 4th Edition, 2002.


**REFERENCES:**


1. Gopal B. Saha, "Physics and Radiobiology of Nuclear Medicine'', Springer, 3rd Edition 2006.

2. B.H.Brown, PV Lawford, RH Smallwood, DR Hose, DC Barber, " Medical physics and Biomedical Engineering'', - CRC Press,1999.
3. Myer Kutz, "Standard handbook of Biomedical Engineering and design", McGraw Hill, 2003.
4. P.Ragunathan, "Magnetic Resonance Imaging and Spectroscopy in Medicine concepts and Techniques'', Orient Longman,2007.

| COURSE OUTCOMES | PROGRAMME OUTCOMES | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 3 | | | | 2 | | 2 | | | | | 3 | | 2 |
| CO2 | 3 | 3 | | | | 2 | | 2 | | | | | 3 | | 2 |
| CO3 | 3 | 3 | | | | 2 | | 2 | | | | | 3 | | 2 |
| CO4 | 3 | 3 | | | | 2 | | 2 | | | | | 3 | | 2 |
| CO5 | 3 | 3 | | | | 2 | | 2 | | | | | 3 | | 2 |
| Avg | 3 | 3 | | | | 2 | | 2 | | | | | 3 | | 2 |

**BM7611 DIAGNOSTIC AND THERAPEUTIC EQUIPMENT LABORATORY** **L T P C 0 0 4 2**

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To provide practice on recording and analysis of different Bio potentials
- Study the function of different therapeutic equipments.

**LIST OF EXPERIMENTS:**

1. Recording and analysis of ECG signals
2. Recording and analysis of EEG signals.
3. Recording and analysis of EMG signal and plotting of fatigue characteristics.
4. Simulation of ECG – detection of QRS complex and heart rate
5. Study of shortwave and ultrasonic diathermy
6. Study of Patient Monitoring System
7. Study of biotelemetry
8. Electrical safety measurements.
9. Analysis of characteristics of surgical diathermy.
10. Measurement of Respiratory parameters using spirometry.
11. Measurement of GSR.
12. Recording of Audiogram.

**TOTAL: 60 PERIODS**

**OUTCOMES:**

**Upon completion of the course, students will be able to:**

CO1: Prepare a theoretical Experimental model on diagnostic and therapeutic equipment.
CO2: Setting up an experiment and verifying its appropriateness.
CO3: Practically conduct the experiment as a team and verify its underlying principles.
CO4: Mathematical and graphical analysis of results.
CO5: Report Writing, Presentation and interpretation.
CO6: Demonstrate the experiments individually and defend the outcomes.

| | PO 1 | PO 2 | PO 3 | PO 4 | PO5 | PO 6 | PO7 | PO8 | PO9 | PO10 | PO1 1 | PO1 2 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | | | 3 | | | | 3 | 3 | | 3 | 3 | 3 | |
| **CO2** | 3 | 3 | | | 3 | | | | 3 | 3 | | 3 | 3 | 3 | |
| **CO3** | 3 | 3 | | | 3 | | | | 3 | 3 | | 3 | 3 | 3 | |
| **C O4** | 3 | 3 | | | 3 | | | | 3 | 3 | | 3 | 3 | 3 | |
| **CO5** | 3 | 3 | | | 3 | | | | 3 | 3 | | 3 | 3 | 3 | |
| **CO6** | 3 | 3 | | | 3 | | | | 3 | 3 | | 3 | 3 | 3 | |
| **Aver age** | 3 | 3 | | | 3 | | | | 3 | 3 | | 3 | 3 | 3 | |

**BM7612 PATHOLOGY AND MICROBIOLOGY LABORATORY L T P C**

**0 0 4 2**

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues.
- The student should be made to use Compound microscope
- To practice on chemical examinations, Cryoprocessing, Histopathological examinations etc

**LIST OF EXPERIMENTS:**

1. Study of parts of compound microscope & Fluorescent Microscope
2. Histopathological slides of benign and malignant tumours.
3. Manual paraffin tissue processing and section cutting (demonstration)
4. Cryo processing of tissue and cryosectioning (demonstration)
5. Basic staining – Hematoxylin and eosin staining.
6. Viability staining studies using Trypan blue and Fluorescent staining
7. Simple stain.
8. Gram stain.
9. AFB stain.
10. Slides of malarial parasites, micro filaria and leishmania donovani.
11. Haematology slides of anemia and leukemia.
12. Study of bone marrow charts.
13. Bleeding time and clotting time.
14. Sterilization methods demonstration.

**TOTAL : 60 PERIODS.**

**Course outcomes**

CO1: Analyze structural and functional aspects of living organisms.
CO2: Explain the function of microscopes.
CO3: Discuss the importance of public health.
CO4: Describe treatment methods involved in curing the pathological diseases.
CO5: Perform practical experiments on tissue processing, sterilization techniques and staining processes.

**Mapping**

| Course outcomes | Po1 | Po2 | Po3 | Po4 | Po5 | Po6 | Po7 | Po8 | Po9 | Po10 | Po11 | Po12 | Pso1 | Pso2 | Pso3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Co1 | 3 | 3 | | | | | | | 3 | 3 | | | 3 | | |
| Co2 | 3 | 3 | | | | | | | 3 | 3 | | | 3 | | |
| Co3 | 3 | 3 | | | | | | 3 | 3 | 3 | | 3 | 3 | | |
| Co4 | 3 | 3 | | | | | | 3 | 3 | 3 | | 3 | 3 | | |
| Co5 | 3 | 3 | | | | | | 3 | 3 | 3 | | 3 | 3 | | |
| avg | 3 | 3 | | | | | | 3 | 3 | 3 | | 3 | 3 | | |

**BM7701** **MEDICAL INFORMATICS** **L T P C**

**3 0 0 3**

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To learn ICT applications in medicine with an introduction to health informatics.
- To understand the theories and practices adopted in Hospital Information Systems in the light of medical standards, medical data formats and recent trends in Hospital Information Systems

**UNIT I MEDICAL INFORMATICS** **9**

Introduction – Medical Informatics – Bioinformatics – Health Informatics - Structure of Medical Informatics –Functional capabilities of Hospital Information System - On-line services and Off –line services - History taking by computer, Dialogue with the computer

**UNIT II MEDICAL STANDARDS** **9**

Evolution of Medical Standards — IEEE 11073 - HL7 — DICOM — IRMA - LOINC — HIPPA — Electronics Patient Records –Healthcare Standard Organizations – JCAHO (Join Commission on Accreditation of Healthcare Organization) - JCIA (Joint Commission International Accreditation) - Evidence Based Medicine - Bioethics.

**UNIT III MEDICAL DATA STORAGE AND AUTOMATION** **9**

Plug-in Data Acquisition and Control Boards — Data Acquisition using Serial Interface - MedicalData formats — Signal, Image and Video Formats — Medical Databases - Automation in clinical laboratories - Intelligent Laboratory Information System - PACS , Data mining.

**UNIT IV HEALTH INFORMATICS** **9**

Bioinformatics Databases, Bio-information technologies, Semantic web and Bioinformatics, Genome projects, Clinical informatics, Nursing informatics, Public health informatics, Education and Training

**UNIT V RECENT TRENDS IN MEDICAL INFORMATICS** **9**

Medical Expert Systems, Virtual reality applications in medicine, Virtual Environment - Surgical simulation

- Radiation therapy and planning – Telemedicine – virtual Hospitals - Smart Medical Homes – Personalized e-health services – Biometrics - GRID and Cloud Computing in Medicine

**TOTAL: 45 PERIODS**

**OUTCOMES:**

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

CO1: To discuss about health informatics and different ICT applications in medicine.
CO2: To explain the function of Hospital Information Systems.
CO3: To appreciate and adopt medical standards.
CO4: Understand the virtual reality tools.
CO5: Understand the concept and need of different information systems.

**TEXT BOOKS:**

1. R.D.Lele, "Computers in Medicine: Progress in Medical Informatics'', Tata McGraw Hill Publishing computers Ltd, New Delhi, 2005.
2. Mohan Bansal, "Medical informatics", Tata McGraw Hill Publishing computers Ltd, New Delhi, 2003.
3. N.Mathivanan, "PC-Based Instrumentation'', Prentice Hall of India Pvt Ltd – New Delhi, 2007.
4. Yi – Ping Phoebe Chen, "Bioinformatics Technologies'', Springer International Edition, New Delhi, 2007.

| COURSE OUTCOMES | PROGRAMME OUTCOMES | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 3 | | | | | | | | | | | | 3 | |
| CO2 | 3 | | | | | | | | | | | | | 3 | |
| CO3 | 3 | 3 | | | | | | 2 | | | | 2 | | 3 | |
| CO4 | 3 | | | | | | | | | | | | | 3 | |
| CO5 | 3 | | | | | | | | | | | | | 3 | |
| Avg | 3 | 3 | | | | | | 2 | | | | 2 | | 3 | |

**BM7702 PATTERN RECOGNITION AND NEURAL NETWORKS L T P C**

**3 0 0 3**



**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with afuturistic vision along with socio-economic impact and issues
- To study the fundamentals of pattern recognition and its application.
- To learn algorithms suitable for pattern classification.
- To understand applications of pattern recognition and classification in image processing and computer vision.

**UNIT I INTRODUCTION AND SUPERVISED LEARNING 9**

Overview of Pattern recognition, Relevance to the field, Types of Pattern recognition, Parametric and Nonparametric approach, Bayesian classifier, Discriminant function, non-parametric density estimation,

histograms, kernels, window estimators, k- nearest neighbor classifier, estimation of error rates.

**UNIT II UNSUPERVISED LEARNING AND CLUSTERING ANALYSIS 9**

Unsupervised learning- Hierarchical clustering- Single-linkage Algorithm, Complete — linkage Algorithm, Average - Linkage Algorithm and Ward's method. Partitional clustering- Forgy's Algorithm, k-means algorithm and Isodata Algorithm, Case studies.

**UNIT III INTRODUCTION AND SIMPLE NEURAL NET 9**

Elementary neurophysiology and biological neural network –Artificial neural network — Architecture, biases and thresholds, Hebb net, Perceptron, Adaline and Madaline.

**UNIT IV BACK PROPAGATION AND ASSOCIATIVE MEMORY 9**

Back propagation network, generalized delta rule, Bidirectional Associative memory Hopfield Network

**UNIT V NEURAL NETWORKS BASED ON COMPETITION 9**

Kohonen Self organizing map, Learning Vector Quantisation, Counter Propagation network, Case studies.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

**At the end of the course, the student will be able to**

CO1: Classify patterns using statistical pattern classifier
CO2: Perform unsupervised classification using clustering techniques.
CO3: Explain the fundamentals of neural networks.
CO4: Design Back Propagation and Hopfield network.
CO5: Perform classification using competitive neural networks.

**TEXT BOOKS:**


1. Duda R.O, Hart P.G, "Pattern Classification and scene analysis'', Wiley Edition, 2000.
2. Earl Gose, Richard Johnsonbaugh Steve Jost, "Pattern Recognition and Image Analysis", Prentice Hall of India Pvt Ltd., New Delhi,1999.
3. Freeman J. A., and Skapura B.M, "Neural networks, algorithms, applications and programming techniques", Addison- Wesley,2003


**REFERENCES:**


1. Hagan, Demuth and Beale, "Neural Network Design'', Vikas Publishing House Pvt Ltd., New Delhi, 2002.
2. Robert Schalkoff, "Pattern recognition, Statistical, Structural and neural approaches", John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2005.
3. Laurene Fausett,"Fundamentals of Neural Networks- Architectures, Algorithms and Application", Prentice Hall, 1994.


| COURSE OUTCOMES | PROGRAMME OUTCOMES | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 3 | 2 | | | | | | | | | | 3 | | 3 |
| CO2 | 3 | 3 | 2 | | | | | | | | | | 3 | | 3 |
| CO3 | 3 | 3 | 2 | | | | | | | | | | 3 | | 3 |
| CO4 | 3 | 3 | 2 | 2 | | | | | | | | 3 | 3 | | 3 |
| CO5 | 3 | 3 | 2 | 2 | | | | | | | | 3 | 3 | | 3 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Avg** | 3 | 3 | 2 | 2 | | | | | | | | 3 | 3 | | 3 |

**EC7751 PRINCIPLES OF DIGITAL IMAGE PROCESSING L T P C**

**3 0 0 3**

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/internationalpolicies with a futuristic vision along with socio-economic impact and issues
- To study the formation of an image and its acquisition
- To introduce the use and application of transforms in image processing
- To study techniques for improving quality of information in spoilt images
- To introduce schemes for compressing images to save storage space

**UNIT I DIGITAL IMAGE FUNDAMENTALS 9**

Elements of digital image processing systems, Vidicon and Digital Camera working principles, - Elements of visual perception, brightness, contrast, hue, saturation, mach band effect, Color image fundamentals - RGB, HSI models, Image sampling, Quantization, dither, Two- dimensional mathematical preliminaries, 2D transforms - DFT, DCT, KLT, SVD.

**UNIT II IMAGE ENHANCEMENT 9**

Point processing, Histograms, Histogram equalization and specification techniques, Noise distributions, Spatial averaging, Directional Smoothing, Median, Geometric mean, Harmonic mean, Contraharmonic mean filters, Homomorphic filtering, Color image enhancement.

**UNIT III IMAGE RESTORATION 9**

Image Restoration - degradation model, Unconstrained and Constrained restoration, Inverse filtering, Wiener filtering, Geometric transformations-spatial transformations.

**UNIT IV IMAGE SEGMENTATION 9**

Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation –Region growing – Region splitting and Merging – Segmentation by morphological watersheds – Hybrid methods

**UNIT V IMAGE COMPRESSION 9**

Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, Vector Quantization, Transform coding, JPEG standard, MPEG.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES**

**At the end of the course, the student will be able to**

CO1: Process color images and compute image transforms.
CO2: Preprocess the image using image enhancement and filtering techniques.
CO3: Restore the degraded images.
CO4: Segment the region of interest in images.
CO5: Apply various compression techniques on images.

**TEXT BOOKS:**


1. Rafael C. Gonzalez, Richard E. Woods, “Digital Image Processing”, Pearson, Education, Inc., 4th Edition, 2017.
2. Anil K. Jain, “Fundamentals of Digital Image Processing”, Pearson Education, Inc., 1st Edition, 2015.

3. Milan Sonka, Vaclav Hlavac and Roger Boyle, "Image Processing, Analysis and Machine vision'', Cengage, 3rd Edition, 2013.

**REFERENCES:**

1. Kenneth R. Castleman, "Digital Image Processing", Pearson, 1st Edition, 2007.
2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, "Digital Image Processing using MATLAB'', Pearson Education, Inc., 2nd Edition, 2017.
3. William K. Pratt, "Digital Image Processing" ,Wiley India Pvt Ltd, 4th Edition, 2010.
4. Alan C. Bovik, "Handbook of image and video processing", Elsevier Academic press, 2005
5. S.Sridhar, "Digital Image processing", Oxford University press, 2ndEdition, 2016

| COURSE OUTCOMES | PROGRAMME OUTCOMES | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
| CO1 | 3 | 3 | | | 2 | | | | | | | | 3 | 3 | |
| CO2 | 3 | 3 | | | 2 | | | | | | | | 3 | 3 | |
| CO3 | 3 | 3 | 3 | | 2 | | | | | | | | 3 | 3 | |
| CO4 | 3 | 3 | 3 | | 2 | | | | | | | | 3 | 3 | |
| CO5 | 3 | 3 | 3 | | 2 | | | | | | | | 3 | 3 | |
| Avg | 3 | 3 | 3 | | 2 | | | | | | | | 3 | 3 | |

**BM7712** **MEDICAL IMAGE PROCESSING LABORATORY** **L T P C**

**0 0 4 2**

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To study the various aspects of image processing techniques for medical images

**LIST OF EXPERIMENTS:**

1. Display of Grayscale Images.
2. Histogram Equalization.
3. Spatial filtering
4. Non-linear Filtering.
5. Edge detection using Operators.
6. 2-D DFT and DCT.
7. Filtering in frequency domain.
8. Display of color images.
9. Conversion between color spaces.
10. DWT of images.
11. Segmentation using watershed transform.
12. Study of DICOM standards.
13. Stenography
14. Medical Image Compression techniques.
15. Medical image fusion

**TOTAL: 60 PERIODS**

**OUTCOMES:**

**Upon completion of the course, students will be able to:**

CO1: Prepare an Experimental model in consultation with team members.
CO2: Implement the software program and verifying its appropriateness.
CO3: Practically test the program as a team and verify its underlying principles.
CO4: Mathematical and graphical analysis of results.

CO5: Report Writing, Presentation and interpretation.
CO6: Demonstrate the experiments individually and defend the outcomes.

**REFERENCES:**

1. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, " Digital Image Processing using MATLAB'', Pearson Education, Inc., 2004.

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO1 0 | PO1 1 | PO1 2 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | | | 3 | | | | 3 | 3 | | 3 | | 3 | |
| **CO2** | 3 | 3 | | | 3 | | | | 3 | 3 | | 3 | | 3 | |
| **CO3** | 3 | 3 | | | 3 | | | | 3 | 3 | | 3 | | 3 | |
| **CO4** | 3 | 3 | | | 3 | | | | 3 | 3 | | 3 | | 3 | |
| **CO5** | 3 | 3 | | | 3 | | | | 3 | 3 | | 3 | | 3 | |
| **CO6** | 3 | 3 | | | 3 | | | | 3 | 3 | | 3 | | 3 | |
| **Averag e** | 3 | 3 | | | 3 | | | | 3 | 3 | | 3 | | 3 | |

**BM7001 ADVANCED BIO ANALYTICAL AND THERAPEUTIC TECHNIQUES L T P C**

**3 0 0 3**

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To understand the basic preparation of standards.
- To study common analytical techniques.
- To learn the appropriate technique for a given size & type of sample.

**UNIT I ANALYTICAL TECHNIQUES 9**

Principle, instrumentation and application of electrophoresis- SDS, native gel. UV and IR spectroscopy and its application. Spectrophotometry, fluorimetry. NMR – principle, instrumentation and application in medical sciences.

**UNIT II ENZYMES AS A DIAGNOSTIC TOOL 9**

Isoenzymes and their significance in diagnosis, enzyme pattern in health and diseased condition –lipase, amylase, ALP, ACP, SGOT, SGPT, LDH & CPK. Techniques in screening isoenzymes. Biosensors- enzyme based, antibody based, DNA based and optical biosensor. Blotting techniques. Automation in clinical laboratory.

**UNIT III RADIOISOTOPIC TECHNIQUES 9**

Types of radioisotopes, units of measurements, methods in measuring radioactivity –G.M liquid scintillation counter application in diagnosis (RIA & ELISA) , autoradiography, biological hazards, safety measures in handling isotopes, disposal of labeled compounds and radiodosimetry

**UNIT IV GENE THERAPY** **9**

Central concept of gene therapy, basic molecular mechanism of gene transfer, human genome project, prerequisite of human gene therapy, biological basis of gene therapy strategies, vehicles for gene transfer, gene transfer methods, clinical gene therapy studies, gene therapy for hereditarydisease, gene therapy for cancer, gene therapy for HIV. Ethical issues in human gene therapy.

**UNIT V NANOTHERAPEUTICS** **9**

Nanoparticles as carriers in drug delivery- design, manufacture and Physiochemical properties, transport across biological barriers, nanotechnology in Cancer therapy, bone treatment, nano particles for oral vaccination and skin disease. Types of nanoparticles-half life. Fate of nano particles.

**TOTAL:45PERIODS**

**COURSE OUTCOMES:**

**At the end of course, the student will be able to**

CO1: Report and discuss on chemical analytical aspects relevant for the selection of proper analytical techniques.

CO2: Implement bio analytical aspects in medical sciences.

CO3: Discuss on preventive measures of radioactive pollution and regulations regarding safety measures for radiation exposure.

CO4: Analyze the underlying etiology of the disease that might be treated by gene therapy.

CO5: Describe the basic science behind the properties of materials at nanoscale and the principles behind advanced experimental and computational techniques for studying nanomaterials.

**TEXT BOOKS:**

1. Douglas A, "Principles of Instrumental Analysis", Skoog Brooks Cole publisher, 6th Edition 2006.
2. Keith Wilson & John Walker, "Practical Biochemistry – Principles and Techniques", Oxford University Press, 7th Edition, 2010.

**REFERENCES:**

1. Trevor Palmer, "Understanding Enzymes", Published by Ellis Horwood LTD, 4th Edition, 1995.
2. Harvey Lodish W. H, "Molecular Cell Biology", Freeman publisher 7th Edition, 2012.
3. G. Louis Hornyak, John J. Moore, Harry F. Tibbals and Joydeep Dutta, "Fundamentals of Nanotechnology", CRC press, 1st Edition, 2008.
4. Gabor L. Hornyak, Joydeep Dutta, H.F. Tibbals, Anil Rao, "Introduction to NanoScience", CRC Press, 2008.



| COURSE OUTCOMES | PROGRAMME OUTCOMES | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 3 | | | 3 | | | | | | | | 3 | | 2 |
| CO2 | 3 | 3 | | | 3 | | | 3 | | | | | 3 | | 2 |
| CO3 | 3 | 3 | | | 3 | | | 3 | | | | | 3 | | 2 |
| CO4 | 3 | 3 | | | 3 | | | 3 | | | | | 3 | | 2 |
| CO5 | 3 | 3 | | | 3 | | | 3 | | | | | 3 | | 2 |
| Avg | 3 | 3 | | | 3 | | | 3 | | | | | 3 | | 2 |

**BM7002** **BIO SIGNAL PROCESSING** **L T P C**

**3 0 0 3**

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international
- policies with a futuristic vision along with socio-economic impact and issues
- To study the characteristics of different biosignals
- To learn linear and non-linear filtering techniques to extract desired information
- To understand various techniques for automated classification and decision making toaid diagnosis

**UNIT I BIOSIGNAL AND SPECTRAL CHARACTERISTICS 9**

Characteristics of some dynamic biomedical signals, Noises- random, structured and physiological noises. Filters- IIR and FIR filters. Spectrum — power spectral density function, cross-spectral density and coherence function, cepstrum and homomorphic filtering. Estimation of mean of finite time signals.

**UNIT II TIME SERIES ANALYSIS AND SPECTRAL ESTIMATION 9**

Time series analysis — linear prediction models, process order estimation, lattice representation, non stationary process, fixed segmentation, adaptive segmentation, application in EEG, PCG signals, Time varying analysis of Heart-rate variability, model based ECG simulator. Spectral estimation –Blackman Tukey method, periodogram, and model based estimation. Application in Heart rate variability, PCG signals.

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

Filtering — LMS adaptive filter, adaptive noise canceling in ECG, improved adaptive filtering in ECG, Wavelet detection in ECG — structural features, matched filtering, adaptive wavelet detection, detection of overlapping wavelets.

**UNIT IV BIOSIGNAL CLASSIFICATION AND RECOGNITION 9**

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

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

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

**TOTAL: 45 PERIODS**



**COURSE OUTCOMES:**

**Upon the completion of this course, the students will be able to**

CO1: Preprocess the Biosignals.

CO2: Analyze biosignals in time domain & to estimate the spectrum.

CO3: Apply wavelet detection techniques for biosignal processing.

CO4: Classify Biosignals using neural networks and statistical classifiers.

CO5: Extract the features using multivariate component analysis.

**TEXT BOOKS:**

1. Arnon Cohen, “Bio-Medical Signal Processing Vol I and Vol II”, CRC Press Inc., Boca Rato, Florida, 1999.
2. Rangaraj M. Rangayyan, “Biomedical Signal Analysis-A case study approach”, Wiley, 2nd Edition, 2016.

| COURSE OUTCOMES | PROGRAMME OUTCOMES | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 3 | | | 2 | | | | | | | | | 3 | 3 |
| CO2 | 3 | 3 | | | 2 | | | | | | | | | 3 | 3 |
| CO3 | 3 | 3 | | | | | | | | | | | | 3 | 3 |
| CO4 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | 3 |
| CO5 | 3 | 3 | 2 | | | | | | | | | | | 3 | 3 |
| Avg | 3 | 3 | 2 | 2 | 2 | | | | | | | | | 3 | 3 |

**REFERENCES:**


1. Willis J. Tompkins, "Biomedical Digital Signal Processing", Prentice Hall of India, New Delhi, 2003.
2. Emmanuel C. Ifeachor, Barrie W.Jervis, "Digital Signal processing- A Practical Approach'',Pearson education Ltd., 2004.
3. Raghuveer M. Rao and Ajith S.Bopardikar, "Wavelets transform – Introduction to theory and its applications", Pearson Education, India, 2000.
4. K.P.Soman, K.Ramachandran, "Insight into wavelet from theory to practice", PHI, New Delhi, 3rd Edition, 2010.
5. John L.Semmlow, "Biosignal and Biomedical Image Processing Matlab Based applications'', Taylor& Francis Inc, 2004.
6. Kayvan Najarian and Robert Splerstor, "Biomedical signals and Image processing'', CRC – Taylor and Francis, New York, 2nd Edition, 2012.
7. D.C.Reddy, "Biomedical Signal Processing – Principles and Techniques'', Tata McGraw-Hill Publishing Co. Ltd, 2005.
8. Gari D. Clifford, Francisco Azuajeand Patrick E.McSharry, "Advanced Methods and Tech for ECG Data Analysis", ARTECH House, Boston, 1st Edition, 2006.


**BM7003 BIO MATERIALS AND ARTIFICIAL ORGANS L T P C**

**3 0 0 3**

**OBJECTIVES:**

- To study the characteristics and classification of biomaterials.
- To understand the response of biomaterials in living system.
- To learn about the polymeric materials and composites in tissue replacements.
- To know the compatibility and functioning of artificial organs inside the living system.

**UNIT I STRUCTURE OF BIO-MATERIALS AND BIO-COMPATIBILITY 9**

Definition and classification of bio-materials, mechanical properties, visco elasticity, wound- healing process, body response to implants, blood compatibility, HLA compatibility

**UNIT II IMPLANT MATERIALS 9**

Metallic implant materials, stainless steels, co-based alloys, Ti-based alloys, ceramic implant materials, aluminum oxides, hydroxyapatite, glass ceramics, carbons, medical applications.

**UNIT III POLYMERIC IMPLANT MATERIALS 9**

Polymerization, polyamides, Acryrilic polymers, rubbers, high strength, thermoplastics, medical applications. Bio polymers: collagen and elastin. Medical Textiles: silica, chitosan, PLA, composites, Sutures, wound dressings. Materials for ophthalmology: contact lens, Intraocular lens.Membranes for plasma separation and blood oxygenation.

**UNIT IV TISSUE REPLACEMENT IMPLANTS** **9**

Small intestinal submucosa and other decellularized matrix biomaterials for tissue repair. Soft- tissue replacements, types of transplant by stem cell, sutures, surgical tapes, adhesive, Percutaneous and skin implants, maxillofacial augmentation, Vascular grafts, hard tissuereplacement Implants, joint replacements, Pancreas replacement.

**UNIT V ARTIFICIAL ORGANS** **9**

Artificial blood, Artificial skin, Artificial Heart, Prosthetic Cardiac Valves, Artificial lung(oxygenator), Artificial Kidney (Dialyser membrane), Dental Implants.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

**At the end of the course, the student will able to**

CO1: Analyze different types of materials and its application in biomedical field.
CO2: Choose materials for design of implants in tissue replacement.
CO3: Evaluate response of biomaterials in living system.
CO4: Assess compatibility and functioning of artificial organs inside the living system.
CO5: Design and develop biomaterial based scaffold for biomedical application.

**TEXT BOOKS:**


1. Sujata V. Bhatt, "Biomaterials", Narosa Publishing House, 7th Edition, 2005.
2. JoonB.Park Joseph D. Bronzino, "Biomaterials - Principles and Applications", CRC press, 2003.


**REFERENCES:**


1. H.H.Willard,D.L.Merrit, " "Instrumental Methods of Analysis",CBS Publishers, 1992.
2. ParkJ.B., "Biomaterials Science and Engineering'', Plenum Press,1984.
3. Myer Kutz, " "Standard Handbook of Biomedical Engineering & Design", McGraw-Hill, 2003
4. John Enderle, Joseph D.Bronzino, Susan M.Blanchard, ""Introduction to Biomedical Engineering", Elsevier, 2005.
5. AC Anand, JF Kennedy, M. Miraftab, S.Rajendran, "Medical Textiles and Biomaterials for Health Care'', Woodhead Publishing Limited, 2006.
6. D F Williams, ""'Medical and Dental Materials: A comprehensive Treatment-Volume 14", VCH Publishers, 1992.
7. BD Ratner, AS Hoffmann,FJ Schoen, JE Lemmons, ""An introduction to Materials in Medicine", Academic Press, 1996.


| COURSE OUTCOMES | PROGRAMME OUTCOMES | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 2 | | | | | | | | | | | 3 | | |
| CO2 | 3 | 2 | | | | | | 2 | | | | | 3 | | |
| CO3 | 3 | 2 | | | | | | | | | | | 3 | | |
| CO4 | 3 | 2 | | | | | | 2 | | | | | 3 | | |
| CO5 | 3 | 2 | | | | | | | | | | | 3 | | |
| Avg | 3 | 2 | | | | | | 2 | | | | | 3 | | |

**BM7004 BIOMATERIALS AND CHARACTERISATION** **L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To study the characteristic features of bio materials in medicine.
- To know biocompatibility and functionality of biomaterials and implement in living system.

**UNIT I BIOMATERIALS AND PROPERTIES 7**

Biomaterials: Introduction to biomaterials and requirements of biomaterials, Classification of biomaterials: Metallic, Ceramic, Polymeric and biological biomaterials. Properties of biomaterials: Bulk properties and Surface properties, ethics.

**UNIT II BIOMATERIALS IN MEDICINE 10**

Materials for Bone and Joint Replacement: Metals in Joint Replacement: Stainless Steels, Titanium based Materials and Porous metals. Ceramics: alumina, zirconia, calcium phosphate and bioactive glass, bone cement. Polymers: PMMA and Polyethylene, rubber and fluorocarbon polymers. Materials for oral and maxillofacial surgery, drug delivery, ophthalmology and overview of intelligent textiles for medical applications. (examples for each).

**UNIT III PHYSIO-CHEMICAL CHARACTERIZATION 10**

Material Characterization: X-ray Diffraction Analysis (XRD), X-ray absorption, -level of exposure and limitations, FT- Raman and micro Raman analysis, Electron Spectroscopy for Chemical Analysis (ESCA) and X-ray Photo electron Spectroscopy (XPS), mechanical testing: tensile, compression, wears, fatigue, corrosion studies and fracture toughness. Thermal and viscoelastic properties, acoustic and ultrasonic properties.

**UNIT IV SURFACE CHARACTERIZATION 9**

Surface properties and adhesion, contact angle measurement, scanning Electron Microscopy (SEM), transmission Electron Microcopy (TEM) and atomic force microscopy (AFM). secondary ion Mass Spectrometry, confocal laser scanning microscopy.

**UNIT V BIOMATERIAL TESTING 9**

Biofunctionality and biocompatibility, preservation techniques for biomaterials, in vitro and invivo Assessment of tissue compatibility, testing of blood (HLA typing and blood grouping) –materials, interactions and animal models.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

**At the end of the course, the student will be able to**

CO1: Apply the knowledge of science and engineering and to function on multidisciplinary team.

CO2: Analyze different types of materials and their properties.

CO3: Explain the basic principles and features of polymeric materials and understand key relationship between the structure, property and processing of polymers.

CO4: Analyze the roles of the natural and synthetic polymer in designing the medical device.

CO5: Explain methods to repair and regenerate injured or lost functional tissue with materials, autologous or stem cells.

**TEXT BOOKS:**


1. Sujata V. Bhatt, ―Biomaterials" Narosa Publishing House, 2nd Edition, 2005.
2. Joon B.Park Joseph D.Bronzino -Biomaterials – Principles and Applications– CRC Press, 2003.


**REFERENCES:**


1. H.H.Willard, "Instrumental Methods of Analysis", CBS Publishers, 1992.
2. Park J.B., "Biomaterials Science and Engineering", Plenum Press, 1984.
3. Myer Kutz ,"Standard Handbook of Biomedical Engineering & Design", McGraw-Hill, 2003.
4. John Enderle, Joseph D. Bronzino, Susan M. Blanchard, "Introduction to Biomedical Engineering'', Elsevier, 2005.
5. AC ANAND, J F Kennedy, M. Miraftab, S. Rajendran, "Medical Textiles and Biomaterials for Healthcare", Woodhead Publishing Limited, 2006.
6. D F Williams, "Medical and Dental Materials: A comprehensive Treatment'', VCH Publishers, 1992.

7. BD Ratner, AS Hoffmann, FJ Schoen, JE Lemmons, "An introduction to Materials in Medicine", Academic Press, 1996.

| COURSE OUTCOMES | PROGRAMME OUTCOMES | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 3 | | | | | | 3 | | | | | 3 | 2 | 2 |
| CO2 | 3 | 3 | | | | | | 3 | | | | | 3 | 2 | 2 |
| CO3 | 3 | 3 | | | | | | 3 | | | | | 3 | 2 | 2 |
| CO4 | 3 | 3 | | | | | | 3 | | | | | 3 | 2 | 2 |
| CO5 | 3 | 3 | 3 | | | | | 3 | | | | | 3 | 2 | 2 |
| Avg | 3 | 3 | 3 | | | | | 3 | | | | | 3 | 2 | 2 |

**BM7005 BIOMETRIC SYSTEMS L T P C**

**3 0 0 3**

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To understand the general principles of design of biometric systems and the underlying trade- offs.
- To study the technologies of fingerprint, iris, face and speech recognition
- To study of evaluation of biometrics systems.
-

**UNIT I INTRODUCTION TO BIOMETRICS 9**

Introduction and back ground – biometric technologies – passive biometrics – active biometrics – Biometric characteristics, Biometric applications – Biometric Authentication systems- Taxonomy of Application Environment, Accuracy in Biometric Systems- False match rate- False non match rate- Failure to enroll rate- Derived metrics-Biometrics and Privacy.

**UNIT II FINGERPRINT TECHNOLOGY 9**

History of fingerprint pattern recognition - General description of fingerprints- fingerprint sensors, fingerprint enhancement, Feature Extraction- Ridge orientation, ridge frequency, fingerprint matching techniques- correlation based, Minutiae based, Ridge feature based, fingerprint classification, Applications of fingerprints, Finger scan- strengths and weaknesses, Evaluation of fingerprint verification algorithms.

**UNIT III FACE RECOGNITION AND HAND GEOMETRY 9**

Introduction to face recognition, face recognition using PCA, LDA, face recognition using shapeand texture, face detection in color images, 3D model based face recognition in video images, Neural networks for face recognition, Hand geometry — scanning — Feature Extraction — classification.

**UNIT IV IRIS RECOGNITION 9**

Introduction, Anatomical and Physiological underpinnings, Iris sensor, Iris representation andlocalization-Daugman and Wilde's approach, Iris matching, Iris scan strengths and Weaknesses, System performance, future directions

**UNIT V VOICE SCAN AND MULTIMODAL BIOMETRICS 9**

Voice scan, speaker features, short term spectral feature extraction, Mel frequency cepstral coefficients, speaker matching, Gaussian mixture model, NIST speaker Recognition Evaluation Program, Introduction to multimodal biometric system – Integration strategies – Architecture – level of fusion – combination strategy, examples of multimodal biometric systems, Securing andtrusting a biometric transaction – matching location – local host - authentication server – match oncard (MOC).

**TOTAL: 45PERIODS**

**COURSE OUTCOMES:**

**At the end of the course, the student will be able to**

CO1: Demonstrate the principles of biometric systems.
CO2: Develop fingerprint recognition technique.
CO3: Design face recognition and hand geometry system.
CO4: Design iris recognition system.
CO5: Develop speech recognition and multimodal biometric systems.

**TEXT BOOKS:**


1. James Wayman& Anil Jain, "Biometric Systems- Technology Design and Performance Evaluation", SPRINGER (SIE), 1st Edition, 2011.
2. Paul Reid, "Biometrics for Network Security", Pearson Education, 2004.


**REFERENCES:**


1. Nalini K Ratha, Ruud Bolle, "Automatic fingerprint recognition system'', Springer, 2003.
2. L C Jain, I Hayashi, S B Lee, U Halici, "Intelligent Biometric Techniques in Fingerprint and Face Recognition", CRC Press, 1st Edition, 1999.
3. S.Y. Kung, S.H. Lin, M.W., "Biometric Authentication: A Machine Learning Approach", Prentice Hall, 2004.
4. John Chirillo, Scott Blaul, "Implementing Biometric Security", John Wiley & Sons, 2003.


| COURSE OUTCOMES | PROGRAMME OUTCOMES | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | | | | | | | | | | | | | 3 | |
| CO2 | 3 | 3 | | | | | | | | | | | | 3 | |
| CO3 | 3 | 3 | | | 2 | | | | | | | | | 3 | |
| CO4 | 3 | 3 | | | 2 | | | | | | | | | 3 | |
| CO5 | 3 | 3 | 3 | | 2 | | | | | | | | | 3 | |
| Avg | 3 | 3 | 3 | | 2 | | | | | | | | | 3 | |

**BM7006** **BODY AREA NETWORKS** **L T P C**

**3 0 0 3**

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To know the hardware requirement of BAN
- To understand the communication and security aspects in the BAN
- To know the applications of BAN in the field of medicine

**UNIT I INTRODUCTION** **9**

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

**UNIT II HARDWARE FOR BAN 9**

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

**UNIT III WIRELESS COMMUNICATION AND NETWORK 9**

RF communication in Body, Antenna design and testing, Propagation, Base Station-Networktopology-Stand –Alone BAN, Wireless personal Area Network Technologies-IEEE 802.15.1,IEEE P802.15.13, IEEE 802.15.14, Zigbee

**UNIT IV COEXISTENCE ISSUES WITH BAN 9**

Interferences — Intrinsic - Extrinsic, Effect on transmission, Counter measures- on physical layer and data link layer, Regulatory issues-Medical Device regulation in USA and Asia, Security and Self protection-Bacterial attacks, Virus infection ,Secured protocols, Self protection.

**UNIT V APPLICATIONS OF BAN 9**

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

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

**At the end of the course the student will be able to**

CO1: Understand the concept of Body Area Network.
CO2: Design a BAN for appropriate application in medicine.
CO3: Assess the efficiency of communication and the security parameters.
CO4: Understand the need for medical device regulation and regulations followed in various regions.
CO5: Extend the concepts of BAN for medical applications.

**TEXT BOOKS:**


1. Annalisa Bonfiglio, Danilo De Rossi, "Wearable Monitoring Systems", Springer, 2011.
2. Sandeep K.S. Gupta,Tridib Mukherjee, Krishna Kumar Venkata Subramanian, "Body Area Networks Safety, Security, and Sustainability'', Cambridge University Press, 2013.


**REFERENCES:**


1. Zhang, Yuan-Ting, "Wearable Medical Sensors and Systems'', Springer, 2013.
2. Guang-Zhong Yang(Ed.), "Body Sensor Networks'', Springer, 2006.
3. Mehmet R. Yuce, Jamil Y.Khan, "Wireless Body Area Networks Technology, Implementation, and Applications", Pan Stanford Publishing Pte. Ltd., Singapore, 2012.


| | PO 1 | PO 2 | PO 3 | PO 4 | PO5 | PO 6 | PO7 | PO8 | PO9 | PO10 | PO1 1 | PO1 2 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | | | | | | | | | | | | | 3 |
| **CO2** | 3 | 3 | | | | | | | | | | | | | 3 |
| **CO3** | 3 | 3 | | | | 2 | 2 | | | | | | | | 3 |
| **CO4** | 3 | 3 | | | | 2 | 2 | | | | | | | | 3 |
| **CO5** | 3 | 3 | | | | 2 | 2 | | | | | | | | 3 |
| **Average** | 3 | 3 | | | | 2 | 2 | | | | | | | | 3 |

**BM7007 BRAIN COMPUTER INTERFACE AND APPLICATIONS L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To understand the basic concepts of brain computer interface
- To study the various signal acquisition methods
- To study the signal processing methods used in BCI

**UNIT I INTRODUCTION TO BCI 9**

Fundamentals of BCI – Structure of BCI system – Classification of BCI – Invasive, Non-invasiveand Partially invasive BCI – EEG signal acquisition - Signal Preprocessing – Artifacts removal.

**UNIT II ELECTROPHYSIOLOGICAL SOURCES 9**

Sensorimotor activity – Mu rhythm, Movement Related Potentials – Slow Cortical Potentials-P300 - Visual Evoked Potential - Activity of Neural Cells - Multiple Neuromechanisms.

**UNIT III FEATURE EXTRACTION METHODS 9**

Time/Space Methods — Fourier Transform, PSD — Wavelets — Parametric Methods —AR,MA,ARMA models – PCA – Linear and Non-Linear Features.

**UNIT IV FEATURE TRANSLATION METHODS 9**

Linear Discriminant Analysis – Support Vector Machines - Regression – Vector Quantization–Gaussian Mixture Modeling – Hidden Markov Modeling – Neural Networks.

**UNIT V APPLICATIONS OF BCI 9**

Functional restoration using Neuroprosthesis - Functional Electrical Stimulation, Visual Feedbackand control - External device controllers, Case study of Brain actuated control of mobile Robot.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

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

CO1: Describe BCI system and its potential applications.
CO2: Analyze event related potentials and sensory motor rhythms.
CO3: Compute features suitable for BCI.
CO4: Design classifier for a BCI system.
CO5: Implement BCI for various applications.

**TEXT BOOKS:**

1. R. Spehlmann, “EEG Primer”, Elsevier Biomedical Press, 1981.
2. Bernhard Graimann, Brendan Allison, Gert Pfurtscheller, “Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction”, Springer, 2010.

**REFERENCES:**

1. Arnon Kohen, “Biomedical Signal Processing”, Vol I and II, CRC Press Inc, Boca Rato, Florida, 1986.
2. Bishop C.M., “Neural Networks for Pattern Recognition”, Oxford, Clarendon Press, 1995.

| COURSE OUTCOMES | PROGRAMME OUTCOMES | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | | | | | | | | | | | | | | 3 |
| CO2 | 3 | 3 | | | 2 | | | | | | | | | | 3 |
| CO3 | 3 | 3 | | | 2 | | | | | | | | | | 3 |
| CO4 | 3 | 3 | 2 | | | | | | | | | | | | 3 |
| CO5 | 3 | 3 | 2 | 2 | | | | | | | | | | | 3 |
| Avg | 3 | 3 | 2 | 2 | 2 | | | | | | | | | | 3 |

**BM7008 COMPUTER HARDWARE AND INTERFACING L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To Introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues.
- The student should be made to Learn advanced 8086 family of processors, motherboards, PCbased data acquisition and troubleshooting of PCs.

**UNIT I INTEL ADVANCED PROCESSORS 9**

8086, 80186, 80286, 80386, 80486 -Architecture, Memory management.

**UNIT II PENTIUM PROCESSORS 9**

Pentium Architecture- Memory Management- Pentium Pro microprocessors – Pentium II,Pentium III, Pentium 4 – Special features and software changes.

**UNIT III PC HARDWARE OVERVIEW 9**

Functional units & Interconnection, New generation motherboards 286 to Pentium 4 Bus interface — ISA — EISA- VESA- PCI- PCIX, Memory and I/O port addresses, Peripheral interfaces and controller.

**UNIT IV PC BASED DATA ACQUISTION 9**

Plug in data acquisition and control boards and programming- ADC, DAC, Digital I/O board and Timing Board, Serial port and parallel port programming. Data acquisition and programming usingserial interfaces- PC and microcontroller serial ports, USB and IEEE 1394, Virtual lab tools.

**UNIT V TROUBLESHOOTING, MAINTAINING & REPAIRING 9**

Memory troubleshooting, Monitor troubleshooting, Motherboard troubleshooting, Port troubleshooting, Sound Boards and Video adapters troubleshooting, USB troubleshooting.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

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

CO1: Explain the concept of 8086 family of processors. CO2: Understand motherboards concepts.
CO3: Able to troubleshoot the PCs.
CO4: Understand the concepts of peripheral controllers.
CO5: Known PC based data acquisition.

**TEXT BOOKS:**

1. B. Govindarajalu, "IBM PC and clones Hardware, Trouble Shooting and Maintanance", Second Edition, Tata McGraw Hill, New Delhi, 2005.
2. N.Mathivanan, "PC –Based Instrumentation Concepts and Practice", Prentice Hall of India, New Delhi, 2007.

**REFERENCES:**

1. Douglus V.Hall, "Microprocessors and Interfacing, Programming and Hardware". Revised second Edition, Indian Edition. Tata McGraw Hill, New Delhi, 2007.
2. A.K.Ray, K.M. Bhurchandi, "Advanced microprocessors and peripherals", 2nd Edition, Tata Mc Graw Hill 2006.
3. Stephen J. Bigelow, "Troubleshooting, Maintaining & Repairing", Tata Mc Graw Hill Edition, 5th Edition.

| | PO 1 | PO 2 | PO 3 | PO 4 | PO5 | PO 6 | PO7 | PO8 | PO9 | PO10 | PO1 1 | PO1 2 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | | | | | | | | | | | 3 | | |
| **CO2** | 3 | 2 | | | | | | | | | | | 3 | | |
| **CO3** | 3 | 2 | | | | | | | | | | | 3 | | |
| **CO4** | 3 | 2 | | | | | | | | | | | 3 | | |
| **CO5** | 3 | 2 | | | | | | | | | | | 3 | | |
| **Average** | 3 | 2 | | | | | | | | | | | 3 | | |

**BM7009 MEDICAL OPTICS L T P C**

**3 0 0 3**

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- The student should be made to study about the optical properties of the tissues and theapplications of laser in diagnosis and therapy.

**UNIT I OPTICAL PROPERTIES OF THE TISSUES 9**

Refraction, Scattering, Absorption, Light transport inside the tissue, Tissue properties, Laser Characteristics as applied to medicine and biology-Laser tissue Interaction-Chemical-Thermal-Electromechanical – Photoabalative processes.

**UNIT II INSTRUMENTATION IN PHOTONICS 9**

Instrumentation for absorption, Scattering and emission measurements, excitation light sources – high pressure arc lamp, LEDs, Lasers, Optical filters, - optical detectors - Time resolved and phase resolved detectors.

**UNIT III SURGICAL APPLICATIONS OF LASERS** **9**

Lasers in ophthalmology- Dermatology –Dentistry-Urology-Otolaryngology- Tissue welding.

**UNIT IV NON THERMAL DIAGNOSTIC APPLICATIONS** **9**

Optical coherence tomography, Elastography, Laser Induced Fluorescence (LIF)-Imaging,FLIM Raman Spectroscopy and Imaging, FLIM — Holographic and speckle application of lasers in biology and medicine.

**UNIT V THERAPEUTIC APPLICATIONS** **9**

Phototherapy, Photodynamic therapy (PDT) - Principle and mechanism - Oncological and non-oncological applications of PDT - Biostimulation effect – applications-Laser Safety Procedures.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

**At the end of the course, the student will be able to**

CO1: Explain the concepts of photonics interaction with tissues
CO2: Demonstrate knowledge of the fundamentals of optical properties of tissues.
CO3: Describe surgical applications of laser.
CO4: Describe photonics and its therapeutic applications.
CO5: Apply the concepts of laser and light to understand the laser safety procedures.

**TEXT BOOKS:**

1. Markolf H.Niemz, “Laser-Tissue Interaction Fundamentals and Applications”, Springer, 2007.
2. Paras N. Prasad, “Introduction to Bio photonics”, A. John Wiley and sons, Inc. Publications, 2003.

**REFERENCES:**

1. Tuan Vo Dinh, “Biomedical photonics – Handbook”, CRC Press LLC, 2003.
2. Mark E. Brezinski, “Optical Coherence Tomography: Principles and Applications”, Academic Press, 2006.
3. R. Splinter and B.A. Hooper, “An Introduction to Biomedical Optics”, Taylor and Francis, 2007.
4. Helena Jelinkova, “Lasers for Medical Applications: Diagnostics, Therapy and Surgery’’, Woodhead Publishing, 1st Edition, 2013.

| COURSE OUTCOMES | PROGRAMME OUTCOMES | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 2 | | | | | | | | | | | 3 | | |
| CO2 | 3 | 2 | | | | | | | | | | | 3 | | |
| CO3 | 3 | 2 | | | | | | | | | | | 3 | | |
| CO4 | 3 | 2 | | | | | | | | | | | 3 | | |
| CO5 | 3 | 2 | | | | | | 2 | | | | | 3 | | |
| Avg | 3 | 2 | | | | | | 2 | | | | | 3 | | |

**BM7010 MEDICAL PHYSICS L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To study effects of sound and light in human body
- To understand the effects of radiation in matter and how isotopes are produced

**UNIT I NON IONIZING RADIATION AND ITS MEDICAL APPLICATION 9**

Overview of non-ionizing radiation effects-Low Frequency Effects- Higher frequency effects. Thermography — Application. Ultrasound Transducer - Interaction of Ultrasound with matter; Cavitations , Conditions for reflection, Transmission-Scanning systems – Artefacts- Ultrasound- Doppler-Double Doppler shift Clinical Applications.

**UNIT II PRINCIPLES OF RADIOACTIVE NUCLIDES 9**

Radioactive Decay – Spontaneous Emission – Isometric Transition – Gamma ray emission, alpha, beta, Positron decay, electron capture, Sources of Radioisotopes Natural and Artificial radioactivity, Radionuclide used in Medicine and Technology ,Decay series, Production of radionuclides – Cyclotron produced Radionuclide- Reactor produced Radio- nuclide-fission and electron Capture reaction, radionuclide Generator-Milking process (Technetium generator)

**UNIT III INTERACTION OF RADIATION WITH MATTER 9**

Interaction of charged particles with matter –Specific ionization, Linear energy transfer range, Bremsstrahlung, Annihilation, Interaction of X and Gamma radiation with matter- Photoelectric effect, Compton Scattering , Pair production, Attenuation of Gamma Radiation ,Interaction of neutron with matter and their clinical significance.

**UNIT IV PRINCIPLES OF RADIATION DETECTION AND DOSIMETERS 9**

Principles of radiation detection, Properties of dosimeters, Theory of gas filled detectors, IonizationChamber, Proportional chamber, G.M. Counter, Film dosimetry, luminescence dosimetry, scintillation detectors, Radiation detection instruments, Area survey meters, Personal Radiation monitoring device, Film badge, TLD, OSLD.

**UNIT V BASIC RADIATION QUANTITIES 9**

Introduction -exposure- Inverse square law-KERMA-Kerma and absorbed dose -stopping power - relationship between the dosimetric quantities - Bremsstrahlung radiation, Bragg‟s curve- concept of LD 50- Stochastic and Non-stochastic effects, Different radiation Unit, Roentgen, gray, Sievert.

**TOTAL: 45 PERIODS.**

**COURSE OUTCOMES:**

**At the end of the course, the student will be able to**

CO1: Explain the basic concepts of medical physics.
CO2: Discuss the effect of non ionising radiation in human body and applications in the field of medicine.
CO3: Understand radioactive decay and production of radio nuclides.
CO4: Discuss the measurement of ionizing radiation.
CO5: Enumerate the effect of ionising radiation in human body.

**TEXT BOOKS:**

1. JohnR Cameron, James G Skofronick, "Medical Physics",John-Wiley&Sons,1978.
2. W.J.Meredith andJ.B. Massey, "Fundamental Physics of Radiology" Varghese Publishing house.1992.

**REFERENCES:**

1. P.Uma Devi, A.Nagarathnam, BS Satish Rao, " Introduction to Radiation Biology", B.I Chur Chill Livingstone Pvt. Ltd, 2000.
2. S.Webb, "The Physics of Medical Imaging", Taylor and Francis, 1988.
3. J.P.Woodcock, Ultrasonic, "Medical Physics Handbook series 1",Adam Hilger, Bristol, 2002.
4. Hylton B.Meire and Pat Farrant, "Basic Ultrasound", John Wiley & Sons, 1995.

| COURSE OUTCOMES | PROGRAMME OUTCOMES | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | | | | | 2 | | 2 | | | | | 3 | | |
| CO2 | 3 | | | | | 2 | | 2 | | | | | 3 | | |
| CO3 | 3 | | | | | 2 | | 2 | | | | | 3 | | |
| CO4 | 3 | | | | | 2 | | 2 | | | | | 3 | | |
| CO5 | 3 | | | | | 2 | | 2 | | | | | 3 | | |
| Avg | 3 | | | | | 2 | | 2 | | | | | 3 | | |

**BM7011 MEMS AND ITS BIOMEDICAL APPLICATIONS L T P C**

**3 0 0 3**

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To learn various MEMS fabrication techniques.
- To understand different types of sensors and actuators and their principles of operation atthe micro scale level.
- To know the applications of MEMS in different fields of medicine

**UNIT I MEMS MATERIALS AND FABRICATION 9**

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

## UNIT II MECHANICAL AND THERMAL SENSORS AND ACTUATORS 9

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

## UNIT III ELECTROSTATIC AND PIEZOELECTRIC SENSORS AND ACTUATORS 9

Parallel plate capacitor, pull in effect, Electrostatic sensors and actuators- Inertia sensor, Pressure sensor, flow sensor, tactile sensor, comb drive. Properties of piezoelectric materials, Piezoelectric sensor and actuator — inchworm motor, inertia sensor, flow sensor.

## UNIT IV MICROFLUIDIC SYSTEMS 9

Fluid dynamics, continuity equation, momentum equation, equation of motion, laminar flow in circular conduits, fluid flow in microconduits, in submicrometer and nanoscale. Microscale fluid, expression for liquid flow in a channel. Fluid actuation methods- electro wetting, thermocapillary effect, electro osmosis, dielectrophoresis. Microfluid dispenser, microneedle, micro pumps- continuous flow system, micromixers.

## UNIT V APPLICATIONS OF BIOMEMS 9

CAD for MEMs, Drug delivery, micro total analysis systems (MicroTAS) detection and measurement methods, microsystem approaches to polymerase chain reaction (PCR),DNA sensor, MEMS based drug delivery, electronic nose.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

**At the end of the course, the student will be able to**

CO1: Discuss various MEMS fabrication techniques.
CO2: Explain different types of sensors and actuators and their principles of operation at the micro scale level.
CO3: Comprehend the characteristics of fluid flow and actuation through micro channels.
CO4: Explain the need and use of CAD for MEMS design.
CO5: Design MEMS devices for different medical applications.

**TEXT BOOKS:**


1. Chang Liu, " Foundations of MEMS", Pearson Education International, New Jersey, USA, 2nd Edition, 2011.
2. Tai Ran Hsu , "MEMS and Microsystems design and manufacture", Tata McGraw Hill Publishing Company, New Delhi, 2002


**REFERENCES:**


1. Wanjun Wang, Stephen A.Soper, "BioMEMS: Technologies and applications", CRC Press, New York, 2007
2. Marc J. Madou, "Fundamentals of Microfabrication: the science of miniaturization'', CRC Press, 2002.
3. Nadim Maluf, Kirt Williams, "An Introduction to Microelectro mechanical Systems Engineering", Second Edition, Artech House Inc, MA, 2004.
4. Nitaigour Premchand Mahalik, "MEMS", Tata McGraw Hill Publishing Company, New Delhi, 2007.

| COURSE OUTCOMES | PROGRAMME OUTCOMES | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO10 | PO11 | PO12 | PSO 1 | PSO 2 | PSO 3 |
| CO1 | 3 | 3 | 2 | | | | | | | | | | | | 3 |
| CO2 | 3 | 3 | 2 | | | | | | | | | | | | 3 |
| CO3 | 3 | 3 | 2 | | | | | | | | | | | | 3 |
| CO4 | 3 | 3 | 2 | | | | | | | | | | | | 3 |
| CO5 | 3 | 3 | 2 | | 2 | | | | | | | | | | 3 |
| Avg | 3 | 3 | 2 | | 2 | | | | | | | | | | 3 |

**BM7012 NEURAL ENGINEERING L T P C**

**3 0 0 3**

**OBJECTIVES:**

- To be familiar with the nervous system development
- To be exposed to neuronal diseases and disorders
- To be familiar with nerve reconstruction and repairing

**UNIT I BASICS OF NEURON STRUCTURE AND FUNCTIONS 9**

Nervous system development. Trophic factors, extra cellular matrix components in nervous system development. Neuron: structure – function – classification. Glial cells – myelination- Neurotransmitter – types and functions. Synapses - Transport of materials and impulse in neurons; Blood Brain barrier.

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

Brain: structures – lobes – functional areas. Brain stem: structures – functional areas. Spinal cord:structure – functions. Concepts of nuclei – sensory and motor Tracts - Reticular formation. Bloodsupply to Brain and spinal cord.

**UNIT III NEUROPHYSIOLOGY & NEURORADIOLOGY 9**

Physiology of nerve conduction. Peripheral nerves — structure & Functions. Synaptic transmission and cellular signaling of Neurons. Electrical activity of the Brain and recording of brain waves. Evoked potentials. Visualization of nervous system.

**UNIT IV NEURONAL DISEASES AND DISORDERS 9**

Neuro degeneration: Degenerative, Demyelinated and injury related disorders associated with nervous system. Wallerian Degeneration. Neuronal plasticity –CNS acting drugs and their pharmacokinetics. Alzheimer‘s, Parkinson‘s and Prion diseases.

**UNIT V NERVE RECONSTRUCTION AND REPAIRING 9**

Regeneration of the peripheral nervous system. Nerve graft; Neural tissue engineering; Drug delivery system in CNS. Cognitive & neurobehavioral rehabilitation.

**TOTAL : 45 PERIODS**

**COURSE OUTCOMES:**

**Upon Completion of the course, the students will be able to**

CO1: Explain the basic structure and functions of human nervous system.

CO2: Understand diseases and degeneration related to nervous system.
CO3: Analyze visualization and radiological assessment of nervous system.
CO4: Apply neural tissue engineering for rehabilitation.
CO5: Discuss about Regeneration of nervous system.

**TEXT BOOKS:**


1. Mathews G.G., "Neurobiology", 2nd edition, Blackwell Science, UK, 2000.
2. Malcom Carpenter, "Textbooks of Neuroanatomy", Mc. Graw hill Edition, 1996.


**REFERENCES:**


1. W. Mark Saltzman, "Tissue Engineering – Engineering principles for design of replacement organs and tissue'', Oxford University Press Inc New York, 2004.
2. Park J.B., "ACS Biomaterials Science and Engineering", Plenum Press, 2014. Saunders, 2006.


| COURSE OUTCOMES | PROGRAMME OUTCOMES | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | | | | | | | | | | | | 3 | | 3 |
| CO2 | 3 | | | | | | | | | | | | 3 | | 3 |
| CO3 | 3 | 2 | | | | | | | | | | | 3 | | 3 |
| CO4 | 3 | 2 | | | | | | | | | | | 3 | | 3 |
| CO5 | 3 | | | | | | | | | | | | 3 | | 3 |
| Avg | 3 | 2 | | | | | | | | | | | 3 | | 3 |

**BM7013 PHYSIOLOGICAL MODELING L T P C**

**3 0 0 3**

**OBJECTIVES:**

- To understand the application of Physiological models and Vital organs.
- To understand methods and techniques for analysis and synthesis of dynamic models
- To model dynamically varying physiological system
- To develop differential equations to describe the dynamic models
- To simulate and visualize, dynamic responses of physiological models using software.

**UNIT I SYSTEM CONCEPT 9**

Introduction to Physiological control systems, Purpose of physiological modeling and signal analysis, Illustration- example of a physiological control system. Difference between engineering and physiological control systems. System variables and properties- Resistance — both static and dynamic, Compliance and combination of resistance and compliance. Resistance and compliance models - respiratory system, aortic segments, lumped model of physiological thermal system, step response of resistance-compliance system — dye dilution study of circulation

**UNIT II SYSTEM ANALYSIS 9**

Review of transfer function, transfer function of coupled system. Impedance based transfer function - flexible tube feeding a single port compliant model, development of a lung model. Periodic signals: sinusoidal analysis

of second order system, analysis of respiratory system based on sinusoidal excitation, pendelluft.

**UNIT III TRANSIENT AND FEEDBACK 9**

Review of transient and stability analysis. Homeostasis, representation, finger tracking. Characterization of Physiological Feedback systems- Hypophysis adrenal systems. Non linear systems and linearization - transfer function analysis of pupillary control system as a closed loop and method of opening the closed loop, pupillary hippus.

**UNIT IV MODELING OF CARDIO PULMONARY SYSTEM 9**

Model of cardiac output regulation - Starling‘s law, Physical Significance of under damped responses of post systolic operations in aortic arch, model of circadian rhythms, chemical regulation of ventilation, Cheyne-Stoke breathing, biot breathing.

**UNIT V OTHER PHYSIOLOGICAL MODELS AND SIMULATION 9**

Steady state analysis of regulation of glucose, Hodgin-Huxley model, Thermal system — model and simulation, modeling of eye movement- types of eye movement, saccade model, model ofocculomotor control. , introduction to digital control system.

**TOTAL: 45PERIODS**

**COURSE OUTCOMES:**

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

CO1: Explain application of Physiological models.
CO2: Model dynamically varying physiological system.
CO3: Analyze and synthesize dynamic models of physiological system.
CO4: Develop differential equations to describe the dynamic models, simulate and visualize.
CO5: Implement physiological models using software to get dynamic responses.

**TEXT BOOKS :**


1. William B.Blesser, “A System Approach to Biomedicine”, McGraw Hill Book Co., New York, 1969.
2. Micheal C.K.Khoo ,“Physiological Control System Analysis, Simulation and Estimation”, Prentice Hall of India , New Delhi ,2001.


**REFERENCES:**


1. Manfreo Clynes and John H.Milsum, “Biomedical Engineering System”, McGraw Hilland Co., New York ,1970.
2. Richard Skalak and ShuChien, “Hand Book of Biomedical Engineering” , McGraw Hilland Co., New York, 1987.
3. Douglas S.Rigg, “Control Theory and Physiological Feedback Mechanism”, The Wilkliam and Wilkins Co. Baltimore, 1970.
4. Joseph D,Bronzino, “’The Biomedical Engineering Handbook”, CRC Press,3rd Edition, 2006.
5. ChristofKoch, “”Biophysics of Computation”, Oxford University Press, 2004.
6. F.C. Hoppensteadt and C.S.Peskin, "Modeling and Simulation in Medicine and the Life Sciences" Springer, 2nd Edition, 2002.

| COURSE OUTCOMES | PROGRAMME OUTCOMES | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 3 | 2 | | 2 | | | | | | | | | 3 | 3 |
| CO2 | 3 | 3 | 2 | | 2 | | | | | | | | | 3 | 3 |
| CO3 | 3 | 3 | 2 | | | | | | | | | | | 3 | 3 |
| CO4 | 3 | 3 | 2 | | | | | | | | | | | 3 | 3 |
| CO5 | 3 | 3 | 2 | | 2 | | | | | | | 3 | | 3 | 3 |
| Avg | 3 | 3 | 2 | | 2 | | | | | | | 3 | | 3 | 3 |

**BM7014 PRINCIPLES OF TISSUE ENGINEERING L T P C**

**3 0 0 3**

**OBJECTIVES:**

- To study Cell cycle and differentiation
- To learn basics about stem cells and its applications
- To describe Different synthetic and biomaterials in tissue replacements

**UNIT I FUNDAMENTALS OF TISSUE ENGINEERING 9**

Tissue exchange and tissue development - Objectives of tissue engineering - Laboratory set up for tissue engineering. Cell cycle and differentiation - cell adhesion - cell adhesion molecules - cell migration - cell aggregation and tissue equivalent.

**UNIT II STEM CELLS 9**

Definition of stem cells — types of stem cells — differentiation, dedifferentiation maturation, proliferation, pleuripotency and immortalization. Sources of stem cells: haematopoetic — fetal - cord blood — placenta - bone marrow - primordial germ cells - cancer stem cells - induced pleuripotent stem cells.

**UNIT III COMPONENTS OF TISSUE ENGINEERING 9**

Cell and Drug delivery systems - Transplantation — Implantation - Synthetic components– nanotechnology in tissue engineering – Imaging methods: SEM, TEM, Fluorescent and Confocal microscopy.

**UNIT IV MATERIALS IN TISSUE ENGINEERING 9**

Biological materials – degradable and non degradable – extra cellular matrix – decellularization - Polymers: synthetic and natural – cell interaction with polymers – applications of polymer.

**UNIT V APPLICATION OF TISSUE ENGINEERING 9**

Replacement Engineering: Artificial organs – cartilage, skin blood, pancreas, kidney and liver. Regenerative engineering: peripheral Nerve regeneration – cardiac tissue regeneration – muscle regeneration.

**TOTAL : 45 PERIODS**

**COURSE OUTCOMES:**

**After the completion of these course students will be able to**

CO1: Understand the basic concepts of tissue engineering

CO2: Acquire ability to function on multi-disciplinary teams

CO3: Apply the knowledge of professional and ethical responsibility in use of stem cells and gene therapy in creating tissue engineered therapies.

CO4: Design and develop different biomaterial in tissue engineering application.

CO5: Gain knowledge in research or clinical application on tissue repair/ engineering.

**TEXT BOOKS:**

1. W. Mark Saltzman, "Tissue Engineering – Engineering principles for design of replacement organs and tissue",Oxford University Press Inc New York, 2004.
2. CS Potten, "Stem cells", Elsevier, 1996.

**REFERENCES:**

1. Gary E. Wnek, Gary L Browlin , "Encyclopedia of Biomaterials and Biomedical Engineering",Marcel Dekker Inc, New York, 2008.
2. R. Lanza, Anthony Atala (Eds), "Essential of Stem Cell Biology", Academic Press, USA, 2013.
3. R. Lanza, Anthony Atala," Handbook of Stem Cells", Academic Press, USA, 2012.

| COURSE OUTCOMES | PROGRAMME OUTCOMES | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | | | | | | | | | | | | | | 3 |
| CO2 | 3 | | | | | | | | | | | | | | 3 |
| CO3 | 3 | | | | | | | | | | | | | | 3 |
| CO4 | 3 | 2 | | | | | | | | | | | | | 3 |
| CO5 | 3 | 2 | | | | | | | | | | | | | 3 |
| Avg | 3 | 2 | | | | | | | | | | | | | 3 |

**BM7015 REHABILITATION ENGINEERING** **L T P C**
**3 0 0 3**



**OBJECTIVES:**

- To explain the need for medical aids.
- To understand the sensory rehabilitation systems.
- To learn the use of the orthopedic prosthetics and orthotics in rehabilitation.
- To have an understanding of rehabilitation medicine and advocacy.

**UNIT I INTRODUCTION** **9**

Definition - Impairments, disabilities and handicaps, rehabilitation engineering. Measurement and assessment. Rehabilitation Engineering - Fundamental principles, structure, function, performance and behavior. Subjective and objective measurement methods.

**UNIT II ENGINEERING CONCEPTS IN SENSORY REHABILITATION**

**ENGINEERING** **9**

Sensory augmentation and substitution- Visual system: Visual augmentation, Tactual vision substitution, and Auditory vision substitution. Auditory system- Auditory augmentation, Hearing aids, cochlear implants, visual auditory substitution, tactual auditory substitution. Tactual system- Tactual augmentation, Tactual substitution, Computerized wheel chairs.

**UNIT III ORTHOPEDIC PROSTHETICS AND ORTHOTICS IN REHABILITATION 9**

Engineering concepts in motor rehabilitation, Artificial limbs- body powered, externally powered and controlled orthotics and prosthetics, Myoelectric hand and arm prosthetics. Functional Electrical Stimulation systems-Restoration of hand function, restoration of standing and walking, Hybrid Assistive Systems (HAS).

**UNIT IV VIRTUAL REALITY IN REHABILITATION 9**

Introduction to virtual reality, Virtual reality based rehabilitation, Hand motor recovery systems with Phantom haptics, Robotics and Virtual Reality Applications in Mobility Rehabilitation.

**UNIT V REHABILITATION MEDICINE AND ADVOCACY 9**

Physiological aspects of Function recovery, Psychological aspects of Rehabilitation therapy, Legal aspect available in choosing the device and provision available in education, job and in day-to-day life.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

**At the end of the course, the student will be able to**

CO1: Understand the key terminologies used by the rehabilitation team.

CO2: Devise new concepts for future development and applications.

CO3: Design and develop different sensory assist devices, orthotics and prosthetics for rehabilitation applications.

CO4: Understand the need of virtual reality tools for different aids.

CO5: Appreciate the legal aspects for building rehabilitation aids for the needed people.

**TEXT BOOKS:**

1. Joseph D Bronzino, “The Biomedical Engineering Handbook”. 2nd edition, CRC Press,2000.
2. Robinson C.J, “Rehabilitation Engineering”, CRC Press , 2006.

**REFERENCES:**

1. Sashi S Kommu, “Rehabilitation Robotics”, 1st edition, CRC Press, 2007.
2. Sunder, “Textbooks of Rehabilitation”, Jaypee Brothers Medical Publishers Pvt. Ltd, New Delhi, 2nd Edition, Reprint 2007.
3. Horia- Nocholai Teodorecu, L.C.Jain, “Intelligent systems and technologies in rehabilitation Engineering”, CRC; December 2000.
4. Etienne Grandjean, Harold Oldroyd, “Fitting the task to the man”, Taylor & Francis,1988.
5. Keswick. J., “what is Rehabilitation Engineering, Annual Reviews of Rehabilitation”, Springer-Verlag, New York, 1982.
6. Warren E. Finn, Peter G. Lopressor, “Handbook of Neuroprosthetic Methods”,CRC, 2002.
7. Rory A Cooper (Editor), Hisaichi Ohnabe (Editor), Douglas A. Hobson (Editor), “An Introduction to Rehabilitation Engineering (Series in Medical Physics and Biomedical Engineering” CRC Press, 2006.

| COURSE OUTCOMES | PROGRAMME OUTCOMES | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | | | | | 2 | | | | | | | | | 3 |
| CO2 | 3 | 2 | 2 | | | | | | | | | | | | 3 |
| CO3 | 3 | 2 | 2 | | | | | | | | | | | | 3 |
| CO4 | 3 | 2 | | | | | | | | | | | | | 3 |
| CO5 | 3 | 2 | | | | 2 | | 2 | | | | | | | 3 |
| Avg | 3 | 2 | 2 | | | 2 | | 2 | | | | | | | 3 |

**BM7016** **VIRTUAL REALITY** **L T P C**

**3 0 0 3**

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To impart the fundamental aspects, principles of virtual reality technology
- To gain knowledge about applications of virtual reality

**UNIT I INTRODUCTION** **10**

The three I's of virtual reality-commercial VR technology and the five classic components of a VR system - **Input Devices :**(Trackers, Navigation, and Gesture Interfaces): Three-dimensional position trackers, navigation and manipulation-interfaces and gesture interfaces-**Output Devices:** Graphics displays-sound displays & haptic feedback.

**UNIT II MODELING** **9**

Geometric modeling - kinematics modeling- physical modeling - behavior modeling - model management.

**UNIT III HUMAN FACTORS** **8**

Methodology and terminology-user performance studies-VR health and safety issues-Usability of virtual reality system- cyber sickness -side effects of exposures to virtual reality environment

**UNIT IV VR PROGRAMMING** **10**

Introducing Java 3D-loading and manipulating external models-using a lathe to make shapes. 3D Sprites-animated 3D sprites-particle systems.

**UNIT V APPLICATIONS** **8**

Medical applications--robotics applications- Advanced Real time Tracking-other applications- games, movies, simulations, therapy

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

**At the end of the course the student will be able to**

CO1: Understand the basic concepts of Virtual reality.
CO2: Understand the concept of modeling and management using Virtual Reality.
CO3: Expose the concept of Virtual Reality Programming with toolkits.
CO4: Design of various modeling concepts.
CO5: Develop the Virtual Reality applications in different areas.

**TEXT BOOKS:**

1. C. Burdea& Philippe Coiffet, "Virtual Reality Technology", Second Edition, Gregory, John Wiley & Sons, Inc.,2008.
2. Andrew Davison, "Killer Game Programming in Java", Oreilly SPD, 2005.

**REFERENCES:**

1. John Vince, "Introduction to Virtual Reality", Springer-Verlag Ltd., 2004.
2. William R.Sherman, Alan B.Craig, "Understanding Virtual Reality – Interface, Application, Design", The Morgan Kaufmann Series, 2003.

| COURSE OUTCOMES | PROGRAMME OUTCOMES | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | | | | | | | | | | | | | | 3 |
| CO2 | 3 | 2 | | | | | | | | | | | | | 3 |
| CO3 | 3 | | | | | | | | | | | | | | 3 |
| CO4 | 3 | 2 | | | | | | | | | | | | | 3 |
| CO5 | 3 | 2 | 2 | | | | | | | | | | | | 3 |
| Avg | 3 | 2 | 2 | | | | | | | | | | | | 3 |

**BM7017 WEARABLE SYSTEMS L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To know the sensor and signal processing requirement of wearable systems
- To understand the communication and security aspects
- To know the level of energy involvement in wearable systems

**UNIT I SENSORS 9**

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

**UNIT II SIGNAL PROCESSING 9**

Wearability issues -physical shape and placement of sensor, Technical challenges - sensor design, signal

acquisition, Constraint on sampling frequency for reduced energy consumption, lightweight signal processing, Rejection of irrelevant information, Data mining

**UNIT III ENERGY HARVESTING FOR WEARABLE DEVICES 9**

Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles.

**UNIT IV WIRELESS HEALTH SYSTEMS 9**

Need for wireless monitoring, Definition of Body area network, BAN and Healthcare, Technical Challenges- System security and reliability, BAN Architecture — Introduction, Wireless communication techniques.

**UNIT V APPLICATIONS OF WEARABLE SYSTEMS 9**

Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, Multi parameter monitoring, Neural recording, Gait analysis, Sports Medicine, Smart Fabrics

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

**At the end of the course student will be able to**

CO1 Selection of suitable sensors for development of wearable systems
CO2 Apply appropriate signal processing techniques for wearable systems
CO3 Assess the energy requirement for a wearable system and analyse and experiment energy harvesting techniques for wearable systems
CO4 Appreciate the need for BAN and the challenges involved in the design of BAN
CO5 Design basic wearable systems for medical applications

**TEXT BOOKS:**


1. Annalisa Bonfiglio, Danilo De Rossi, "Wearable Monitoring Systems", Springer,2011.
2. Sandeep K.S. Gupta, Tridib Mukherjee, Krishna Kumar Venkata subramanian, "Body Area Networks Safety, Security, and Sustainability," Cambridge University Press,2013.


**REFERENCES:**


1. Hang,Yuan-Ting, "Wearable medical sensors andsystems",Springer-2013.
2. Mehmet R. Yuce, Jamil Y. Khan, "Wireless Body Area Networks Technology, Implementation and Applications", Pan Stanford Publishing Pvt. Ltd, Singapore,2012.
3. Guang-Zhong Yang(Ed.), "Body Sensor Networks, "Springer,2006.
4. Andreas Lymberis, Danilo de Rossi ,'Wearable eHealth systems for Personalized Health Management - State of the art and future challenges ' IOS press, The Netherlands,2004.


| COURSE OUTCOMES | PROGRAMME OUTCOMES | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 2 | | | | | | | | | | | | | 3 |
| CO2 | 3 | 2 | | | | | | | | | | | | | 3 |
| CO3 | 3 | 2 | | | | | | | | | | | | | 3 |
| CO4 | 3 | 2 | | | | | | | | | | | | | 3 |
| CO5 | 3 | 2 | 2 | | | | | | | | | | | | 3 |
| Avg | 3 | 2 | 2 | | | | | | | | | | | | 3 |

**EC7022 INTERNET AND JAVA L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case

studies, simulations, contributions of scientist, national/internationalpolicies with a futuristic vision along with socio-economic impact and issues

- To introduce various concepts of internetworking with TCP/IP
- To introduce the principles of world wide web
- To introduce Java programming and Java script programming
- To teach students to develop simple web pages with data bases

**UNIT I INTERNET WORKING WITH TCP/IP 9**

Review of network technologies, Internet addressing, Address resolution protocols (ARP/ RARP), Routing IP data grams Reliable stream transport service (TCP) TCP/IP over ATM networks, Internet applications-E-mail, Telnet, FTP, NFS, Internet traffic management.

**UNIT II WORLD WIDE WEB 9**

HTTP protocol, Web browsers Netscape, Internet explorer, Web site and web page design, HTML,XHTML, XML, CSS, Dynamic HTML, CGI.

**UNIT III JAVASCRIPT PROGRAMMING 9**

Introduction, Control statements, Functions, Arrays and Objects – Programming

**UNIT IV JAVA PROGRAMMING 9**

Language features, Classes, Object and methods. Sub-classing and dynamic binding, Multithreading, Overview of class library, Object method serialization, Remote method invocation, Java Servelets and Javaserver pages.

**UNIT V WEB DESIGN AND DATABASES 9**

Macromedia Dream Weaver, Web Servers, Databases – SQL, MYSQL, DBI and ADO.NET, Webdesign

**TOTAL : 45 PERIODS**

**COURSE OUTCOMES:**

**Upon completion of the course, the student should be able to:**

CO1: Design problem solutions using Object Oriented Techniques.
CO2: Apply the concepts of polymorphism, overloading, and inheritance for problem solutions.
CO3: Use the concepts of Java for problem solving.
CO4: Examine important technologies that are being used today by web developers to build a wide variety of web applications.
CO5: To design web applications using Java, Servlets, XML.

**TEXT BOOKS:**


1. Paul Dietel and Harvey Deitel, "Java How to Program" Pearson Education, 10th Edition, 2016.
2. Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", Morgan Kaufmann Publishers Inc., 5th Edition, 2011.
3. Robert W. Sebesta, "Programming the World Wide Web", Addison Wesley, 8th Edition, 2015.


**REFERENCES:**


1. Y. Daniel Liang, "Introduction to Java Programming Comprehensive Version", Pearson Education, 10th Edition, 2014.
2. Sachin Malhotra, Sourabh Choudhary, "Programming in Java", Oxford University Press, 2nd Edition, 2018.
3. William Stallings, "Data and Computer Communications", Pearson Education, 10th Edition,2013.
4. Deitel and Deitel, "Internet and World Wide Web: How to Program", Pearson Education, 5th Edition, 2012.
5. http://www.w3schools.com

| COURSE OUTCOMES | PROGRAMME OUTCOMES | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 3 | 3 | | 2 | | | | | | | | 3 | | |
| CO2 | 3 | 3 | 3 | | 2 | | | | | | | | 3 | | |
| CO3 | 3 | 3 | 3 | | 2 | | | | | | | | 3 | | |
| CO4 | 3 | 3 | 3 | | 2 | | | | | | | | 3 | 2 | |
| CO5 | 3 | 3 | 3 | | 2 | | | | | | | | 3 | 2 | |
| Avg | 3 | 3 | 3 | | 2 | | | | | | | | 3 | 2 | |

**EC7071 ADVANCED MICROCONTROLLERS L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To introduce the concept of microcontroller based system development.
- To introduce the concept of RISC and CISC microcontrollers.
- To study the architecture of PIC, R8C and MSP430 family microcontrollers

**UNIT I RISC PROCESSORS 9**

RISC Vs CISC, RISC properties and evolution, Advanced RISC microcontrollers, PIC18xx microcontroller family, Architecture, Instruction set, ROM, RAM, Timer programming, Serial port programming, Interrupt programming, ADC and DAC interfacing, CCP module and programming.

**UNIT II CISC PROCESSORS 9**

RL78 16 BIT Microcontroller architecture, addressing modes, on-Chip memory, ADC, interrupts, MAC unit, Barrel shifter, internal and external clock generation, memory CRC, on chip debug function and self programming.

**UNIT III MSP430 16 - BIT MICROCONTROLLER 9**

The MSP430 Architecture, CPU Registers, Instruction Set, addressing modes, the MSP430 family viz. MSP430x2x, MSP430x4x, MSP430x5x. Low power aspects of MSP430 : low power modes, active Vs standby current consumption, FRAM Vs Flash for low power and reliability.

**UNIT IV PROGRAMMING AND PERIPHERAL INTERFACE USING MSP430 FAMILIES 9**

Memory mapped peripherals, I/O pin multiplexing, Timers, RTC, watchdog timer, PWM control, Analog interfacing and data acquisition, DMA, programming with above internal peripherals using optimal power consumption. Case study: Remote control of air conditioner and home appliances.

**UNIT V COMMUNICATION INTERFACE USING MSP 430 MICROCONTROLLER 9**

Serial and parallel communication, synchronous and asynchronous interfaces, Implementing and programming of : UART, I2C and SPI protocol. wireless connectivity : NFC, Zigbee, bluetooth and WiFi. MSP430 development tools. Case study: Implementing WiFi connectivity in smart electric meter.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

CO1: Ability to discriminate RISC and CISC processors, and work with PIC microcontrollers.
CO2: Ability to work with the 16 bit microcontroller RL78 and design microcontroller based systems for a Real world application.
CO3: Gaining design knowledge and concepts on MSP430 family of Microcontroller.
CO4: Ability to design real time systems by deploy the Interfacing peripherals.
CO5: Ability to design and develop microcontroller based smart electronic system and home appliances.

**TEXT BOOK:**

1. Alaxander G, James M. Conard, " Creating fast, Responsive and energy efficient Embedded systems using the Renesas RL78 microcontroller", micrium press, USA, reprinted by S.P Printers, Haryana, 2011.

**REFERENCES:**

1. Muhammad Ali Mazidi, Rolind D. Mckinlay and Danny Causey. "PIC Microcontroller and Embedded Systems", Pearson Education, 2008.
2. John H. Davies, "MSP 430 Micro controller basics", Elsevier, 2008.

| COURSE OUTCOMES | PROGRAMME OUTCOMES | | | | | | | | | | | | PSO | | |
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| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 3 | | | | | | | | | | | | | 3 |
| CO2 | 3 | 3 | | | | | | | | | | | | | 3 |
| CO3 | 3 | 3 | | | 2 | | | | | | | | | | 3 |
| CO4 | 3 | 3 | 3 | | 2 | | | | | | | 3 | | | 3 |
| CO5 | 3 | 3 | 3 | | 2 | | | | | | | 3 | | | 3 |
| Avg | 3 | 3 | 3 | | 2 | | | | | | | 3 | | | 3 |

**EC7072 CRYPTOGRAPHY AND NETWORK SECURITY L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To teach the importance of security for networks
- To teach the basics of number theory and Galois field concepts
- To teach symmetric and asymmetric key in crypto systems
- To teach authentication and key management techniques
- To teach security specific to network layer.

**UNIT I NUMBER THEORETIC AND ALGEBRAIC ALGORITHMS 9**

Significance of network and data security in todays communication scenario — Overall Classification- Integer Arithmetic Modular Arithmetic – matrices – Linear congruence- Substitution ciphers – Transposition ciphers – Stream cipher- Block ciphers – Algebraic structures – GF($2^n$) fields.

**UNIT II MODERN SYMMETRIC KEY CIPHERS 9**

Modern block ciphers – Modern stream ciphers – DES – AES – uses of modern block ciphers andstream cipher, Application Examples

**UNIT III ASYMMETRIC KEY ENCIPHERMENT 9**

Mathematics of cryptography – Primality Testing – Factorization – Chinese Remainder Theorem – Quadratic – Exponentiation & Logarithm – RSA, Rabin – Elliptic curve, Application Examples

**UNIT IV INTEGRITY AUTHENTICATION AND KEY MANAGEMENT** **9**

Message integrity – random oracle model – message authentication – SHA-512 – WHIRL POOL-Digital signature schemes Entity authentication– password — challenge response — zero knowledge – Biometrics – Kerberos – symmetric key management – public key distribution – steganography, Application Examples

**UNIT V NETWORK SECURITY** **9**

Security at the Application Layer: E-mail – PGP – S/MIME – Security at the transport layer: SSLand TLS – Security at the network layer: IPsec, Two Security Protocol – Security Association – Internet Key Exchange – ISAKMP, Application Examples.

**TOTAL : 45 PERIODS**

**COURSE OUTCOMES:**

CO1: Ability to comprehend and appreciate the significance and role of this course in the present contemporary world

CO2: The student would have gained the knowledge about the importance of security for networks, use of number theory and Galois field concepts.

CO3: The student would have ability to design new symmetric and Asymmetric key crypto system

CO4: The student would have ability to develop new authentication and key management techniques

CO5: The student would have ability to develop a new network security protocols

**TEXT BOOKS:**

1. Behrouz A. Ferouzan, "Cryptography & Network Security", 5th Edition, Tata McGraw Hill,.
2. W.Stallings, "Cryptography & Network Security: Principles and Practice", Prentice Hall, 4th Edition, 2003.

**REFERENCES:**

1. Douglas R.Stlinson, "Cryptography Theory and Practice", CRC Press series on Discrete Mathematics and its application 1995.
2. Charlie Kaufman, Radia Perlman, Mike Speciner, "Network Security Private Communication in a Public World", Pearson Education, 2nd Edition, 2003.

| COURSE OUTCOMES | PROGRAMME OUTCOMES | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 3 | 2 | | | | | | | | | | | | 3 |
| CO2 | 3 | 3 | 2 | | | | | | | | | | | | 3 |
| CO3 | 3 | 3 | 2 | | | | | | | | | | | | 3 |
| CO4 | 3 | 3 | 2 | | | | | | | | | | | | 3 |
| CO5 | 3 | 3 | 2 | | | | | | | | | | | | 3 |
| Avg | 3 | 3 | 2 | | | | | | | | | | | | 3 |

**EC7073 ELECTRO MAGNETIC INTERFERENCE AND COMPATIBILITY** **L T P C 3 0 0 3**

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision

along with socio-economic impact and issues

- To tutor the basics of EMI,EMC
- To instill knowledge on the EMI coupling mechanism and its mitigation techniques
- To impart comprehensive insight about the current EMC standards and about various measurement techniques.

**UNIT I BASIC CONCEPTS 7**

Definition of EMI and EMC; Intra and Inter system EMI; Sources and victims of EMI, Conducted and Radiated EMI emission and susceptibility; Transient & ESD; Case Histories; Radiation Hazards to humans.

**UNIT II COUPLING MECHANISM 9**

Common made coupling; Differential mode coupling; Common impedance coupling; Ground loop coupling; Field to cable coupling; Cable to cable coupling; Power mains and Power supply coupling.

**UNIT III EMI MITIGATION TECHNIQUES 10**

Shielding — principle, choice of materials for H, E and free space fields, and thickness; EMI gaskets; Bonding; Grounding — circuits, system and cable grounding; Filtering; Transient EMI control devices and applications; PCB Zoning, Component selection, mounting, trace routing.

**UNIT IV STANDARDS AND REGULATION 7**

Units of EMI; National and International EMI Standardizing Organizations — IEC, ANSI, FCC, CISPR, BIS, CENELEC; FCC standards; EN Emission and Susceptibility standards andspecifications; MIL461E Standards.

**UNIT V TEST METHODS AND INSTRUMENTATION 12**

EMI test sites - Open area site; TEM cell; Shielded chamber; Shielded Anechoic chamber; EMItest receivers; Spectrum Analyzer; Transient EMI Test wave Simulators; EMI coupling Networks - Line impedance Stabilization Networks; Feed through capacitors; Antennas and factors; Current probes and calibration factor; MIL-STD test methods; Civilian STD Test methods, Government policies.

**TOTAL : 45 PERIODS**

**COURSE OUTCOMES:**

**Ability to comprehend and appreciate the significance and role of this course in the present contemporary world Upon Completion of the course, the students will be able to:**

CO1: Understand the basic concept of Electromagnetic Interference
CO2: Analyse the different coupling mechanism used for EMI.
CO3: Design high speed Printed Circuit board with minimum interference.
CO4: Understand and apply the standards and regulations of EMI for real world scenario.
CO5: Analyse the testing concepts and policies of EMI

**TEXT BOOKS:**


1. V.P. Kodali, "Engineering EMC Principles, Measurements and Technologies", IEEE Press,New york, 2nd Edition, 2010
2. Henry W.Ott., "Noise Reduction Techniques in Electronic Systems", A Wiley Inter Science Publications, John Wiley and Sons, Newyork, 2009.

**REFERENCES:**


1. Don R.J.White Consultant Incorporate, "Handbook of EMI/EMC", Vol I-V, 1988
2. Bemhard Keiser, "Principles of Electromagnetic Compatibility", 3rd Edition, Artech house, Norwood, 1987
3. C.R. Paul, "Introduction to Electromagnetic Compatibility", John wiley& sons Inc. 2006.


| | PO1 | PO2 | PO3 | PO 4 | PO 5 | PO 6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | | | | 3 | 3 | 3 | | | | | 3 | | |
| **CO2** | 3 | 2 | | | | 3 | 3 | 3 | | | | | 3 | | |
| **CO3** | 3 | 2 | | | | 3 | 3 | 3 | | | | | 3 | | |
| **CO4** | 3 | 2 | | | | 3 | 3 | 3 | | | | | 3 | | |
| **CO5** | 3 | 2 | | | | 3 | 3 | 3 | | | | | 3 | | |
| **Avg** | 3 | 2 | | | | 3 | 3 | 3 | | | | | 3 | | |

**EC7074 FOUNDATIONS FOR NANO ELECTRONICS L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/internationalpolicies with a futuristic vision along with socio-economic impact and issues
- The objectives of the course is to introduce quantum mechanics concepts, approximationsand statistical mechanics for understanding nano systems

**UNITI INTRODUCTION TO QUANTUM MECHANICS 9**

Particles, waves, probability amplitudes, schrodinger equation, wave packets solutions, operators,expectation values, eigenfuntions, piecewise constant potentials.

**UNIT II SIMPLE HARMONIC OSCILLATORS AND APPROXIMATIONS 9**

SHM Operators, SHM wavepacket solutions, Quantum LC circuit, WKB approximations, variational methods.

**UNIT III SYSTEMS WITH TWO AND MANY DEGREES OF FREEDOM 9**

Two level systems with static and dynamic coupling, problems in more than one dimensions,electromagnetic field quantization, density of states.

**UNIT IV STATISTICAL MECHANICS 9**

Basic concepts, microscopic, quantum systems in equilibrium, statistical models applied to metalsand semiconductors

**UNIT V APPLICATIONS 9**

Hydrogen and Helium atoms, electronic states, Atomic force microscope, Nuclear MagneticResonance, carbon nanotube properties and applications

**TOTAL : 45 PERIODS**

**COURSE OUTCOMES:**

CO1: Ability to comprehend and appreciate the significance and role of this course in the present contemporary world

CO2: The student would have gained the knowledge on quantum mechanics concepts, approximations and statistical mechanics for understanding nano systems

**TEXT BOOKS:**

1. Hagelstein, Peter L., Stephen D. Senturia, and Terry P. Orlando, "Introduction to Applied Quantum and Statistical Physics",, New York, NY: Wiley, 2004.
2. Rainer Waser, "Nanoelectronics and Information Technology", Wiley, 3rd Edition, 2012.
3. Michael A. Nielsen and Isaac L. Chuang, "Quantum Computation and Quantum Information", Cambridge University Press, 2000.

**REFERENCES:**

1. Neil Gershenfeld, "The Physics of Information Technology", Cambridge University Press, 2000.
2. Adrian Ionesu and Kaustav Banerjee eds. "Emerging Nanoelectronics Life with and after CMOS", , Vol I, II, and III, Kluwer Academic, 2005.

| | PO1 | PO2 | PO3 | PO 4 | PO 5 | PO 6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | | | | 3 | 3 | 3 | | | | | 3 | | |
| **CO2** | 3 | 2 | | | | 3 | 3 | 3 | | | | | 3 | | |
| **CO3** | 3 | 2 | | | | 3 | 3 | 3 | | | | | 3 | | |
| **CO4** | 3 | 2 | | | | 3 | 3 | 3 | | | | | 3 | | |
| **CO5** | 3 | 2 | | | | 3 | 3 | 3 | | | | | 3 | | |
| **Avg** | 3 | 2 | | | | 3 | 3 | 3 | | | | | 3 | | |

**EC 7075** **MULTIMEDIA COMPRESSION AND NETWORKS** **L T P C**

**3 0 0 3**

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To introduce probability related study of the characteristics of text, voice, image and video data
- To introduce various compression schemes for text, voice, image and video
- To analyse the compression schemes
- To introduce communication protocols for voice over internet and multimedia networking

**UNIT I MULTIMEDIA COMPONENTS** **9**

Introduction- Multimedia skills- Multimedia components and their characteristics- Text, sound, images, graphics, animation, video, hardware.

**UNIT II AUDIO AND VIDEO COMPRESSION** **9**

Audio compression–DPCM-Adaptive DPCM –adaptive predictive coding-linear Predictive coding- code excited LPC-perpetual coding – Video compression principles-H.261, H.263, MPEG 1, 2, 4.

**UNIT III TEXT AND IMAGE COMPRESSION** **9**

Compression principles-source encoders and destination encoders-lossless and lossycompression-entropy encoding –source encoding- text compression –static Huffman coding dynamic Huffman coding –arithmetic coding –Lempel Ziv-Welsh Compression-image compression

**UNIT IV VoIP TECHNOLOGY 9**

Basics of IP transport, VoIP challenges, H.323/ SIP –Network Architecture, Protocols, Call establishment and release, VoIP and SS7, Quality of Service — CODEC Methods-VOIP applicability

**UNIT V MULTIMEDIA NETWORKING 9**

Multimedia networking- Applications-streamed stored and audio-making — Best Effort service- protocols for real time interactive Applications-distributing multimedia-beyond best effort service- secluding and policing Mechanisms-integrated services-differentiated Services-RSVP.

**TOTAL : 45 PERIODS**

**COURSE OUTCOMES:**

CO1: Ability to characterize the features of multimedia components. CO2:
Ability to develop audio and video processing systems.
CO3: Ability to develop compression algorithms for processing text and images.
CO4: Ability to tackle network issues in the transmission of text, audio and video signals.

**TEXT BOOKS:**

1. Fred Halshall, "Multimedia Communication - Applications, Networks, Protocols and Standards", Pearson education, 2007.
2. Tay Vaughan, "Multideai: Making It Work", TMH, 8th Edition, 2007.

**REFERENCES:**

1. Kurose and W. Ross, "Computer Networking A Top Down Approach", Pearson education, 3rd Edition, 2005.
2. Marcus Goncalves ―Voice over IP Networks, McGraw Hill,
3. KR. Rao,Z S Bojkovic, D A Milovanovic, "Multimedia Communication Systems: Techniques, Standards, and Networks", Pearson Education, 2007
4. R. Steimnetz, K. Nahrstedt, "Multimedia Computing, Communications and Applications", Pearson Education, 1st Edition, 1995.
5. Ranjan Parekh, "Principles of Multimedia", TMH, 2006.

**EC7076 REAL TIME AND EMBEDDED SYSTEMS L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To study the architecture and programming of ARM processors.

- To introduce the basic concepts of hard real time multiprocessing.
- To introduce the analytical concepts for effective programming.
- To study about the basics of the buses used for embedded system networking.

**UNIT I INTRODUCTION TO EMBEDDED COMPUTING AND ARM PROCESSORS 9**

Complex systems and microprocessors — Embedded system design process — Formalism for system design– Design example: Model train controller- ARM Processor Fundamentals- Instruction Set and Programming using ARM Processor.

**UNIT II COMPUTING PLATFORM 9**

CPU: Programming input and output – Supervisor mode, exception and traps – Coprocessor – Memory system mechanism – CPU performance – CPU power consumption- CPU buses – Memory devices – I/O devices – Component interfacing- System Level Performance Analysis- Parallelism. Design Example: Data Compressor.

**UNIT III PROGRAM DESIGN AND ANALYSIS 9**

Program design – Model of programs – Assembly and Linking – Basic compilation techniques – Program Optimization- Analysis and optimization of execution time, power, energy, program size – Program validation and testing- Example: Software Modem.

**UNIT IV PROCESS AND OPERATING SYSTEMS 9**

Multiple tasks and Multi processes – Processes – Context Switching – Operating Systems – Priority based Scheduling- RMS and EDF - Inter Process Communication mechanisms – Evaluating operating system performance – Power optimization strategies for processes.

**UNIT V HARDWARE ACCELERATORS & NETWORKS 9**

Multiprocessors- CPUs and Accelerators – Performance Analysis- Distributed Embedded Architecture – Networks for Embedded Systems: - I2C, CAN Bus, Ethernet, Myrinet – Network based design – Internet enabled systems. Design Example: Elevator Controller.

**TOTAL : 45 PERIODS**

**COURSE OUTCOMES:**

- Ability to design and develop ARM processor based systems.
- Ability to comprehend and appreciate the significance and role of microcontrollers in embedded systems.
- Ability to analyze and demonstrate program design and optimization and proper scheduling of the process.
- Ability to apply the concept of process, multiprocesses and operating systems in embedded system design.
- Ability to implement various communication protocols in distributed embedded computing platform .

**TEXT BOOKS:**

1. Wayne Wolf, "Computers as Components - Principles of Embedded Computing System Design", Morgan Kaufmann Publisher (An imprint of Elsevier), 3rd Edition, 2008.
2. Andrew N Sloss, Dominic Symes, Chris Wright, "ARM System Developer‘s Guide- Designing and Optimizing System Software", Elsevier/Morgan Kaufmann Publisher, 2008.

**REFERENCES:**

1. David E-Simon, "An Embedded Software Prime", Pearson Education, 2010.
2. K.V.K.K.Prasad, "Embedded Real-Time Systems: Concepts, Design & Programming", Dreamtech press, 2005.
3. Jane. W. S. Liu, "Real-Time Systems", Pearson Education Asia, 2011.
4. Sriram V Iyer, Pankaj Gupta, "Embedded Real Time Systems Programming", Tata Mc-Graw Hill, 2004.
5. Tammy Noergaard, "Embedded Systems Architecture", Elsevier, 2006.

| | PO1 | PO2 | PO3 | PO 4 | PO 5 | PO 6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | | 1 | 2 | | | | | | 2 | | | 3 |
| **CO2** | 3 | | 3 | 2 | 1 | | | | | | | | | | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 1 | | | | | | | | | | 3 |
| **CO4** | 3 | | 3 | 1 | | | | | | | | | | | 3 |
| **CO5** | 3 | 3 | 3 | 2 | | 1 | | | | | | 2 | | | 3 |
| | 3 | | | | | | | | | | | | | | 3 |

**EC7077 ROBOTICS L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/internationalpolicies with a futuristic vision along with socio-economic impact and issues
- To introduce the electronics and software aspects in the design of robots
- To bring out the different languages for programming robot
- To specify robot requirements in the industry
- To introduce latest state of the art robots

**UNIT I SCOPE OF ROBOTS 4**

The scope of industrial Robots - Definition of an industrial robot - Need for industrial robots — Economic and Social Issues- applications.

**UNIT II ROBOT COMPONENTS 9**

Fundamentals of Robot Technology - Automation and Robotics - Robot anatomy - Work volume - Precision of movement - End effectors - Sensors.

**UNIT III ROBOT PROGRAMMING 9**

Robot Programming - Methods - interlocks textual languages. Characteristics of Robot level languages, characteristic of task level languages.

**UNIT IV ROBOT WORK CELL 9**

Robot Cell Design and Control - Remote Center compliance - Safety in Robotics.

**UNIT V FUTURE TRENDS 14**

Telepresence robot, Autonomous mobile robots, Walker Robots, Solar-ball Robot, Underwater bots, Aerobots, Advanced robotics in Space - Specific features of space robotics systems - long- term technical developments, Next generation robots.

**TOTAL : 45 PERIODS**

**COURSE OUTCOMES**:

CO1: Ability to comprehend and appreciate the significance and role of this course in the present contemporary world

CO2: Ability to design and develop robotic based systems.

CO3: Ability to develop system for industrial automation and medical applications.

CO4: Ability to provide automatic solution for replacing humans in life threatening area.

**TEXT BOOKS:**


1. Barry Leatham - Jones, "Elements of industrial Robotics", Pitman Publishing, 1987.
2. J. M. Selig, "Introductory Robotics", Prentice Hall, 1992.
3. John Iovine, "Robots, Android and Animatronics", McGraw-Hill, 2nd Edition, 2012.
4. John M. Holland, "Designing Autonomous Mobile Robots-Inside the mind of an Intelligent Machine", Newnes Publication, 2004.
5. Robert J. Schilling, "Fundamentals of Robotics- Analysis and Control", Pearson Education, 2006.


**REFERENCES:**


1. MikellP.Groover, Mitchell Weiss, Roger N.Nagel Nicholas G.Odrey, "Industrial Robotics Technology, Programming and Applications", McGraw Hill Book Company 1986.
2. Fu K.S. Gonzaleaz R.C. and Lee C.S.G., "Robotics Control Sensing, Vision and Intelligence", McGraw Hill, International Editions, 1987.
3. Bernard Hodges and Paul Hallam, "Industrial Robotics", British Library Cataloging in Publication 1990.
4. Deb, S.R. , "Robotics Technology and Flexible Automation", Tata McGraw Hill, 1994.


| COURSE OUTCOMES | PROGRAMME OUTCOMES | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 3 | | | | | | | | 2 | | | | | 3 |
| CO2 | 3 | 3 | | | | | | | | 2 | | | | | 3 |
| CO3 | 3 | 3 | 3 | | | | | | | 2 | | 1 | | | 3 |
| CO4 | 3 | 3 | 3 | 3 | | | | 1 | | 2 | | 1 | | | 3 |
| CO5 | 3 | 3 | 3 | | | | | 1 | | 2 | | 1 | | | 3 |
| Avg | 3 | 3 | 3 | 3 | | | | 1 | | 2 | | 1 | | | 3 |

**EC7078** **SOFT COMPUTING AND APPLICATIONS** **L T P C**

**3 0 0 3**

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/internationalpolicies with a futuristic vision along with socio-economic impact and issues
- This course gives an idea and principles of various soft computing techniques, which are applicable to core areas such as networks , pattern recognition, image processing
- To introduce fuzzy set theory
- To teach different optimization techniques

- To introduce neural networks and neuro-fuzzy modeling
- To teach various applications of computational intelligence

**UNIT I FUZZY SET THEORY 10**

Introduction to Neuro — Fuzzy and Soft Computing — Fuzzy Sets — Basic Definition and Terminology– Set-theoretic Operations – Member Function Formulation and Parameterization –Fuzzy Rules and Fuzzy Reasoning – Extension Principle and Fuzzy Relations – Fuzzy If-Then Rules – Fuzzy Reasoning – Fuzzy Inference Systems – Mamdani Fuzzy Models – Sugeno FuzzyModels – Tsukamoto Fuzzy Models – Input Space Partitioning and Fuzzy Modeling.

**UNIT II OPTIMIZATION 8**

Derivative-based Optimization – Descent Methods – The Method of Steepest Descent – Classical Newton‘s Method – Step Size Determination – Derivative-free Optimization – Genetic Algorithms – Simulated Annealing – Random Search – Downhill Simplex Search.

**UNIT III NEURAL NETWORKS 10**

Supervised Learning Neural Networks – Perceptrons - Adaline – Backpropagation Mutilayer Perceptrons – Radial Basis Function Networks – Unsupervised Learning Neural Networks – Competitive Learning Networks – Kohonen Self-Organizing Networks – Learning Vector Quantization — Hebbian Learning.

**UNIT IV NEURO FUZZY MODELING 9**

Adaptive Neuro-Fuzzy Inference Systems – Architecture – Hybrid Learning Algorithm – Learning Methods that Cross-fertilize ANFIS and RBFN – Coactive Neuro Fuzzy Modeling– Framework Neuron Functions for Adaptive Networks – Neuro Fuzzy Spectrum.

**UNIT V APPLICATIONS OF COMPUTATIONAL INTELLIGENCE 8**

Printed Character Recognition – Inverse Kinematics Problems – Automobile Fuel EfficiencyPrediction – Soft Computing for Color Recipe Prediction**.**

**TOTAL : 45 PERIODS**

**COURSE OUTCOMES:**

**Ability to comprehend and appreciate the significance and role of this course in the present contemporary world.**

**Upon completion of the course, the student should be able to:**

| | |
|---|---|
| CO1 | Apply various soft computing frame works |
| CO2 | Apply various Optimization Schemes |
| CO3 | Design of various neural networks |
| CO4 | Use fuzzy logic |
| CO5 | Discuss hybrid soft computing |

**TEXT BOOKS:**


1. J.S.R.Jang, C.T.Sun and E.Mizutani, "Neuro Fuzzy and Soft Computing", PHI, 2004, Pearson Education 2004.
2. N.P.Padhy, "Artificial Intelligence and Intelligent Systems", Oxford University Press, 2006.


**REFERENCES:**


1. Timothy J.Ross, "Fuzzy Logic with Engineering Applications", McGraw-Hill, 1997.
2. Davis E.Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning, Addison Wesley, N.Y., 1989.
3. S. Rajasekaran and G.A.V.Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI, 2003.

4. R.Eberhart, P. Simpson and R. Dobbins, "Computational Intelligence - PC Tools", AP, Professional, Boston, 1996.
5. Dr.S.N.Sivanandam and S.N.Deepa, "Principles of Soft Computing", Wiley India, 2007.

| COURSE OUTCOMES | PROGRAMME OUTCOMES | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO 7 | PO8 | PO 9 | PO1 0 | PO1 1 | PO1 2 | PSO 1 | PSO 2 | PSO 3 |
| CO1 | 3 | 3 | 3 | | 2 | | | | | 1 | | | | | 3 |
| CO2 | 3 | 3 | 3 | | | | | | | | | | | | 3 |
| CO3 | 3 | 3 | 3 | | 2 | | | | | | | | | | 3 |
| CO4 | 3 | 3 | 3 | | | | | | | | | | | | 3 |
| CO5 | 3 | 3 | 3 | | | | | | | 1 | | | | | 3 |
| Avg | 3 | 3 | 3 | | | | | | | 1 | | | | | 3 |

**EC7079**

## SPEECH PROCESSING

**L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/internationalpolicies with a futuristic vision along with socio-economic impact and issues
- To introduce speech production and related parameters of speech
- To show the computation and use of techniques such as short time Fourier transform,linear predictive coefficients and other coefficients in the analysis of speech
- To understand different speech modeling procedures such as Markov and theirimplementation issues
- To introduce speech recognition and synthesis techniques

**UNIT I BASIC CONCEPTS** **10**

Speech Fundamentals: Articulatory Phonetics – Production and Classification of Speech Sounds; Acoustic Phonetics — Acoustics of speech production; Review of Digital Signal Processing concepts; Short-Time Fourier Transform, Filter-Bank and LPC Methods.

**UNIT II SPEECH ANALYSIS** **10**

Features, Feature Extraction and Pattern Comparison Techniques: Speech distortion measures – mathematical and perceptual – Log–Spectral Distance, Cepstral Distances, Weighted CepstralDistances and Filtering, Likelihood Distortions, Spectral Distortion using a Warped Frequency Scale, LPC, PLP and MFCC Coefficients, Time Alignment and Normalization –Dynamic Time Warping, Multiple Time – Alignment Paths.

**UNIT III SPEECH MODELING** **8**

Hidden Markov Models: Markov Processes, HMMs – Evaluation, Optimal State Sequence – Viterbi Search, Baum-Welch Parameter Re-estimation, Implementation issues

**UNIT IV SPEECH RECOGNITION** **8**

Large Vocabulary Continuous Speech Recognition: Architecture of a large vocabulary continuous speech recognition system – acoustics and language models – n-grams, context dependent sub-word units; Applications and present status.

**UNIT V SPEECH SYNTHESIS 9**

Text-to-Speech Synthesis: Concatenative and waveform synthesis methods, sub-word units for TTS, intelligibility and naturalness – role of prosody, Applications and present status.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

CO1: Ability to use speech related parameters.
CO2: Ability to extract significant features from speech to reduce redundancy in speech by using several distortion measures.
CO3: Ability to develop models for speech signals.
CO4: Ability to develop speech recognition algorithms.
CO5: Ability to develop artificial speech generation of human speech.

**TEXT BOOKS**:


1. Lawrence Rabinerand Biing-Hwang Juang, "Fundamentals of Speech Recognition", Pearson Education, 2003.
2. Daniel Jurafsky and James H Martin, "Speech and Language Processing – An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", Pearson Education, 3rd Edition, 2018.


**REFERENCES:**


1. Frederick Jelinek, "Statistical Methods of Speech Recognition", MIT Press, Reprint 2001
2. Steven W. Smith, "The Scientist and Engineer‘s Guide to Digital Signal Processing", California Technical Publishing, 1997.
3. Thomas F Quatieri, "Discrete-Time Speech Signal Processing Principles and Practice", Pearson Education, 2004.
4. Claudio Becchetti and LucioPrinaRicotti, "Speech Recognition", John Wiley and Sons, 1999.
5. Ben Gold and Nelson Morgan, "Speech and Audio Signal Processing and Perception of Speech and Music", Wiley- India Edition, 2006 Edition.


| COURSE OUTCOMES | PROGRAMME OUTCOMES | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO 7 | PO8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
| CO1 | 3 | | | | | | | | | | | | | | 3 |
| CO2 | 3 | 2 | | | 2 | | | | | | | | | | 3 |
| CO3 | 3 | 2 | 2 | | 2 | | | | | | | | | | 3 |
| CO4 | 3 | 2 | 2 | 1 | | | | | | | | | | | 3 |
| CO5 | 3 | 2 | 2 | 1 | | | | | | | | | | | 3 |
| Avg | 3 | 2 | 2 | 1 | 2 | | | | | | | | | | 3 |

**EC7551 COMPUTER ARCHITECTURE AND ORGANIZATION L T P C**

**3 0 0 3**

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To study the general purpose architecture for computer system .
- To study the design of data path unit and control unit for ALU operation.
- Understanding the concept of various memories.
- To introduce the concept of interfacing and organization of multiple processors.
-

**UNIT I INTRODUCTION 9**

Computing and Computers, Evolution of Computers, VLSI Era, System Design- Register Level,Processor Level, CPU Organization, Data Representation, Fixed – Point Numbers, Floating Point Numbers, Instruction Formats, Instruction Types. Addressing modes.

**UNIT II DATA PATH DESIGN 9**

Subtraction, Multiplication and Division, Combinational and Sequential ALUs, Carry look ahead adder, Robertson algorithm, booth's algorithm, non-restoring division algorithm, Floating Point Arithmetic, Coprocessor, Pipeline Processing, Pipeline Design, Modified booth's Algorithm

**UNIT III CONTROL DESIGN 9**

Hardwired Control, Micro programmed Control, Multiplier Control Unit, CPU Control Unit, Pipeline Control, Instruction Pipelines, Pipeline Performance, Superscalar Processing, Nano Programming.

**UNIT IV MEMORY ORGANIZATION 9**

Random Access Memories, Serial - Access Memories, RAM Interfaces, Magnetic Surface Recording, Optical Memories, multilevel memories, Cache & Virtual Memory, Memory Allocation, Associative Memory.

**UNIT V SYSTEM ORGANIZATION 9**

Communication methods, Buses, Bus Control, Bus Interfacing, Bus arbitration, IO and system control, IO interface circuits, Handshaking, DMA and interrupts, vectored interrupts, PCI interrupts,pipeline interrupts, IOP organization, operation systems, multiprocessors, fault tolerance, RISC and CISC processors, Superscalar and vector processor.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

CO1: Ability to comprehend and appreciate the significance and role of this course in the present contemporary world

CO2: Describe data representation, instruction formats and the operation of a digital computer. (Level – II (Comprehension))

CO3: Illustrate the data path unit and control unit for ALU operation. (Level – I(Comprehension)) CO4: Discuss about implementation schemes of control unit and pipeline performance. (Level – II (Comprehension))

CO5: Explain the concept of various memories, interfacing and organization of multiple processors. (Level – II (Comprehension))

CO6: Discuss about the interrupts, I/Os and other components of the system. (Level – II (Comprehension))

**TEXTBOOKS:**


1. John P.Hayes,, "Computer architecture and Organization", Tata McGraw-Hill, 3rd Edition, 1998.
2. V.Carl Hamacher, Zvonko G. Varanesic and Safat G. Zaky, "Computer Organisation", 5th Edition, McGraw-Hill Inc, 1996.


**REFERENCES:**


1. Morris Mano, "Computer System Architecture", Prentice-Hall ofIndia,2000.
2. Behrooz Paraami, "Computer Architecture, From Microprocessor to Supercomputers", Oxford University Press, Sixth impression, 2010.
3. P.PalChaudhuri, "Computer organization and design", Prentice Hall of India, 2nd Edition, 2007.
4. Miles J. Murdocca and Vincent P. Heuring, "Principles of Computer Architecture", Prentice Hall,2000.
5. William Stallings, "Computer Organization and Architecture, Designing for Performance", Pearson Education, 8th Edition, 2010.


**EC7651 VLSI DESIGN L T P C**

**3 0 0 3**

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To learn the fundamentals of VLSI design
- To understand the IC Manufacturing Process
- To familiarize with VLSI combinational logic circuits design
- To familiarize with VLSI sequential logic circuits design
- To learn the various arithmetic circuits and testing methodologies
- To familiarize with the different FPGA architectures.
-

**UNIT I MOS TRANSISTOR PRINCIPLES 9**

MOS Technology and VLSI, Pass transistors, NMOS, CMOS Fabrication process and Electrical properties of CMOS circuits and Device modeling. Characteristics of CMOS inverter, Scaling principles and fundamental limits. Propagation Delays, CMOS inverter scaling, Stick diagram, Layout diagrams, Elmore's constant, Logical Effort. Case study: Study of technology development in MOS.

**UNIT II COMBINATIONAL LOGIC CIRCUITS 9**

Static CMOS logic Design, Design techniques to improve the speed, power dissipation of CMOS logic, low power circuit techniques, Ratioed logic .Pass transistor Logic, Transmission CPL, DCVSL, Dynamic CMOS logic, Domino logic, Dual Rail logic, NP CMOS logic and NOR arraylogic.

**UNIT III SEQUENTIAL LOGIC CIRCUITS 9**

Static and Dynamic Latches and Registers, Timing Issues, Pipelines, Clocking strategies, Memory Architectures, and Memory control circuits.

**UNIT IV DESIGNING ARITHMETIC BUILDING BLOCKS & TESTING 9**

Data path circuits, Architectures for Adders, Accumulators, Multipliers, Barrel Shifters, Need for testing- Manufacturing test principles- Design for testability. Case study: Analysis of area, power and delay for 16 bit adder and 8 bit multiplier

**UNIT V IMPLEMENTATION STRATEGIES 9**

Full Custom and Semicustom Design, Standard Cell design and cell libraries, FPGA building block architectures, FPGA interconnect routing procedures. Demo: Complete ASIC flow using Backend tool and fabrication flow Overall case study: Development of IC in commercial aspects (design, testing and fab cost)

**TOTAL:45 PERIODS**

**COURSE OUTCOMES:**

CO1: Ability to comprehend and appreciate the significance and role of this course in the present contemporary world

CO2: At the end of the course students will be in a position to apply the basics of VLSI design, testing and different FPGA architectures.

**TEXT BOOK:**

1. Jan Rabaey, Anantha Chandrakasan, B.Nikolic, “Digital Integrated circuits: A design perspective”. Second Edition, Prentice Hall of India, 2003.

**REFERENCES:**

1. N.Weste, K.Eshraghian, “Principles of CMOS VLSI DESIGN”, A system Perspective, Addision Wesley, 2nd Edition, 2004.
2. A.Pucknell, Kamran Eshraghian, “BASIC VLSI DESIGN”, Prentice Hall of India, 3rd Edition, 2007.
3. M.J. Smith, “Application Specific Integrated Circuits”, Addisson Wesley, 1997.
4. R.Jacob Baker, Harry W.LI., David E.Boyee, “CMOS Circuit Design, Layout and Simulation”, Prentice Hall of India, 2005.

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PROGRESS THROUGH KNOWLEDGE