VELS

INSTITUTE OF SCIENCE, TECHNOLOGY & ADVANCED STUDIES (VISTAS)

(Deemed to be University Estd. u/s 3 of the UGC Act, 1956)

PALLAVARAM - CHENNAI

NAAC ACCREDITED WITH 'A' GRADE

*Marching Beyond 25 Years Successfully*

# B.E
# Biomedical
# Engineering

## Curriculum and Syllabus

**Effective from the Academic year**

**2018 - 2019**

## Department of Biomedical Engineering

## School of Engineering

## VISION OF THE DEPARTMENT

To be a premiere in Biomedical Engineering field by imparting technical knowledge and nurture talents with strong research focus towards betterment of healthy nation**.**

## MISSION OF THE DEPARTMENT

**M1**. To provide quality education in Biomedical Engineering by effective teaching learning process and inculcating value-based education.

**M2**. To incorporate collaborative research with institution, hospitals and health care industry to bring out leadership and professionalism.

**M3**. Encourage to explore innovative ideas to create enabling technologies to improve healthcare technologies.

**M4**. Exhibit societal and ethical values, teamwork spirit, multidisciplinary approach for successful careers globally, as entrepreneurs and to engage in lifelong learning.

## PROGRAM SPECIFIC OUTCOMES (PEO)

The Graduates of the B.E biomedical engineering within few years will be

**PEO 1**: Engaged in professional practise as biomedical engineers/related positions in industry, academia, hospital and government sectors.

**PEO 2**: Continuing towards professional development in biomedical engineering or other related fields by successfully engaging in post graduate education, scientific research, entrepreneurship throughout their careers.

**PEO 3**: Utilizing Engineering knowledge in creating innovative solutions or enabling technologies for the betterment of healthcare society

**PEO 4**: Exhibiting leadership and decision-making skills with societal and ethical responsibilities to function in multi-disciplinary settings.

## PROGRAM OUTCOME (PO)

PO1: **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: **Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: **Conduct investigations of complex problems:** Use research-based knowledge and research methods 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 diverse teams, and in multidisciplinary settings.

PO10: **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clearinstructions.

PO11: **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and 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.

## PROGRAMME SPECIFIC OUTCOME (PSO)

**PSO1**: To examine, interpret, recognize and resolve challenges through acquired knowledge, skills, values to draw conclusions in multidisciplinary fields.

**PSO2**: To design, develop and Evaluate innovative solutions to meet healthcare needs and committed with ethical values for well-being of healthy society

# BOARD OF STUDIES

| S. No | NAME | AFFILIATION | ROLE |
|---|---|---|---|
| 1 | Dr.R.J.Hemalatha | Head & Assistant professor, VISTAS, Chennai | Chairperson |
| 2 | Dr. V.Vijayabaskar | Professor and Head, Department of Electronics & Instrumentation Sathyabama Institute of Science and Technology, Chennai | (Academic Expert) External member |
| 3 | Mr. B. Venkatraman | Managing Partner (Technical), Biovision Medical Systems, Chennai. | (Industrial Expert) External member |
| 4 | Ms.T.R.Thamizhvani | Assistant professor, VISTAS, Chennai | Internal member |

**VELS INSTITUTE OF SCIENCE, TECHNOLOGY AND ADVANCED STUDIES (VISTAS)**
**B.E. BIOMEDICAL ENGINEERING DEGREE COURSE**
**COURSES OF STUDY AND SCHEME OF ASSESSMENT**
**(MINIMUM CREDITS TO BE EARNED: 170)**

| Category | CourseTitle | Hours/Week | | | | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | Credits | CA | SEE | Total |
| **SEMESTER I** | | | | | | | | |
| HS | English | 2 | 0 | 0 | 2 | 40 | 60 | 100 |
| BS | Physics (Oscillation, Waves and Optics) | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| BS | Mathematics – I (Calculus and Linear Algebra) | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| ES | Basic Electrical Engineering | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| ES | Engineering Graphics & Design | 1 | 0 | 4 | 3 | 40 | 60 | 100 |
| BS | Physics Lab | 0 | 0 | 3 | 2 | 40 | 60 | 100 |
| ES | Electrical Engineering Lab | 0 | 0 | 2 | 1 | 40 | 60 | 100 |
| HS | English Lab | 0 | 0 | 2 | 1 | 40 | 60 | 100 |
| | | 12 | 3 | 11 | 21 | | | |
| **SEMESTER II** | | | | | | | | |
| BS | Chemistry | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| BS | Mathematics – II (Probability and Statistics) | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| ES | Programming for Problem Solving | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| BS | Chemistry Lab | 0 | 0 | 3 | 2 | 40 | 60 | 100 |
| ES | Programming for Problem solving Lab | 0 | 0 | 4 | 2 | 40 | 60 | 100 |
| ES | Workshop/Manufacturing Practices | 1 | 0 | 4 | 3 | 40 | 60 | 100 |
| | | 10 | 2 | 11 | 18 | | | |

CA - Continuous Assessment
SEE - Semester End Examination

**B.E. BIOMEDICAL ENGINEERING**

| Category | CourseTitle | Hours/Week Lecture | Tutorial | Practical | Credits | MaximumMarks CA | SEE | Total |
|---|---|---|---|---|---|---|---|---|
| **SEMESTER III** | | | | | | | | |
| BS | Mathematics III | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| BS | Biochemistry | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| ES | Electronic Devices and Circuits | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| PC | Human Anatomy and Physiology | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| PC | Bioinstrumentation and Measurements | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| PC | Biomechanics and Biofluids | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| PC | Human Anatomy and Physiology Lab | 0 | 0 | 3 | 1 | 40 | 60 | 100 |
| EC | Electronic Devices &Circuits Lab | 0 | 0 | 3 | 1 | 40 | 60 | 100 |
| HS | Personality Development I | 2 | 0 | 0 | 2 | 40 | 60 | 100 |
| MC | , Essence of Indian Traditional Knowledge | 2 | 0 | 0 | 2 | 40 | 60 | 100 |
| | | 22 | 0 | 6 | 24 | | | |

| Category | Course Title | Hours/Week Lecture | Tutorial | Practical | Credits | Maximum Marks CA | SEE | Total |
|---|---|---|---|---|---|---|---|---|
| **SEMESTER IV** | | | | | | | | |
| BS | Fiber optics and Lasers in Medicine | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| ES | Biosensors and Transducers | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| PC | Biocontrol Systems | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| PC | Biomaterials and Artificial Organs | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| PC | Microprocessor&Microcontroller | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| MC | Environmental Science and Engineering | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| HS | Personality Development II | 2 | 0 | 0 | 2 | 40 | 60 | 100 |
| PC | Sensors and Transducers Laboratory | 0 | 0 | 3 | 1 | 40 | 60 | 100 |
| PC | Microprocessor and Microcontroller Laboratory | 0 | 0 | 3 | 1 | 40 | 60 | 100 |
| BS | Basic Life Skills | 0 | 0 | 2 | 1 | 40 | 60 | 100 |
| | | 20 | 1 | 8 | 24 | | | |

**B.E. BIOMEDICAL ENGINEERING**

| Category | Course Title | Hours/Week | | | | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | Credits | CA | SEE | Total |
| **SEMESTER V** | | | | | | | | |
| PC | Diagnostic Instrumentation | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| PC | Bio Signal Processing | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| PC | Medical Optics | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| PC | Radiological Equipment | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| OE | Open Elective – I | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| PE | Professional Elective - I | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| HS | Personality Development III | 2 | 0 | 0 | 2 | 40 | 60 | 100 |
| PC | Diagnostic Instrumentation Laboratory | 0 | 0 | 3 | 1 | 40 | 60 | 100 |
| PC | Bio Signal Processing Laboratory | 0 | 0 | 3 | 1 | 40 | 60 | 100 |
| | Industrial Visit | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | 20 | 1 | 6 | 23 | | | |

| Category | Course Title | Hours/Week | | | | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | Credits | CA | SEE | Total |
| **SEMESTER VI** | | | | | | | | |
| PC | Therapeutic Equipments | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| PC | Medical Image Processing | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| PC | Rehabilitation Engineering | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| PE | Professional Elective– II | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| PE | Professional Elective– III | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| OE | Open Elective – II | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| HS | Personality Development IV | 2 | 0 | 0 | 2 | 40 | 60 | 100 |
| PC | Therapeutic Equipment Laboratory/ Hospital Visit | 0 | 0 | 3 | 1 | 40 | 60 | 100 |
| PC | Medical Image Processing Laboratory | 0 | 0 | 3 | 1 | 40 | 60 | 100 |
| PC | Internship | 0 | 0 | 2 | 1 | 40 | 60 | 100 |
| | | 20 | 0 | 8 | 23 | | | |

**B.E. BIOMEDICAL ENGINEERING**

| Category | Course Title | Hours/Week | | | Credits | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | | CA | SEE | Total |
| **SEMESTER VII** | | | | | | | | |
| PE | Professional Elective– IV | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| PE | Professional Elective - V | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| PE | Professional Elective - VI | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| OE | Open Elective - III | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| PC | Virtual Instrumentation Laboratory | 0 | 0 | 3 | 1 | 40 | 60 | 100 |
| HS | Intellectual property rights & regulatory | 2 | 0 | 0 | 2 | 40 | 60 | 100 |
| PC | Project Phase I | 0 | 0 | 10 | 5 | 40 | 60 | 100 |
| | | 14 | 0 | 13 | 20 | | | |

| Category | Course Title | Hours/Week | | | Credits | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | | CA | SEE | Total |
| **SEMESTER VIII** | | | | | | | | |
| PE | Professional Elective - VII | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| OE | Open Elective - IV | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| OE | Open Elective - V | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| PC | Project Phase II | 0 | 0 | 16 | 8 | 40 | 60 | 100 |
| | | 9 | 0 | 16 | 17 | | | |

## LIST OF COURSES

### Basic Sciences

| Code No. | Course | Hours / Week | | | Credits |
|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | |
| BS – 01 | Physics (Oscillation, Waves and Optics) | 3 | 1 | 0 | 4 |
| BS – 02 | Physics Lab | 0 | 0 | 3 | 2 |
| BS – 03 | Mathematics – I (Calculus and Linear Algebra) | 3 | 1 | 0 | 4 |
| BS – 04 | Chemistry | 3 | 1 | 0 | 4 |
| BS – 05 | Chemistry Lab | 0 | 0 | 3 | 2 |
| BS – 06 | Mathematics – II (Probability and Statistics) | 3 | 1 | 0 | 4 |
| BS – 07 | Mathematics III | 3 | 0 | 0 | 3 |
| BS – 08 | Biochemistry | 3 | 1 | 0 | 3 |
| BS – 09 | Fiber optics and Lasers in Medicine | 3 | 1 | 0 | 3 |
| BS – 10 | Basic Life Skills | 0 | 0 | 2 | 1 |

### Humanities and Social Sciences

| Code No. | Course | Hours / Week | | | Credits |
|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | |
| HS – 01 | English | 2 | 0 | 0 | 2 |
| HS – 02 | English Lab | 0 | 0 | 2 | 1 |
| HS – 03 | Personality Development I | 2 | 0 | 0 | 2 |
| HS – 04 | Personality Development II | 2 | 0 | 0 | 2 |
| HS – 05 | Personality Development III | 2 | 0 | 0 | 2 |
| HS – 06 | Personality Development IV | 2 | 0 | 0 | 2 |
| HS – 07 | Intellectual property rights | 2 | 0 | 0 | 2 |

## Engineering Sciences

| Code No. | Course | Hours / Week | | | Credits |
|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | |
| ES – 01 | Basic Electrical Engineering | 3 | 0 | 0 | 3 |
| ES – 02 | Basic Electrical Engineering Lab | 0 | 0 | 4 | 2 |
| ES – 03 | Engineering Graphics & Design | 1 | 0 | 4 | 3 |
| ES – 04 | Programming for Problem Solving | 3 | 1 | 0 | 4 |
| ES – 05 | Programming for Problem Solving Lab | 0 | 0 | 2 | 1 |
| ES – 06 | Workshop/Manufacturing Practices | 1 | 0 | 4 | 3 |
| ES – 07 | Electronic Devices and Circuits | 3 | 0 | 0 | 3 |
| ES – 08 | Electronic Devices and Circuits Lab | 0 | 0 | 3 | 1 |
| ES – 09 | Biosensors and Transducers | 3 | 0 | 0 | 3 |

## Professional Core Courses

| Code No. | Course | Hours / Week | | | Credits |
|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | |
| PC– 01 | Human Anatomy and Physiology | 3 | 0 | 0 | 3 |
| PC– 02 | Human Anatomy and Physiology Lab | 0 | 0 | 3 | 1 |
| PC– 03 | Bioinstrumentation and Measurements | 3 | 0 | 0 | 3 |
| PC– 04 | Biomechanics and Biofluids | 3 | 0 | 0 | 3 |
| PC– 05 | Biocontrol Systems | 3 | 0 | 0 | 3 |
| PC– 06 | Biomaterials and Artificial Organs | 3 | 0 | 0 | 3 |
| PC– 07 | Microprocessor Microcontroller | 3 | 1 | 0 | 4 |
| PC– 08 | Microprocessor& Microcontroller Lab | 0 | 0 | 3 | 1 |
| PC– 09 | Sensors and Transducers Laboratory | 0 | 0 | 3 | 1 |
| PC–10 | Diagnostic Instrumentation | 3 | 1 | 0 | 4 |

| | | | | | |
|---|---|---|---|---|---|
| PC– 11 | Diagnostic Instrumentation Lab | 0 | 0 | 3 | 1 |
| PC– 12 | Bio Signal Processing | 3 | 0 | 0 | 3 |
| PC– 13 | Bio Signal Processing Lab | 0 | 0 | 3 | 1 |
| PC– 14 | Medical Optics | 3 | 0 | 0 | 3 |
| PC– 15 | Radiological Equipment | 3 | 0 | 0 | 3 |
| PC– 16 | Therapeutic Equipments | 3 | 0 | 0 | 3 |
| PC– 17 | Therapeutic Equipments / Hospital Visit | 0 | 0 | 3 | 1 |
| PC– 18 | Medical Image Processing | 3 | 0 | 0 | 3 |
| PC– 19 | Medical Image Processing Lab | 0 | 0 | 3 | 1 |
| PC– 20 | Rehabilitation Engineering | 3 | 0 | 0 | 3 |
| PC– 21 | Internship | 0 | 0 | 2 | 1 |
| PC– 22 | Virtual Instrumentation Laboratory | 0 | 0 | 3 | 1 |
| PC– 23 | Project Phase I | 0 | 0 | 10 | 5 |
| PC-24 | Project Phase II | 0 | 0 | 16 | 8 |

## Mandatory Courses

| Code No. | Course | Hours / Week | | | Credits |
|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | |
| MC – 01 | Essence of Indian Traditional Knowledge | 2 | 0 | 0 | 2 |
| MC – 02 | Environmental Science and Engineering | 3 | 0 | 0 | 3 |

## Professional Electives

| Code No. | Course | Hours / Week | | | Credits |
|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | |
| PE– 01 | Medical Physics | 3 | 0 | 0 | 3 |
| PE– 02 | Robotics in Medicine | 3 | 0 | 0 | 3 |
| PE– 03 | Biology for Engineers | 3 | 0 | 0 | 3 |
| PE– 04 | Pathology and Microbiology | 3 | 0 | 0 | 3 |
| PE– 05 | Analog and Digital Communications | 3 | 0 | 0 | 3 |
| PE– 06 | Biomedical Informatics | 3 | 0 | 0 | 3 |
| PE– 07 | Lasers in Medicine | 3 | 0 | 0 | 3 |
| PE– 08 | Physiological Modelling and Simulation | 3 | 0 | 0 | 3 |
| PE– 09 | Telehealth Technology | 3 | 0 | 0 | 3 |
| PE– 10 | Fundamentals of Nanoscience and Nanotechnology | 3 | 0 | 0 | 3 |
| PE– 11 | Clinical Engineering | 3 | 0 | 0 | 3 |
| PE– 12 | Neuroscience for Biomedical Applications | 3 | 0 | 0 | 3 |
| PE– 13 | Hospital Management | 3 | 0 | 0 | 3 |
| PE– 14 | Biophotonics | 3 | 0 | 0 | 3 |
| PE– 15 | Biomems and Nanotechnology | 3 | 0 | 0 | 3 |
| PE– 16 | Human Assist Devices | 3 | 0 | 0 | 3 |
| PE– 17 | Pattern Recognition and Neural Networks | 3 | 0 | 0 | 3 |
| PE-18 | Biometrics Systems | 3 | 0 | 0 | 3 |
| PE-19 | Advanced Bioanalytical and Therapeutic Techniques | 3 | 0 | 0 | 3 |
| PE-20 | Bioprocess Technology | 3 | 0 | 0 | 3 |
| PE-21 | Virtual Instrumentation in Medicine | 3 | 0 | 0 | 3 |
| PE-22 | Tissue Engineering | 3 | 0 | 0 | 3 |

| | | | | | |
|---|---|---|---|---|---|
| PE-23 | Brain Computer Interface and its Applications | 3 | 0 | 0 | 3 |
| PE-24 | Body Area Networks | 3 | 0 | 0 | 3 |
| PE-25 | Biological Effects of Radiation | 3 | 0 | 0 | 3 |
| PE-26 | Genetic Engineering | 3 | 0 | 0 | 3 |
| PE-27 | Effects of Radiation and Radiation safety | 3 | 0 | 0 | 3 |
| PE-28 | Electromagnetic Interference and Compatibility | 3 | 0 | 0 | 3 |
| PE-29 | Ultrasound principles and Applications in Medicine | 3 | 0 | 0 | 3 |
| PE-30 | Medical Electronics | 3 | 0 | 0 | 3 |
| PE-31 | Artificial Intelligence and Fuzzy logic | 3 | 0 | 0 | 3 |
| PE-32 | Trouble shooting of Medical Equipments | 3 | 0 | 0 | 3 |
| PE-33 | Prosthetic Engineering | 3 | 0 | 0 | 3 |
| PE-34 | Cryptography and Network Security | 3 | 0 | 0 | 3 |
| PE-35 | Wearable Medical Systems | 3 | 0 | 0 | 3 |

## Open Electives

| Code No. | Course | Hours / Week | | | Credits |
|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | |
| OE– 01 | Internet of Medical Things | 3 | 0 | 0 | 3 |
| OE– 02 | Basics of Python and MATLAB softwares | 3 | 0 | 0 | 3 |
| OE– 03 | Forensic Science | 3 | 0 | 0 | 3 |
| OE– 04 | Foundation of Nano Electronics | 3 | 0 | 0 | 3 |
| OE– 05 | Health Policy and Equipment Management | 3 | 0 | 0 | 3 |
| OE– 06 | Lifestyle Modification and Health care | 3 | 0 | 0 | 3 |
| OE– 07 | Total Quality Management | 3 | 0 | 0 | 3 |
| OE– 08 | Foundation Skills In Integrated Product Development and Design | 3 | 0 | 0 | 3 |
| OE– 09 | Virtual Reality | 3 | 0 | 0 | 3 |
| OE–10 | Hospital Finance Management | 3 | 0 | 0 | 3 |
| OE– 11 | Human Rights and values | 3 | 0 | 0 | 3 |
| OE– 12 | Medical Nanotechnology | 3 | 0 | 0 | 3 |
| OE– 13 | Innovation, Technology And Intellectual Property Rights | 3 | 0 | 0 | 3 |
| OE– 14 | Effects Of Industrial Pollution, Prevention And Control | 3 | 0 | 0 | 3 |
| OE– 15 | Industrial Instrumentation, Automation and Control | 3 | 0 | 0 | 3 |
| OE– 16 | Engineering Ethics and Human Values | 3 | 0 | 0 | 3 |
| OE– 17 | Product Design and Engineering | 3 | 0 | 0 | 3 |
| OE-18 | Principles of CAD and 3D printing Technology | 3 | 0 | 0 | 3 |
| OE-19 | Rapid prototyping | 3 | 0 | 0 | 3 |
| OE-20 | Research and Patent Development | 3 | 0 | 0 | 3 |
| OE-21 | Electronics in Healthcare Industry | 3 | 0 | 0 | 3 |
| OE-22 | Architecture of Computer and Networks | 3 | 0 | 0 | 3 |

| | | | | | |
|---|---|---|---|---|---|
| OE-23 | Human Resources Management in Hospital | 3 | 0 | 0 | 3 |
| OE-24 | Internet & JAVA | 3 | 0 | 0 | 3 |
| OE-25 | Disaster Management | 3 | 0 | 0 | 3 |

## Value Added Courses

| Code No. | Course | Hours / Week | | | Credits |
|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | |
| | Biomedical Waste Management | 2 | 0 | 1 | 0 |

| BS – 03 | MATHEMATICS-I<br>(CALCULUS AND LINEAR ALGEBRA) | 3 1 0 4 |
|---|---|---|

**COURSE OBJECTIVES:**

1. To familiarize the prospective engineers with techniques in calculus and linear algebra.
2. To equip the students with standard concepts and tools at an intermediate to advanced level of mathematics that would be useful in their disciplines.

**UNIT I CALCULUS 12**

Evolutes and involutes - Evaluation of definite and improper integrals- Beta and Gamma functions and their properties

**UNIT II CALCULUS 12**

Rolle's Theorem-Mean value theorems-Taylor's and Maclaurin theorems with remainders-Indeterminate forms and L'Hospital's rule.

**UNIT III SEQUENCES AND SERIES 12**

Convergence of sequence and series – tests for convergence – Power series-Taylor's series - series for exponential – trigonometric and logarithm functions.

**UNIT IV MULTIVARIABLE CALCULUS (DIFFERENTIATION) 12**

Limit, continuity and partial derivatives – directional derivatives – total derivative – Tangent plane and normal line - Maxima, minima and saddle points – Method of Lagrange multipliers.

**UNIT V MATRICES 12**

Introduction to matrix and rank of a matrix – System of linear equations – Symmetric, skew - symmetric and orthogonal matrices- Eigen values and eigen vectors – Diagonalization of matrices –Cayley – Hamilton Theorem, and Orthogonal transformation.

**TOTAL: 60 h**

**COURSE OUTCOME: (Skill Development)**

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

CO1: Apply differential and integral calculus to Notions of curvature and to improper integrals.
CO2: Analyse engineering problems using Rolle'sTheorem.
CO3: Derive power series for learning advanced Engineering Mathematics.
CO4: Perform partial, directional and total derivatives.
CO5: Compute Eigen values and vectors for matrices.

**TEXTBOOKS:**


1. G.B.ThomasandR.L.Finney, Calculusand Analytic geometry, 9thEdition,Pearson, Reprint,2002
2. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi,11th th reprint 2010.


**REFERENCE BOOKS:**


1. Erwinkreyszig,Advanced EngineeringMathematics,9th Edition,JohnWiley&Sons, 2006.
2. VeerarajanT.,Engineering Mathematicsforfirstyear,TataMcGraw-Hill,NewDelhi,2008.
3. D.Poole,LinearAlgebra:A ModernIntroduction,2nd Edition,Brooks/Cole,2005.
4. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, LaxmiPublications,Reprint,2008.
5. B.S.Grewal,HigherEngineeringMathematics,KhannaPublishers,36$^{th}$Edition,2010.

| HS – 01 &02 | ENGLISH | 2 0 2 3 |
|---|---|---|

**COURSE OBJECTIVE: (Skill Development)**

- To acquire ability to speak effectively in real life situations.
- To write letters and reports effectively in formal and business situations.
- To develop listening skills for academic and professional purposes.
- To gain effective speaking and listening skills in communication.
- To develop the soft skills and interpersonal skills to excel in their career.
- To enhance the performance of students at Placement Interviews, Group Discussions and other recruitment procedures.

**UNIT I VOCABULARY BUILDING** **10**

General Vocabulary –Nouns- Compound nouns, Word borrowing & Word making, Foreign machinery in English, Dictionary and Thesaurus usages, Synonyms , Antonyms, Prefixes and Suffixes, Homonyms, Homographs and Homophones, Changing words from one form to another, Acronyms and Abbreviations.

**UNIT II BASIC WRITING** **10**

Sentences structures –Kinds of sentences, Types of sentences, Clauses and Phrases, Punctuations, Word Links and Connectives, Summarizing, Precise writing, Paragraph Writing.

**UNIT III IDENTIFYING COMMON ERRORS IN ENGLISH** **10**

Articles, Prepositions, Subject-verb Agreement, Pronouns - Relative pronouns, Demonstrative pronouns, Misplaced Modifiers, Redundancies, Clichés, Infinitives & Gerund

**UNIT IV NATURE AND STYLE OF SENSIBLE WRITING** **10**

Describing people, place and situations, Process description, Definitions, Numerical Expressions, Information Transfer- Flow chart Bar chart and Pie chart, Checklists, Writing introduction and conclusion.

**UNIT V WRITING PRACTICES** **10**

Letter Writing- Formal & Informal Letters, Report Writing- Letter Report, Accident Report, Investigation Report and Survey, Essay writing, Comprehension Passages.

**UNIT VI ORAL COMMUNICATION** **40**

**(This unit involves interactive practice sessions in Language Lab)**

Listening comprehensions, Pronunciation, Phonology, Intonation, Stress and Rhythm, Situational Dialogues, Communication in workplace, Interviews, Seminar, Formal Presentations, Group Discussions, Debates, JAM sessions

**TEXT BOOKS:**


1. **'English for Scientists**, Prof. K.R.Lakshminarayanan, Former Head, Department of Humanities and Social sciences, Sri Venkateshwara College of Engineering, Pennalur , Sriperumbudur, Tamilnadu SCITECH PUBLICATIONS (INDIA PVT.LTD)2014
2. Department of English, Anna University, Mindscapes, '**English for Technologists and Engineers**', Orient Longman Pvt. Ltd, Chennai: 2012.
3. Department of Humanities and Social Sciences, Anna University, '**English for Engineers and Technologists**' Combined Edition (Volumes 1 and 2), Chennai: Orient Longman Pvt. Ltd., 2006.
4. Department of English, Anna University, Mindscapes, '**English for Technologists and Engineers**', Orient Longman Pvt. Ltd, Chennai: 2012.
5. Department of Humanities and Social Sciences, Anna University, ''**English for Engineers and Technologist**s'' Combined Edition (Volumes 1 and 2), Chennai: Orient Longman Pvt. Ltd., 2006.
6. M.Ashraf Rizvi, "**Effective Technical Communication**", Tata McGraw-Hill Publishing Company Limited, New Delhi.2009.

**SUGGESTED READINGS:**


(i) Practical English Usage. Michael Swan. OUP. 1995.
(ii) Remedial English Grammar. F.T. Wood. Macmillan.2007
(iii) On Writing Well. William Zinsser. Harper Resource Book. 2001
(iv) Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
(v) Communication Skills. Sanjay Kumar and Pushp Lata. Oxford University Press. 2011.
(vi) Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press


**Course Outcomes (Skill Development)**

The student will be

CO1: Acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.
CO2: Write letters and reports effectively in formal and business situations.
CO3: Develop listening skills for academic and professional purposes.
CO4: Gain effective speaking and listening skills in communication.
CO5: Develop the soft skills and interpersonal skills to excel in their career

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| BS – 01 | PHYSICS<br>(OSCILLATIONS, WAVES AND OPTICS) | 3 1 0 4 |
|---|---|---|

**(FOR BE BIOMEDICAL & ECE AND B. TECH BIOTECH, PETROLEUM & NAVAL)**

**UNIT I: Simple harmonic motion, damped and forced simple harmonic oscillator** **12**

Harmonic oscillator – Differential equation and solution of simple harmonic oscillator – simple pendulum – damped harmonic oscillator: Equation of motion and its solution, qualitative description of heavy, critical and light damping – energy decay in a damped harmonic oscillator – Q factor – forced mechanical and electrical oscillators – power absorbed by oscillator.

**UNIT II: Non-dispersive transverse and longitudinal waves in one dimension and introduction to dispersion** **12**

Waves, travailing waves example of waves, characteristics of a waves - longitudinal and transverse waves– Examples - Transverse wave on a string, the wave equation on a string- longitudinal waves and the wave equation- acoustics waves and speed of sound- characteristics of musical sound, quality of tone, decibel- noise pollution- acoustics- of buildings - Reverberation - Reverberation time.

**UNIT III: The propagation of light and geometric optics** **12**

Fermat's principle of stationary time- laws of reflection and refraction- Fresnel equations, reflectance and transmittance, Brewster's angle, total internal reflection - Dispersion, Dispersive power of prism- Defect of lenses- spherical aberration- coma-achromatic lenses.

**UNIT IV: Wave optics** **12**

Huygens' Principle, superposition of waves - Young's double slit experiment- Newton's rings-Michelson interferometer, Mach Zehnder interferometer - Fraunhofer diffraction from a single slit and a circular aperture, the Rayleigh criterion for limit of resolution and its application to vision - Dispersion of a diffraction of grating and their resolving power.

**UNIT V: Lasers** **12**

Einstein's theory of matter radiation interaction and A and B coefficients- population inversion, different types of lasers: gas lasers (He-Ne, $CO_2$), solid-state lasers (ruby, Neodymium), dye lasers; Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, laser speckles, applications of lasers in science, engineering and medicine

**TOTAL: 60 HOURS**

**COURSE OUTCOMES: (Employability)**

After successful completion of the Engineering physics-I course, the student will be able to

CO1: Estimate the differential equation and solution of simple harmonic oscillator
CO2: Understand the basic concepts of longitudinal and transverse waves
CO3: Understand the concept of propagation of light and geometric optics
CO4: Estimate the Dispersive power of prism
CO5: Explain the significance of Fraunhofer diffraction from a single slit and a circular aperture.

**SUGGESTED REFERENCE BOOKS**

(i) Ian G. Main, Oscillations and waves in physics
(ii) H.J. Pain, The physics of vibrations and waves
(iii) E. Hecht, Optics
(iv) A. Ghatak, Optics
(v)O. Svelto, Principles of Lasers

| BS – 02 | PHYSICS LABORATORY | 0 0 3 1.5 |
|---|---|---|

**Any 8 Experiments**

1. Spectrometer –Dispersive Power of prism
2. Spectrometer – Grating
3. Semiconductor Laser – To find Wavelength and particle size.
4. Ultrasonic Interferometer
5. Torsional Pendulum
6. Hooke's Law
7. Compound pendulum- To determine 'g'
8. Newtons' Ring
9. Air wedge
10. Bifilar Pendulum

**COURSE OUTCOMES: (Skill Development)**

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

CO1: Examine the Wavelength of spectral line using grating
CO2: Analyze the Wavelength and particle size using Semiconductor laser.
CO3: Appraise the dispersive power of the prism using spectrometer.
CO4: Determine the acceleration due to gravity using compound pendulum..
CO5: Measure the thickness of the thin wire by air wedge method

| ES – 01 | BASIC ELECTRICAL ENGINEERING | 3 1 0 4 |
|---|---|---|

| UNIT I | DC CIRCUITS | 12 |
|---|---|---|

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, Mesh and Nodal analysis, Analysis of simple circuits with dc excitation, Wye↔Delta Transformation, Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.

| UNIT II | AC CIRCUITS | 12 |
|---|---|---|

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance.Three phasebalanced circuits, voltage and current relations in star and delta connections.

| UNIT III | TRANSFORMERS | 12 |
|---|---|---|

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency.Auto-transformer and three-phase transformer connections.

| UNIT IV | ELECTRICAL MACHINES & POWER CONVERTERS | 12 |
|---|---|---|

Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Single phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. DC-DC buck and boost converters, duty ratio control. Single phase Bridge Rectifier, Single Phase voltage source inverters.

| UNIT IV | ELECTRICAL INSTALLATIONS | 12 |
|---|---|---|

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries.Elementary calculations for energy consumption, power factor improvement and battery backup.

**TOTAL: 60 HOURS**

**TEXT / REFERENCES:**


1. D. P. Kothari and I. J. Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, 2010.
2. D. C. Kulshreshtha, “Basic Electrical Engineering”, McGraw Hill, 2009.
3. L. S. Bobrow, “Fundamentals of Electrical Engineering”, Oxford University Press, 2011.
4. E. Hughes, “Electrical and Electronics Technology”, Pearson, 2010.
5. V. D. Toro, “Electrical Engineering Fundamentals”, Prentice Hall India, 1989


**COURSE OUTCOMES: (Employability)**

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

CO1: Understand and analyze DC circuits
CO2: Understand and analyze AC circuits
CO3: Explain the construction, operation and characteristics of transformer and classify the types of three – phase transformer connections..
CO4: Understand and Examine the various electrical machines and converter circuits

CO5: Identify the use of low tension switchgears and Classify the various types of wires, cables, batteries and earthing.

| | | |
|---|---|---|
| **ES – 02** | **ELECTRICAL ENGINEERING LABORATORY** | **0 0 2 1** |

**List of Laboratory Experiments/Demonstrations: (Skill Development)**

1. Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
2. Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification.
3. Resonance in R-L-C circuits.
4. Loading of a transformer: measurement of primary and secondary voltages and currents, and power
5. Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line-line voltage, phase-to-neutral voltage, line and phase currents).
6. Load Characteristics of a DC Motor
7. Torque - Slip Characteristic of an Induction motor
8. Three phase induction motors - Direction reversal by change of phase-sequence of connections.
9. Demonstration of dc-dc converter.
10. Demonstration of dc-ac converter.
11. Demonstration of ac-dc converter.

**TOTAL: 30 HOURS**

**COURSE OUTCOMES: (Skill Development)**

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

CO1: Understand the basic safety precautions and learn to make use of measuring instruments
CO2: Analyze the steady state response of R-L, R-C circuits and Resonance in RLC circuits
CO3: Experiment with loading of transformer to measure the primary and secondary voltages, currents and power and classify the different types of transformer connections
CO4: Understand and Experiment with single phase induction motor and three phase induction motor
CO5: Demonstrate DC-DC, DC-AC and AC-DC converters

| ES – 03 | ENGINEERING GRAPHICS & DESIGN | 1 0 4 3 |
|---|---|---|

**COURSE OBJECTIVE: (Skill Development)**

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

**CONCEPTS AND CONVENTIONS (Not for Examination)**

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 INTRODUCTION TO ENGINEERING DRAWING AND PLANE CURVES 12**

Curves used in engineering practices: Conics – Construction of ellipse, Parabola and hyperbola by eccentricity method – Construction of cycloid, Epicycloid, Hypocycloid – construction of involutes of squad and circle – Drawing of tangents and normal to the above curves. Scales – Plain, Diagonal and Vernier Scales.

**UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES 12**

Projection of points and straight lines located in the first quadrant – Determination of true lengths and true inclinations – Projection of polygonal surface and circular lamina inclined to both reference planes - Auxiliary Planes

**UNIT III PROJECTION OF SOLIDS 12**

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method - Auxiliary Views

**UNIT IV SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES 12**

Sectioning of above solids in simple vertical position by cutting planes inclined to one reference plane and perpendicular to the other – Obtaining true shape of section - Auxiliary Views. Development of lateral surfaces of simple and truncated solids – Prisms, pyramids, cylinders and cones – Development of lateral surfaces of solids with cylindrical cutouts, perpendicular to the axis.

**UNIT V ORTHOGRAPHIC PROJECTION AND ISOMETRIC PROJECTION 12**

Free hand sketching: Representation of Three Dimensional objects – General principles of orthographic projection – Need for importance of multiple views and their placement - layout views – Developing visualization skills through free hand sketching of multiple views from pictorial views of objects.

Principles of isometric projection – isometric scale – isometric projections of simple solids, truncated prisms, pyramids, cylinders and cones.

**TOTAL: 60 PERIODS**

**COURSE OUTCOMES: (Skill Development)**

After successful completion of the Engineering Graphics course, the student will be able to

CO1: Understand the theory of projection able to know and understand the conventions and the methods of engineering drawing.

CO2: Improve their visualization skills so that they can apply these skills in developing new products. Able to prepare the simple layout of factory buildings

CO3: Improve their visualization skills so that they can apply these skills in developing new products.

CO4: Impart and inculcate a proper understanding of the theory of projection. Improve the visualization skills

CO5: Understand the various concepts like dimensioning, conventioning and standards related to working drawings in order to become professionally efficient. Impart the knowledge for understanding and drawing of simple residential/office buildings

**TEXT BOOKS:**

1. N.D. Bhatt, "Engineering Drawing" Charotar Publishing House, 46 th Edition, (2003).

**REFERENCES:**

1. K. V. Natrajan, "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai (2006).
2. M.S. Kumar, "Engineering Graphics", D.D. Publications, (2007).
3. K. Venugopal & V. Prabhu Raja, "Engineering Graphics", New Age International (P) Limited (2008).
4. M.B. Shah and B.C. Rana, "Engineering Drawing", Pearson Education (2005).
5. K. R. Gopalakrishnana, "Engineering Drawing" (Vol.I&II), Subhas Publications (1998).

6. Dhananjay A.Jolhe, “Engineering Drawing with an introduction to AutoCAD” Tata McGraw Hill Publishing Company Limited (2008).
7. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill Publishing Company Limited, New Delhi, (2008).

**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. Whenever the total number of candidates in a college exceeds 150, the University Examination in that college will be conducted in two sessions (FN and AN on the same day) for 50 percent of student (approx) at a time.

| BS – 04 | ENGINEERING CHEMISTRY | 3 1 0 4 |
|---|---|---|

**COURSE OBJECTIVE (Employability)**

The concepts developed in this course will aid in quantification of several concepts in chemistry that have been introduced at the 10+2 levels in schools. Technology is being increasingly based on the electronic, atomic and molecular level modifications.Quantum theory is more than 100 years old and to understand phenomena at nanometerlevels, one has to base the description of all chemical processes at molecular levels.

**Unit I Atomic and molecular structure, Intermolecular forces and potential energy surfaces 14**

Molecular orbitals of diatomic molecules and plots of the multicentreorbitals.Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Pi-molecular orbitals of butadiene and benzene and aromaticity.Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties.Ionic, dipolar and van Der Waals interactions.Equations of state of real gases and critical phenomena. Potential energy surfaces of $H_3$, $H_2F$ and HCN.

**Unit II Spectroscopic techniques and applications 12**

Principles of spectroscopy and selection rules.Electronicspectroscopy.Vibrational and rotational spectroscopy of diatomic molecules.Applications. Diffraction and scattering

**Unit III Use of free energy in chemical equilibria 12**

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies.Free energy and emf.Cell potentials, the Nernst equation and applications.Acid base, oxidation reduction and solubility equilibria.Waterchemistry.Corrosion.

**Unit IV Periodic properties 12**

Variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries

**Unit V Organic reactions and synthesis of a drug molecule 10**

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings.Synthesis of a commonly used drug molecule.

**TOTAL : 60 HOURS**

**COURSE OUTCOMES (Employability)**

The course will enable the student to

CO1: Analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
CO2: Rationalise bulk properties and processes using thermodynamic considerations.
CO3: Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques.
CO4: Rationalise periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity.
CO5: List major chemical reactions that are used in the synthesis of molecules.

**TEXT BOOKS**

1. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane.
2. Fundamentals of Molecular Spectroscopy, by C. N. Banwell.
3. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan.

**REFERENCE BOOKS**

1. Physical Chemistry, by P. W. Atkins.
2. Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition http://bcs.whfreeman.com/vollhardtschore5e/default.asp.
3. University chemistry, by B. H. Mahan.

| BS – 05 | ENGINEERING CHEMISTRY PRACTICAL | 0 0 4 2 |
|---|---|---|

**COURSE OBJECTIVE:**

1. To help students estimate rate constants of reactions from concentration of reactants/products as a function of time.
2. To measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc.
3. To synthesize a small drug molecule and analyse a salt sample.

**Choice of 10-12 experiments from the following**

1. Determination of surface tension and viscosity
2. Thin layer chromatography
3. Ion exchange column for removal of hardness of water
4. Determination of chloride content of water
5. Colligative properties using freezing point depression
6. Determination of the rate constant of a reaction
7. Determination of cell constant and conductance of solutions
8. Potentiometry - determination of redox potentials and emfs
9. Synthesis of a polymer/drug
10. Saponification/acid value of an oil
11. Chemical analysis of a salt
12. Lattice structures and packing of spheres
13. Models of potential energy surfaces
14. Chemical oscillations- Iodine clock reaction
15. Determination of the partition coefficient of a substance between two immiscible liquids
16. Adsorption of acetic acid by charcoal
17. Use of the capillary viscosimeters to the demonstrate of the isoelectric point as the pH of minimum viscosity for gelatin sols and/or coagulation of the white part of egg .

**COURSE OUTCOMES (Skill Development)**

The students will learn to:

CO6: Explain the relation between the intermolecular forces present within a substance and the temperatures associated with changes in its physical state.

CO7: Apply formalisms based on molecular symmetry to predict spectroscopic properties.

CO8: Determine and understand the operation of electrochemical systems for the production of electric energy, i.e. batteries and fuel cells

CO9: Explain general corrosion in terms of electrochemistry

CO10: Explain the arrangement of elements in the periodic table and relate the arrangement to electronic configuration, bonding and properties.

**TEXT BOOKS**


1. S. Sundaram and K. Raghavan "Practical Chemistry", S. Viswanathan. Co. 3rd edition **2011**.
2. Gnanaprakasam, Ramamurthy, "Organic Chemistry Lab Manual" S. Viswanathan Pvt. Ltd. 3rd edition **2011**


**REFERENCE BOOK**


1. Vogel's – "Textbook of qualitative organic Analysis", Longmann, 12th edition, **2011**
2. J. N. Gurtu and R. Kapoor "Advanced experimental Chemistry", S. Chand and Co. 6th edition, **2010**

| ES – 04 | PROGRAMMING FOR PROBLEM SOLVING | 0 0 4 2 |
|---|---|---|

**COURSE OBJECTIVE: (Skill Development)**

- To understand the basic concepts of programming – Flow chart, Pseudocode.
- To learn the fundamentals of C programming - declarations, operators, expressions and control statements.
- To learn the manipulation of strings, functions, pointers and file operations.
- To understand the concepts of arrays, basic sorting and searching algorithms.
- To find the order of time complexity of basic algorithms

**UNIT 1: INTRODUCTION TO PROGRAMMING** **9**

Introduction to Programming (Flow chart / pseudo code, compilation etc.), Variables (including data types) - Arithmetic expressions and precedence, Conditional Branching and Loops - Writing and evaluation of conditionals and consequent branching Iteration and loops

**UNIT 2: ARRAYS AND BASIC ALGORITHMS** **9**

Arrays (1-D, 2-D), Character arrays and Strings, Searching, Basic Sorting Algorithms, Finding roots of equations, Notion of order of time complexity through example programs

**UNIT 3: FUNCTION AND POINTERS** **9**

Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference, Recursion with example programs such as Finding Factorial, Fibonacci series, etc. Pointers - Defining pointers, Use of Pointers in self-referential structures

**UNIT 4: STRUCTURES AND UNIONS** **9**

Structures - Defining structures and Array of Structures, Structures containing Pointers, Unions - Storage classes: auto, static, extern, register – Dynamic memory allocation

**UNIT 5: STRING FUNCTIONS AND FILES** **9**

Strings - library string functions, pointers in strings, pointers and function arguments, Files - file Operations, processing a file, Preprocessor directives, use of typedef, Command line arguments, Enumerated data types.

**TOTAL : 45 HOURS**

**COURSE OUTCOME:(Skill Development)**

CO1: Construct a pictorial representation with a stepwise procedure for solving complex problems.
CO2: Develop a high level programming code using c languages.
CO3: Evaluate the various functional operations for solving problem.
CO4: Make use of various c operations like array, pointer, strings and searching method.
CO5: Develop a C module for a given set of instruction.

**TEXT BOOKS:**


1. Byron Gottfried, “Schaum's Outline of Programming with C”, McGraw-Hill
2. E. Balaguruswamy, “Programming in ANSI C”, Tata McGraw-Hill


**REFERENCES:**


1. Brian W. Kernighan and Dennis M. Ritchie, “The C Programming Language”, Prentice Hall of India
2. Yashavant Kanetkar, “Let Us C”, BPB Publications
3. Ashok.N.Kamthane, “Computer Programming”, Pearson Education (India)

| ES – 05 | LABORATORY - PROGRAMMING FOR PROBLEM SOLVING | 0 0 4 2 |
|---|---|---|

**COURSE OBJECTIVE: (Skill Development)**

To design and develop C Programs for various applications

1. Familiarization with programming environment
2. Simple computational problems using arithmetic expressions
3. Problems involving if-then-else structures
4. Iterative problems
5. 1D Array manipulation
6. Matrix problems
7. String operations
8. Simple functions
9. Solving Numerical methods problems
10. Recursive functions
11. Pointers and structures
12. File operations

**COURSE OUTCOME: (Skill Development)**

CO1: Determine the advanced features of the C language
CO2: Develop the model data using primitive and structured types.
CO3: Construct programs that demonstrate effective use of C features including arrays, structures, pointers and files.
CO4: Develops the ability to analyze a problem, develop an algorithm to solve it.
CO5: Develops the use of the C programming language to implement various algorithms, and develops the basic concepts and terminology of programming in general.

| BS – 06 | MATHEMATICS – II<br>(PROBABILITY AND STATISTICS) | 3 1 0 4 |
|---|---|---|

**COURSE OBJECTIVE: (Skill Development)**

- To familiarize the students with statistical techniques.
- To equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling various problems in the discipline.

**UNIT 1: Basic Probability: (12)**

Probability spaces- conditional probability-Independence- Bayes'rule- Discrete random variables- Continuous random variables- Expectation of Discrete Random Variables-Continuous Random variables.

**UNIT2:Continuous Probability Distributions (12)**

Discrete Distributions-Binomial, Poisson, Geometric-Continuous Distribution Normal, Uniform, Exponential and gamma densities.

**UNIT3:Bivariate Distributions (12)**

Bivariate distributions and their properties-Covariance- Correlation and Regression Analysis

**UNIT4: Basic Statistics (12)**

Measures of Central tendency: Mean, Median and Mode- Measure of Dispersion- Range, Standard Deviation and coefficient of variation-Moments, Skewness and Kurtosis (Simple Problems)

**UNIT 5: Applied Statistics (12)**

Introduction to Large and small sample – t-test-Single mean, difference of means, and Paired t-test Small samples: Test for single mean, difference of means-F-test-Chi-square test for goodness of fit and independence of attributes.

**COURSE OUTCOME: (Skill Development)**

CO1: The students will have a fundamental knowledge of the concepts of probability.
CO2: Knowledge of standard distributions which can describe real life phenomenon.
CO3: The notion of sampling distributions and statistical techniques used in engineering
CO4: Use appropriate statistical methods in the analysis of simple datasets
CO5: Develop skills in presenting quantitative data using appropriate diagrams, tabulations and summaries

**Text Books**


1. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications,Reprint,2010.
2. VeerarajanT.,EngineeringMathematics(forsemesterIII),TataMcGraw-Hill,New Delhi,2010.
3. S.Ross,AFirstCourseinProbability,6thEd.,PearsonEducationIndia,2002.


**Reference Books**


1. ErwinKreyszig,AdvancedEngineeringMathematics,9th Edition,JohnWiley&Sons, 2006.
2.P.G.Hoel,S.C.PortandC.J.Stone,IntroductiontoProbabilityTheory,Universal BookStall,2003(Reprint).
3. W.Feller,AnIntroductiontoProbabilityTheoryanditsApplications,Vol.1,3rd Ed., Wiley,1968.
4. B.S.Grewal,HigherEngineeringMathematics, KhannaPublishers, 35thEdition,2000.

| ES – 06 | WORKSHOP/MANUFACTURING PRACTICES (LAB.) | 1 0 4 3 |
|---|---|---|

**WORKSHOP/MANUFACTURING PRACTICES (LECTURES & VIDEOS): (10 HOURS)**

**COURSE OBJECTIVES: (Skill Development)**

1. To study bench fitting drawings for making male and female fittings as per the given dimensions and Tolerances.
2. To study Arc welding drawings for making common weld joints as per the given dimensions.
3. To study sheet metal development drawings for making common metal parts/components as per the given dimensions.

**DETAILED CONTENTS:**

1. 1.Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods (3 lectures)
2. CNC machining, Additive manufacturing (1 lecture)
3. Fitting operations & power tools (1 lecture)
4. Electrical &Electronics (1 lecture)
5. Carpentry (1 lecture)
6. Plastic moulding, glass cutting (1 lecture)
7. Metal casting (1 lecture)
8. Welding (arc welding & gas welding), brazing (1 lecture)

**WORKSHOP PRACTICE:**

**Machine shop** 10

To make Facing and plain turning, step turning, drilling in the lathe

**Fitting shop** 8

To make square, V joint in bench fitting as per the given dimension and tolerances

**Carpentry** 6

To make half lap joint, dovetail, TEE Lap joint

**Electrical & Electronics** 8

i. To make fluorescent lamp wiring.
ii. To make stair case wiring.
iii. To make residential wiring.
iv. To measure Peak-peak, RMS, period, frequency using CRO.
v. To solder components devices and circuits by using general purpose PCB.

**Welding shop (Arc welding 4 hrs + gas welding 4 hrs)** 8

To make single, butt, lap and T fillet joint by arc welding with the back hand and fore hand welding techniques as per the given dimensions.

**Plumbing Works**

Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.

Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.

**Sheet Metal Work**

To make simple Dust pan, Rectangular trays in sheet metal with the jigs as per the given Dimensions.

**COURSE OUTCOMES (Skill Development)**

Upon completion of this laboratory course, students will be able

CO1: Understand the various type of welding joints ,fitting work and plumbing works
CO2: Develop operating skill in turning and shaper machine
CO3: Develop simple Cubical blocks, Rectangular trays in sheet metal with the jigs as per the given dimensions.
CO4: Measure the electrical quantities in the given circuit
CO5: Demonstrate staircase wiring, fluorescent lamp wiring and residential wiring.

**TEXT/REFERENCE BOOKS:**

1. HajraChoudhury S.K., HajraChoudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.

2. Kalpakjian S. And Steven S. Schmid, “Manufacturing Engineering and Technology”, 4th edition, Pearson Education India Edition, 2002.
3. Gowri P.Hariharan and A. Suresh Babu, “Manufacturing Technology – I” Pearson Education, 2008. 23 4. Roy A. Lindberg, “Processes and Materials of Manufacture”, 4thedition, Prentice Hall India, 1998.
4. Rao P.N., “Manufacturing Technology”, Vol. I and Vol. II, Tata McGraw Hill House, 2017

| BS – 07 | MATHEMATICS – III<br>(NUMERICAL METHODS) | 3 1 0 4 |
|---|---|---|

**COURSE OBJECTIVE: (Skill Development)**

- Using appropriate numerical methods, determine approximate solutions to ordinary differential equations.
- Analyse the errors obtained in the numerical solution of problems.

**UNIT I: Solution Of Equations And Eigenvalue Problems** **12**

Solution of algebraic and transcendental equations –iteration method – Newton Raphson method – Solution of linear system of equations- Gauss elimination method –- Gauss-Jordon method–Matrix Inversion by Gauss Jordon method – Eigen value of a matrix by power method .

**UNIT II : Interpolation And Approximation** **12**

Interpolation with unequal intervals- Lagrange's interpolation – Newton's Divided difference interpolation– Interpolation with equal intervals- Newton's forward and backward difference formulae.

**UNIT III : Numerical Differentiation And Integration** **12**

Approximation of derivatives using interpolation polynomials- Numerical integration using trapezoidal and Simpson's 1/3 and 3/8 rule – Romberg's method

**UNIT IV: Initial Value Problems For Ordinary Differential Equations** **12**

Single step methods: Taylor series method – Euler's method-Modified Euler's method– Fourth order Runge – Kutta method for solving first order equations

**UNIT V: Boundary Value Problems In Ordinary And Partial Differential Equations 12**

Finite difference methods for solving two-point linear boundary value problems – Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain

**COURSE OUTCOME:**

CO1: Apply appropriate algorithms to solve selected problems based on Eigenvalues
CO2: Compare different algorithms with respect to accuracy and efficiency of solution.
CO3: Appropriate numerical methods, determine the solutions to given non-linear equations.
CO4: Appropriate numerical methods, determine approximate solutions to systems of linear equations.
CO5: Demonstrate the use of interpolation methods to find intermediate values in given graphical and/or tabulated data.

**TEXT BOOKS:**

1. Grewal, B.S. and Grewal,J.S., " Numerical methods in Engineering and Science ", 9th Edition, Khanna Publishers, New Delhi, 2012.
2. Gerald, C. F. and Wheatley, P.O., "Applied Numerical Analysis", 6th Edition, Pearson Education, Asia, New Delhi, 2006.
3. Sivaramakrishna Das.P and Vijayakumari.C, Numerical Analysis, 2014, Pearson Eduaction limited in south Asia.

**REFERENCE BOOKS:**

1. Chapra, S. C and Canale, R. P., "Numerical Methods for Engineers",Tata McGraw-Hill, New Delhi, 5th Edition, 2007.
2. Sankara Rao K, "Numerical Methods for Scientisits and Engineers",Printice Hall of India,New Delhi, 3rd Edition,2007 .

| BS – 08 | BIOCHEMISTRY | 3 0 0 3 |
|---|---|---|

**COURSE OBJECTIVE (Employability)**

The students will be able to

- Understand the insight into the chemical aspects of biological macromolecules and their importance
- Analyze the basics of biochemistry, i.e, synthesis and carbohydrates, lipids etc
- Understand the Classification, structure and properties of carbohydrates, Lipids, Protein and Enzymes

**UNIT 1 CARBOHYDRATES** **9**

Introduction.Classification, Properties and Biological importance.Isomers, epimers, enantiomers, mutarotation, open chain and closed chain structures of glucose.

**UNIT 2 AMINOACIDS AND PROTEINS** **9**

Aminoacids: classification- essential and non-essential amino acids, protein and non-protein amino acids, Zwitter ions. Proteins: Classification- based on i) shape and solubility and ii) increasing complexity of structure. Structure of proteins: primary, secondary, tertiary and quaternary, biological significance. Concept of isoelectric point and its significance.

**UNIT 3 LIPIDS** **9**

Introduction, Classification, Properties and Biological importance. Fatty acid nomenclature and structure, Lipids in cell membrane Cholesterol and Steroids, Hormones - structure and function.

**UNIT 4 NUCLEIC ACIDS** **9**

Introduction- Nitrogeneous bases - Purines and Pyrimidines - Nucleosides and Nucleotides -- Structure of nucleic acids - DNA, RNA: m-RNA, t-RNA, r-RNA - Biological importance of nucleic acids. 16s rRNA and its significance.

**UNIT 5 VITAMINS AND MINERALS** **9**

Vitamins: fat soluble and water soluble vitamins. Minerals: Micro and Macro minerals. Biological importance of vitamin and minerals, deficiency symptoms

**TOTAL: 45 HOURS**

**COURSE OUTCOMES:**

**At the end of the course, the student will learn the:**

CO1: Explain the chemical aspects of classification of carbohydrates
CO2: Illustrate the basic concepts of proteins and amino acids
CO3: Examine the properties and biological importance of lipids
CO4: Explain in detail about nucliec acids and their biological importance
CO5: Examine the significance of vitamins and minerals and deficiency caused by them

**TEXT / REFERENCE BOOKS**

1. Lehninger, Nelson and Cox, Principles of Biochemistry, W.H.Freeman, 4th Edition, 2005
2. Donald Voet, Judith Voet and Charlotte Pratt, Principles of Biochemistry, John Wiley and Sons, 2008
3. Pamela C.Champe, Richard A.Harvey and Denise R.Ferrier, Biochemistry, Lippincott's Illustrated reviews, 4th edition, 2007
4. Stryer, L., Biochemsitry, 4th Edition, W.H. Freeman & Co., 2000.

| ES – 06 | ELECTRONIC DEVICES AND CIRCUITS | 3 0 0 3 |
|---|---|---|

**COURSE OBJECTIVE(Employability)**

To help the student understand the basics of the principles of circuit analysis and design

- To understand the basic concepts and characteristics of the electronic devices and circuits.
- To impart a sound knowledge about the Basic Concepts of semiconductor devices – PN Junction Diode Characteristics and Field effect Transistors.
- To impart knowledge about the design of Rectifiers and Amplifiers.
- To study and design the applications of Oscillators and its Medical Applications.

**UNIT 1 SEMICONDUCTOR DIODE** **9**

Intrinsic and Extrinsic semiconductor, PN junction Diode: Construction, Working and VI Characteristics, Application of diode: Diode switch, Clipper, Clamper and Voltage multipliers - Zener diode - Zener voltage regulators.

**UNIT II FIELD EFFECT TRANSISTORS** **9**

JFET: Construction, Operation and Characteristics, Expression for pinch off voltage and drain current, MOSFET: Enhancement mode and Depletion mode MOSFET operation and characteristics, handling precautions of MOSFET, FET as VVR - Comparison of MOSFET and JFET - Comparison of BJT and JFET**.**

**UNIT III RECTIFIERS AND POWER SUPPLIES** **9**

Half Wave and Full Wave Rectifier, Bridge rectifier - performance measures of rectifiers, filters: Full Wave rectifier with inductive filter, capacitive filter, LC filter, Regulators-Shunt and series voltage regulators - Performance measures of regulators - Simple power supply circuits for medical instruments.

**UNIT IV MULTISTAGE AMPLIFIERS AND POWER AMPLIFIERS** **9**

Introduction to multistage amplifiers, Two stage RC Coupled amplifier, Darlington emitter follower amplifier, Bootstrap amplifier Introduction, Power Amplifiers: Class A Power Amplifier, Push Pull Principle, Class B push pull amplifier and complementary symmetry amplifier, Class C amplifier, Distortion in amplifiers - Medical applications.

**UNIT V FEEDBACK AMPLIFIERS AND OSCILLATORS** **9**

Effects of negative feedback, Voltage series, voltage shunt, current series and current shunt feedback amplifiers, Barkhausen Criterion for Oscillation, Construction and working of RC, Wein bridge oscillator, Hartley Oscillator, Colpitt's Oscillator, Crystal Oscillator - Medical applications.

**TOTAL: 45 HOURS**

**COURSE OUTCOMES:**

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

CO1: Understand the Basics of electronic devices like diodes, transistors
CO2: Develop knowledge about the principles, construction, characteristics and functioning of different devices
CO3: Determine a deep knowledge about the basic circuits in electronics
CO4: Articulate knowledge about the multistage and power amplifiers
CO5: Analyse and understand the design of oscillators and feedback amplifiers

**TEXT / REFERENCE BOOKS**

1. Robert L. Boystead and Louis Nashelky, Electronic Devices and Circuits, 8th Edition, PHI, 2005.
2. Theodore F. Bogart Jr., Jeffrey S. Beasley, Guillermo Rico, Electronic devices and circuits, PPH, 2004.
3.Millman& Halkias, Integrated Electronics, McGraw Hill International Edition. 1991
4. David A. Bell, Electronic Devices and Circuits, PHI

| PC – 01 | HUMAN ANATOMY AND PHYSIOLOGY | 3 0 0 3 |
|---|---|---|

**COURSE OBJECTIVES (Skill Development)**

**The students will be able:**

- To learn to appreciate the fascinating and ancient branch of science because it unfolds the mystery of complicated and functional aspects of individual organs of the body.
- The learning provides a solid foundation for understanding the structure and function of the human body. It also explains how body systems function to maintain homeostasis on day-to-day basis through the process of circulation, respiration, digestion, cellular metabolism, urinary functions and buffer systems.
- It is geared to preparing students for careers in health related professions.

**UNIT 1 CARDIOVASCULAR SYSTEM** **9**

Blood, Blood groups, Blood coagulation, structure and function of hemoglobin. Heart - Anatomy of heart; origin, conduction and regulation of heart beat, Cardiac cycle, Electrocardiogram, Blood pressure, regulation of blood pressure.

**UNIT 2 DIGESTIVE AND EXCRETORY SYSTEM** **9**

Overview of organs of digestive system-mouth, stomach, Small intestine, large intestine, Liver, Structure of Kidney, Physiology of urine formation, Role of the kidney in the regulation of water, salt and acid base balance.

**UNIT 3 ENDOCRINE AND NERVOUS SYSTEM** **9**

Endocrine System - Hormones - Pituitary Gland,Pineal Gland, Thyroid Gland, Pancreas, Adrenal Glands, Neuron, Organization of Nervous System - Brain and Spinal cord, Synapse, Reflex activity, Pain, EEG.

**UNIT 4 RESPIRATORY AND SENSORY SYSTEM** **9**

Physiology of Respiration, Pulmonary Function tests, Exchange and transport of gases in the Blood, Regulation of respiration.Structure of eye and ear, physiology of vision, Mechanism of hearing.

**UNIT 5 BONES AND MUSCLE PHYSIOLOGY** **9**

Bones - types, formation, Development and growth of bone, Axial and Appendicular Skeleton, Joints of Skeleton, Types of muscles - Skeletal, Cardiac and Smooth muscle structure. Changes during muscular contraction.Structure of neuro muscular junction.Electromyogram.

**TOTAL: 45 HOURS**

**COURSE OUTCOMES:**

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

CO1: Analyse the various concepts of cardiovascular system
CO2: Examine various parts of digestive and excretory system
CO3: Illustrate the concepts of Endocrine and nervous system
CO4: Explain the various functions of respiratory and sensory system
CO5: Explain about bones and muscle physiology

**TEXT / REFERENCE BOOKS**

1. Ross and Wilson, Anatomy and Physiology in Health and Illness, Churchill Livingstone, 9th Edition.2001
2. Gerard. J. Tortora. Principles of Human Anatomy and physiology, Harper Collins College Publishers, 7th Edition.2005
3. Arthur C. Guyton & John E. Hall, Text Book of Medical Physiology, W.B.Saunders Company, London, 12th Edition.1996.
4. P. Saraswathi, Handbook of Anatomy for Nurses Jaypee Brothers Medical Publishers (P) Ltd, 1st Edition.2014.
5. K Sembulingam and Prema Sembulingam, Essentials of Medical Physiology, Jaypee Brothers Medical Publishers P Ltd., 2nd Edition, 2001.

| PC – 02 | ANATOMY AND PHYSIOLOGY LAB | 0 0 3 1 |
|---|---|---|

**COURSE OBJECTIVE: (Skill Development)**

- **To provide the students the exposure to the fundamentals in human anatomy and physiology.**

**LIST OF EXPERIMENTS**

1. Identification and study of human eye
2. Identification and study of human brain
3.Identification and study of human heart
4.Identification and Study of Human Skull
5. Study of ECG.
6. Blood Pressure Monitoring.
7. Blood group identification
8. Auscultation for Heart Sounds(Sthethescope)
9.Identification and study of human bones
a.Upper limb bones
b.Lower limb bones
10.Physical examination of Urine
11.Study and Identification of Human Skeleton System
12.Working of Galvanic Skin Resistance(GSR)
13.Measurement of Human Body Temperature

**COURSE OUTCOMES:**

**At the end of the course, the students would**

CO1: Analyse the various parts of eye, brain, heart and skull
CO2: Examine various physiological signals.
CO3: Determine various blood groups
CO4: Distinguish various types of bones in human skeletal systems
CO5: Examine the physiological properties of urine

| PC – 03 | BIOINSTRUMENTATION AND MEASUREMENTS | 3 0 0 3 |
|---|---|---|

**COURSE OBJECTIVES (Employability)**

**The students will be able to learn:**

- The purpose of learning the course onIntegrated circuit design for bioinstrumentation for biomedical engineering students is to enable the students to understand the fundamentals of linear integrated circuits and to implement and study in relation to the various medical related applications
- To study the static and dynamic behavior of analog and digital instruments and basic construction and working of AC and DC instruments for measurement of Voltage and Current.
- To obtain basic knowledge of digital instruments for measurement of voltage and current.
- To study signal generator and signal analysis. Also to study the different output devices analog and digital recorders.

**UNIT 1 INTRODUCTION** **9**

Function elements of measuring instrument, Error in Measurement, Sources of Error, Static Characteristics: Accuracy, Sensitivity, Reproducibility, Drift, Static error types and Dead zone, Dynamic Characteristics: Speed of Response, Fidelity, Lag and Dynamic Error, Dynamic response of different order systems.

**UNIT 2 BASICS OF ANALOG INSTRUMENTS** **9**

D'arsonval Galvanometer, Moving coil Instruments: Permanent magnet moving coil instrument, PMMC ammeter and PMMC voltmeter, Ohmmeter: Shunt type and Series type.Basic Electrodynamomter type instrument, Electrodynamometer type Ammeter and Electrodynamometer type voltmeter - Construction and working principle-Wheatstone's Bridge-Kirchoff's Law.

**UNIT 3 BASICS OF DIGITAL INSTRUMENTS** **9**

Basic building block of a digital instrument, Ramp type digital voltmeter, Digital frequency meter, Digital phase meter and Digital storage oscilloscope, Comparison between analog and digital instruments.

**UNIT 4 SIGNAL GENERATION AND SIGNAL ANALYSIS** **9**

Standard signal generator, AF Sine and square wave generator, Function generator, RF generator, Basic Wave Analyzer, Heterodyne wave analyzer Spectrum analyzer and Harmonic distortion analyzer.

**UNIT 5 DISPLAY DEVICES AND RECORDERS** **9**

Digital Display System and Indicators: Classification of display devices, DOT MATRIX display, LED Seven Segment display, LED matric display, LCD seven segment display, Recorders: Graphic Recorders - Strip chart recorders, Galvanometer type recorders and Self balancing type potentiometric recorders, Magnetic tape recorders and Disc recorders

**TOTAL: 45 HOURS**

**COURSE OUTCOMES:**

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

CO1: Explain the introduction and characteristics of instruments
CO2: Illustrate the basic working of Analog instruments
CO3: Examine the basic characteristics of digital instruments and its advantages
CO4: Explain the structure of signal generation and signal analysis
CO5: Explain the working of display devices and recorders

**TEXT / REFERENCE BOOKS**

1. A. K. Sawhney, A course in electronic Measurements and Instruments, Dhanpat Rai sons, 1991.
2. H.S. Kalsi, Electronic Instrumentation & Measurement, Tata McGraw HILL, 1995
3. W.D cooper and A. D. Helfrick, Electronic Instruments and Measurements Techniques, Prentice Hall of India-1991
4. E. O. Doeblin, Measurement System - Application & Design, Mc Graw Hill, 1990

| PC – 04 | BIOMECHANICS AND BIOFLUIDS | 3 0 0 3 |
|---|---|---|

**COURSE OBJECTIVE: (Employability)**

**The students will be able to:**

- Enable the student gain knowledge about the structure and function of biological systems such as humans, animals, plants, organs, and cells by means of the methods of mechanics and their applications in different fields.
- Know the rehabilitation robotics for biomedical engineering students is to acquire knowledge on the working concepts of various rehabilitation equipments for human movements

**UNIT 1 BIOMECHANICS** **9**

Biomechanics- Definition and perspective, Fundamental Mechanical Concepts- Kinetics and Kinematics, Newton's Laws, Mechanical Properties -Stress, Strain, Elasticity, Shear, Tension,Forces, Compression, Plastic Deformation, Creep, and Fatigue. Mechanical testing of biomaterials.

**UNIT 2 FLUID MECHANICS** **9**

Viscosity-Definition, properties.Types of fluids- Newtonian fluid, Non- Newtonian fluid, Types of fluid flow.Hagen-Poiseulle's equation. Viscoelasticity-Viscoelastic Models, Vascular tree, Flow properties of Blood, Physical, Chemical and Rheological properties of blood, Apparent and Relative and viscosity, Fahraeus-Lindqvist Effect

**UNIT 3 HUMAN LOCOMOTION** **9**

Anthropometric Characteristics of human body.Types of motion in humans, Gait analysis.Goniometry.Accelerometer, Foot Pressure Measurements-Pedobarograph-Force platform.Mechanics of foot.

**UNIT 4 HARD AND SOFT TISSUE MECHANICS** **9**

Biomechanics of upper extremities-Elbow, Shoulder.Biomechanics of lower extremities-Hip and Knee.-Tissue Mechanics-Mechanical Properties of Tissues, Biological materials, Properties of Cortical, Cancellous Bone.Soft Tissue properties Mechanical testing of Soft tissue.

**UNIT 5 SPORTS MECHANICS** **9**

Application of biomechanics to neuromuscular fitness, gymnastics, Application of aerodynamics in sports, hydrodynamics in swimming. Analysis of throw and push patterns. Sports Medicine

**TOTAL: 45 HOURS**

**COURSE OUTCOMES**:

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

CO1: Understand the principles of mechanics and Mechanical testing of biomaterials
CO2: Analyze the Fluid mechanics principles
CO3: Explain the fundamentals of Human Locomotion and its measuring techniques
CO4: Apply the knowledge of joint mechanics.
CO5: Apply the principles of the Sports Mechanics

**TEXT / REFERENCE BOOKS**

1. Susan J Hall, Basic Biomechanics, Mc Graw Hill, 1999.
2. Y. G. Fung, Biomechanics, Springer-verlag New York Inc, 1990
3. Ellen Kreighbaum, Barthels, Biomechanics - A qualitative approach for studying human movement, Macmillan,2nd Edition,1985.
4. Joseph Bronzino Hand book of Biomedical Engineering, Springer,2nd Edition,2000. 5. Buddy Ratner etal., Biomaterials Science - An Introduction to Materials in Medicine, Academic Press, San Diego, 1996.

| ES – 07 | ELECTRONIC DEVICES&CIRCUITS LAB | 0 0 3 1 |
|---|---|---|

**COURSE OBJECTIVE: (Skill Development)**

**The student should be able to**

- Describe principles and applications of different ammeters and voltmeters
- Explain the types and working of watt meters and energy meters
- Learn the types, construction, and working of different types of potentiometers
- Describe in detail the different methods of resistance measurements
- Describe in detail the different methods of impedance measurements

**LIST OF EXPERIMENTS**

1. Rectifiers – HWR and FWR (with & without capacitor filter)
2. Zener diode as regulator
3. Study of biasing circuits a. i). Fixed bias, ii). Self bias, iii). collector to base bias
4. FET amplifier
5. Differential amp – CMRR and determination of Gain
6. Design of RC coupled amplifier
7. Design of Voltage series feedback amplifier
8. Design of Class A and Class B amplifier
9. Design of RC phase shift oscillator
10. Design of Hartely Oscillator
11. Design of Colpit oscillator
12. Study of pulse shaping circuits i). AstableMultivibrator ii). MonostableMultivibrator

**COURSE OUTCOMES:**

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

CO6: Articulate knowledge about the simple and basic circuits.
CO7: Develop knowledge about responses and design of the coupled amplifiers
CO8: Analyse and understand the basic design of power amplifiers
CO9: Categorise and define the design of different oscillators
CO10: Analyse the multibrivators and determine the applications of electronic circuits

| HS – 03 | PERSONALITY DEVELOPMENT I | 0 0 2 1 |
|---|---|---|

**COURSE OBJECTIVES:(Skill Development)**

- To nurture and develop winning personalities and eventually leading them to become dynamicand socially responsible leaders
- To avoid negative spiritual experiences it's important to keep the balance between spiritual and physical life.
- To guide and orient students into becoming effective and exceptional communicators

**UNIT I SOFT SKILLS I 6**

Introduction to Personality Development – Meaning-Features of personality=Dimensions of Personality=Determinants of Personality-Features and Traits- Components of self concept-Barriers-Self analysis

**UNIT II SOFT SKILLS II 6**

Importance of Soft Skills – First impression-Workplace requirements-Discipline-Cleanliness-Hygiene-general Appearance--Building Confidence—Concept of Thinking and Usage-Value of Time-Focus & Commitment.

**UNIT III SOFT SKILLS IN ACTION 6**

Grooming – Attire – Understanding others- – Stability & Maturity Development – Strengths – Weakness –Opportunities-threats -Merits of SWOT Analysis-Components-how to convert weakness into strengths-Goal settings

**UNIT IV SELF AWARENESS AND SELF ESTEEM 6**

Definitions-Components of self awareness-Developing Self awareness-Self esteem-meaning-Steps to improve self esteem

**UNIT V SELF MOTIVATION 6**

Motivation –Meaning-Techniques of self motivation-Motivation & goal setting – Motivation and emotion – Motivation at work.

**Total: 30 Hours**

**COURSE OUTCOME**

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

CO1: Be familiar with the features, dimensions and determinants of personality.
CO2: Understand the barriers and perform self analysis.
CO3: Understand the significance of first impression.
CO4: Demonstrate confidence, punctuality and commitment as an engineer.
CO5: Understand the significance of modest grooming and attire.

**REFERENCES:**


1. Personality Development And Soft Skills---Barun K Mitra, Oxford Publication
2. Seven habits of Higly Effective people – Stephen R. covey
3. Emotion, motivation and Self regulation - Nathan C. Hall , McGill University, Canada, Thomas Goetz, University of Konstanz, Germany
4. http://www.emeraldgrouppublishing.com/
5. Psychology of Selfesteem – Nathaniel Branden, Nash (1st edition), Jossey-Bass (32nd anniversary edition

| MC – 01 | ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE | 2 0 0 2 |
|---|---|---|

**Course objective (Skill Development)**

The course aims at imparting basic principles of thought process, reasoning and inferencing. Sustainability is at the core of Indian Traditional knowledge Systems connecting society and nature. Holistic life style of yogic science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions. Part-I focuses on introduction to Indian Knowledge Systems, Indian perspective of modern scientific world-view, and basic principles of Yoga and holistic health care system. Part-2 focuses on Indian philosophical traditions, Indian linguistic Tradition, and Indian artistic tradition.

**Course Contents**

**Part-I**

Basic structure of Indian Knowledge System

Modern Science and Indian Knowledge System

Yoga and Holistic Health care

Case studies

**Part-II**

Philosophical Tradition

Indian Linguistic Tradition (Phonology, morphology, syntax and semantics)

Indian Artistic Tradition

Case studies

**References**


1. V. Sivaramakrishnan (Ed.), *Cultural Heritage of India-course material*, Bharatiya
2. Vidya Bhavan, Mumbai. 5th Edition, 2014
3. Swami Jitatmanand, *Modern Physics and Vedant*, Bharatiya Vidya Bhavan
4. Swami Jitatmanand, *Holistic Science and Vedant*, Bharatiya Vidya Bhavan
5. Fritzof Capra, *Tao of Physics*
6. Fritzof Capra, *The Wave of life*
7. VN Jha (Eng. Trans.), *Tarkasangraha of Annam Bhatta*, International Chinmay
8. Foundation, Velliarnad, Arnakulam
9. *Yoga Sutra of Patanjali*, Ramakrishna Mission, Kolkata
10. GN Jha (Eng. Trans.), Ed. RN Jha, *Yoga-darshanam with Vyasa Bhashya*,
11. Vidyanidhi Prakashan, Delhi 2016
12. RN Jha, *Science of Consciousness Psychotherapyand Yoga Practices*, Vidyanidhi
13. Prakashan, Delhi 2016
14. P B Sharma (English translation), *Shodashang Hridayan*
15. V. Sivaramakrishnan (Ed.), *Cultural Heritage of India-course material*, Bharatiya
16. Vidya Bhavan, Mumbai. 5th Edition, 2014
17. S.C. Chaterjee & D.M. Datta, *An Introduction to Indian Philosophy*, University of
18. Calcutta, 1984
19. K.S. Subrahmanialyer, *Vakyapadiya of Bhartrihari, (Brahma Kanda)*, Deccan
20. College Pune 1965 *Panini Shiksha*, MotilalBanarasidas

*21.* V.N. Jha, *Language, Thought and Reality,*
22. Pramod Chandra, *India Arts,* Howard Univ. Press, 1983
23. Krishna Chaitanya, *Arts of India*, Abhinav Publications, 1987
24. R. Nagaswamy, *Foundations of Indian Art,* Tamil Arts Academy, 2002

**Pedagogy:** Problem based learning, group discussions, collaborative mini projects.

**COURSE OUTCOME**

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

CO1: Determine the Connectedness between society and the natural world is facilitated.
CO2: Apply Sense of theology together with yogic knowledge paves way for mental health.
CO3: Illustrate the Ancient Indian knowledge system and the Indian perception of the modern world develops wider outlook of learners.
CO4: Analyse the Case studies facilitate pragmatic realization of the Indian knowledge system.
CO5: Describe to realize the significance of culture and metaphysics in life.

| BS – 09 | FIBER OPTICS AND LASERS IN MEDICINE | 3 0 0 3 |
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**COURSE OBJECTIVE:(Employability)**

**The students will be able:**

- To enable the student to understand the basics of tissue properties, instrumentation principles in medical optics and the the therapeutic applications.
- Explain the principles of light emission in LED and LASER
- Learn the surgical applications of LASER
- Basics of holography and its applications

**UNIT- I TYPES OF LASERS AND DISPLAY DEVICES 9**

Lasers-Definition-Types-Working-Helium Neon Laser-Argon Laser-Ruby Laser-Nd:Yag Laser-Semiconductor Laser Diode-LCD display: --liquid crystals, construction and types.

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

Refraction, scattering, absorption, light transport inside the tissue, tissue properties, Light interaction with tissues, optothermal interaction, fluorescence, speckles.

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

Lasers in ophthalmology- Dermatology – Types of lasers used in dermatology – Dentistry- Types of Dental lasers - Urology – Surgical Laser therapy in urology - Otolaryngology - Tissue welding – Specifications Laser in tissue welding,lasers in ophthalmology.

**UNIT - IV OPTICAL HOLOGRAPHY &NON THERMAL DIAGNOSTIC APPLICATIONS 9**

Wave fronts, interference patterns, principle of hologram, optical hologram, applications,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 APP LICATIONS 9**

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

**TOTAL: 45 HOURS**

**COURSE OUTCOMES:**

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

CO1: Describe the laser radiation characteristics and interaction of lasers with tissues

CO2: Explain the types, construction and operation of different laser systems

CO3: Associate the role of different types of laser systems used for biomedical applications

CO4: Understand the applications of laser in ophthalmology, dermatology, urology, gynecology and neurology

CO5: Attain the knowledge on applications of laser in orthopedic surgery, dentistry and precautionary method in laser safety.

.**TEXT BOOKS:**

1. Leon Goldman, M.D., &R.James Rockwell, Jr., “Lasers in Medicine”, Gordon and Breach, Science Publishers Inc., 1975.
2. Abraham Katzir, “Lasers and Optical Fibers in Medicine”, Academic Press Edition,1998.

**REFERENCES:**

1. Tuan Vo Dirh, “Biomedical Photonics – Handbook”, CRC Press, Bocaraton,2003 (Unit I – III, V)
2. Glasser, O., “Medical Physics -- Vol 1, 2, 3 “Adam HilgarBrustolInc, 1987.
3. G.David Baxter “Therapeutic Lasers – Theory and practice”, Churchill Livingstone Publications Edition- 2001.

| ES – 08 | BIOSENSORS AND TRANSDUCERS | 3 0 0 3 |
|---|---|---|

**COURSE OBJECTIVES (Employability)**

- To enable the student to gain knowledge about the measuring instruments and the methods of measurements
- To know about the types of transducers available and their applications in different fields.

**UNIT 1 INTRODUCTION** **9**

General measurement system - purpose, structure and elements-Transducers - Definition, Classification.Resistance type- strain gauges, thermometers, potentiometers.Capacitive type, Inductive type- variable reluctance and LVDT.Biomedical Applications.

**UNIT 2 TRANSDUCERS** **9**

Temperature transducers, Piezoelectric transducers, Piezo resistive transducers, Photoelectric transducers, Pressure transducers, Magnetostrictive transducers Biomedical applications.

**UNIT 3 BIO POTENTIAL ELECTRODES** **9**

Half cell potential (or) Electrode potential, Types of Electrodes - Micro electrodes, Depth and needle electrodes, Surface electrodes, and Chemical electrodes. Catheter type electrodes, stimulation electrodes, electrode paste, electrode material.

**UNIT 4 BIOSENSORS** **9**

Introduction, biological elements, immobilization of biological components. Micro machined biosensor - cantilever based chemical sensors - Biosensors for diabetes mellitus, FAB. Biochip - introduction, gene chip.

**UNIT 5 APPLICATIONS OF BIOSENSORS** **9**

ISFET for glucose and urea.IMFET, MOSFET biosensors, affinity biosensor (catalytic biosensor), Enzyme electrodes, Ion exchange membrane electrodes.

**COURSEOUTCOMES:**

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

CO1: Explain the introduction and characteristics of transducers
CO2: Illustrate the types of transducers
CO3: Examine the basic characteristics of biopotential recorders
CO4: Explain the structure of biosensors in detail
CO5: Explain the working and applications of Biosensors

**TEXT / REFERENCE BOOKS**

1. H.S. Kalsi, Electronic Instrumentation & Measurement, Tata McGraw HILL, 1995.
2. Brain R Eggins, Biosensors: An Introduction", John Wiley Publication.1996.
3. A. K.Sawhney, A course in Electronic Measurements and Instruments, Dhapat Rai & sons, 1991
4. John G Webster, Medical Instrumentation: Application and design, John Wiley Publications.2007.
5. John P Bentley, Principles of Measurement Systems, 3rd Edition, Pearson Education Asia, (2000 Indian reprint)
6. Geddes and Baker, Principles of Applied Biomedical Instrumentation, John Wiley Publications. 1975.

| PC – 05 | BIOCONTROL SYSTEMS | 3 0 0 3 |
|---|---|---|

**COURSE OBJECTIVES:(Employability)**

- To study concept and different mathematical techniques applied in analyzing any given system
- To learn to do the analysis of given system in time domain and frequency domain
- To study the techniques of plotting the responses in both domain analysis
- To study techniques of modeling the physiological systems

**UNIT I CONTROL SYSTEM MODELLING** **9**

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

**UNIT II 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 computation, definition of stability, RouthHurwitz criteria of stability, root locus technique, construction of root locus and study of stability, definition of dominant poles and relative stability .

**UNIT III 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 resonance frequency and band width.

**UNIT IV PHYSIOLOGICAL CONTROL SYSTEMS** **9**

Block diagram representation of the muscle stretch reflex, difference between engineering and physiological control systems, generalized system properties , models with combination of system elements, introduction to simulation.

**UNIT V PHYSIOLOGICAL SYSTEM MODELING** **9**

Linear model of respiratory mechanics, model of chemical regulation of ventilation, linear model of muscle mechanics, model of regulation of cardiac output, model of Neuromuscular reflex motion.

**TOTAL: 45 HOURS**

**COURSE OUTCOMES:**

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

CO1: Make use mathematical modeling of various systems, representation of systems in block diagrams and signal flow graphs and are introduced to biological control systems

CO2: Analyze the time response of various systems and discuss the concept of system stability

CO3: Analyze the frequency response characteristics of various systems using different charts

CO4: Apply the concept of modeling basic physiological systems

CO5: Comprehend the application aspects of time and frequency response analysis in physiological control systems.

**TEXT BOOKS:**

1. M. Gopal "Control Systems Principles and design", Tata McGraw Hill ,2002
2. Benjamin C. Kuo, "Automatic control systems", Prentice Hall of India, 1995
3. Michael C K Khoo, "Physiological control systems", IEEE press, Prentice –Hall of India, 2001.

**REFERENCES**

1. John Enderle, Susan Blanchard, Joseph Bronzino "Introduction to Biomedical Engineering" second edition, Academic Press, 2005.
2. Richard C. Dorf, Robert H. Bishop," Modern control systems",Pearson, 2004

| PC – 06 | BIOMATERIALS AND ARTIFICIAL ORGANS | 3 0 0 3 |
|---|---|---|

**COURSE OBJECTIVE:(Employability)**

**The student will be able**

- To provide a general introduction to the use of artificial materials in the human body for the purpose of aiding healing, correcting deformities and restoring lost function.
- To have successfully completed elementary course in the mechanics of deformable bodies and an introductory course to material science prior to undertake a course in biomaterials.
- To have deep knowledge in metals,polymers in manufacturing medical devices.

**UNIT 1 BIOMATERIALS** **9**

Biomaterials - Overview, Classification of biomaterials, Interfacial Phenomena and tissue response to biomaterials, Metals and alloys for orthopedic implants-Stainless steel, Cobalt chromium alloy, Titanium and its alloys, Precious metal alloys, Other metal alloys. Dental implants - materials, types and designs.

**UNIT 2 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 3TISSUE REPLACEMENT IMPLANTS** **9**

Small intestinal submucosa and other decullarized matrix biomaterials for tissue repair. Softtissue replacements, sutures, surgical tapes, adhesive, Percutaneous and skin implants, maxillofacial augmentation, Vascular grafts, hard tissue replacement Implants, joint replacements, Pancreas replacement.

**UNIT 4 OPTHALMOLOGY, CORROSION AND TESTS** **9**

Ophthalmology- Introduction, Contact lenses, Eye shields, Viscoelastic solutions, Vitreous implants, Acrylate adhesives, artificial tears. Corrosion, Biocompatibility and Hemocompatibility, Biological Tests.Material surface characterization.

**UNIT 5 ARTIFICIAL ORGANS** **9**

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

**TOTAL: 45 HOURS**

**COURSE OUTCOMES:**

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

CO1: Classify the different types of biomaterials
CO2: Illustrate the basic concepts of polymers and Amino acids
CO3: Explain the principles of tissue replacement implants
CO4: Compare interactions of tissues with biomaterials and ophthalmology
CO5: Evaluate the significance of artificial organs and its effect to human body

**TEXT / REFERENCE BOOKS**


1. Sujata V. Bhatt, ―Biomaterials, Second Edition, Narosa Publishing House, 2005.
2. Park J.B., ―Biomaterials Science and Engineering‖, Plenum Press, 1984.
3. Myer Kutz, ―Standard Handbook of Biomedical Engineering & Design‖ McGraw Hill, 2003

| PC – 07 | MICROPROCESSOR AND MICROCONTROLLER | 3 1 0 4 |
|---|---|---|

**COURSE OBJECTIVE(Employability)**

**The students will be able to learn:**

- The prime objective of this course is to introduce to the students the fundamentals of microprocessor and microcontroller.
- The students will be equipped with the basic knowledge of microprocessor and microcontroller interfacing and their applications.

**UNIT 1 INTRODUCTION TO INTEL 8085 9**

Evolution of Microprocessor - Architecture of 8085 - Instruction format - Addressing modes - Basic timing diagram of opcode fetch, memory read, memory write, I/O read and I/O write - Interrupts of 8085 - Software interrupts, Hardware interrupts, Priorities of interrupts8085 based system design-Example programming 8085.

**UNIT II INTEL 8086 MICROPROCESSOR 9**

Architecture of 8086 ,Addressing Modes,Assembly Language Programming,Procedure,Macros-Interrupts and its applications.Example programming-8086

**UNIT III PERIPHERAL INTERFACING 9**

Interfacing devices- 8255 Programmable Peripherals Interface- Architecture & various modes of operation - 8251 keyboard display controller (8279), ADC, DAC Interface, Programmable Timer Controller (8254).

**UNIT IV MICROCONTROLLER 9**

Architecture of 8051 Microcontroller- Instruction Set – Assembly Language Programming – Branching, I/O and ALU Instructions. Programming 8051 - Timers, Serial Port, Interrupts. C programming for 8051.

**UNIT V APPLICATIONS 9**

Application of microprocessors: Stepper Motor Control, Temperature control, TTL to RS232 Conversion - RS232 to TTL Conversion - Interfacing Biosignal to Microprocessor- block diagram. –Working-Applications.

**TOTAL: 45 HOURS**

**COURSE OUTCOMES**

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

CO1: Understand the fundamental concepts of 8085&8086 microprocessors
CO2: Analyse the application the assembly language of 8085&8086 microprocessors
CO3: Determine the basic concepts of 8051 microcontroller
CO4: Articulate the knowledge of Interfacing Peripheral devices with Microprocessor and Micro controller
CO5: Apply microprocessor and microcontroller in Biomedical Applications.

**TEXT / REFERENCE BOOKS**

1. Ramesh S Gaonkar, Microprocessor Architecture, Programming and application with 8085, 4 th Edition, Penram International Publishing, New Delhi, 2000
2. Kennith J. Ayala, 8051 Microcontroller, Thomson, 2005.
3. Dougles V. Hall, Microprocessor and Interfacing, Tata MC Graw Hill Publication, 2nd Edition, 1992.
4. Charless M. Gilmore, "Microprocessor Principle and application, McGraw Hill publication, 1995.
5. A.NagoorKani, Microprocessor & Microcontroller, Tata Mc Graw Hill, 3rd Edition, 2012
6. B. Ram, Fundamentals of Microprocessors and Microcomputers, Dhanpat Rai Publications, 2001

| PC – 09 | MICROPROCESSOR AND MICROCONTROLLER LABORATORY | 0 0 3 1 |
|---|---|---|

**COURSE OBJECTIVE:(Employability)**

**The student should be made to:**

- Program the 8086 microprocessor.
- Learn the design aspects of I/O and Memory Interfacing circuits.
- Practically interface the communication and bus interfacing.
- Implement the programming of 8051 microcontroller.

**LIST OF EXPERIMENTS**

**Assembly Language Programming of 8085 /8086 based experiments**

1. Programs for 16 bit Arithmetic, Sorting, Searching and String operations,
2. Programs for Digital clock, Interfacing ADC and DAC
3. Interfacing and Programming 8279, 8259, and 8253.
4. Serial Communication between two Microprocessor Kits using 8251.
5. Interfacing and Programming of Stepper Motor and DC Motor Speed control and Parallel Communication between two Microprocessor Kits using Mode 1 and Mode 2 of 8255.
6. Macroassembler

**Programming for 8086/ 8051 based experiments**

1. Programming using Arithmetic, Logical and Bit Manipulation instructions of 8051 microcontroller.
2. Programming and verifying Timer, Interrupts and UART operations in 8051 microcontroller.
3. Interfacing – DAC and ADC and 8051 based temperature measurement
4. Interfacing – LED and LCD
5. Interfacing – stepper motor traffic light control
6. Communication between 8051 Microcontroller kit and PC.

**TOTAL: 45 HOURS**

**COURSE OUTCOMES:**

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

CO1: Design and implement programs on 8085 microprocessor.
CO2: Analyse and implement programs on 8086 microprocessor.
CO3: Design and implement 8051 microcontroller based programs
CO4: Design and implement programs for interfacing peripheral devices
CO5: Illustrate and Implement the instruction sets and interfacing

| PC – 10 | SENSORS AND TRANSDUCERS LABORATORY | 0 0 3 1 |
|---|---|---|

**COURSE OBJECTIVE:(Employability)**

- To study and analyze the theory and practical characteristics of the various transducers for the measurement of the vital physiological signals.
- To get familiar with the various types of transducers and to study the compatibility for any clinical measurements.

**LIST OF EXPERIMENTS**

1. Characteristics of pressure transducer
2. Measurement of displacement capacitive transducer, LVDT and Inductive transducer
3. Characteristics of optical transducer for SpO2 measurement
4. Measurement of skin temperature by both contact and non-contact method
5. Study of the characteristics of capacitor level sensor for saline level measurement in a I-V set.
6. Data acquisition of physiological signals
7. Study of hot-wire anemometry
8. Study of amperometric sensor for blood glucose measurement
9. Electronic weighing machine for the measurement of chemical compounds
10. Non-invasive gas analyzer as an electronic nose.

**TOTAL: 45 HOURS**

**COURSE OUTCOMES:**

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

CO1: Analyze about various theory, practical characteristics and conversions of the various transducers
CO2: Evaluate the measurement of the vital physiological signals such as heart rate, spo2 etc
CO3: Analyze various types of transducers
CO4: Test compatibility for any clinical measurement
CO5: Apply the biosensors in different measurement techniques

| BS – 10 | BASIC LIFE SKILLS | 0 0 2 1 |
|---|---|---|

**COURSE OBJECTIVE:(Skill Development)**

Providing value education to improve the students' character - understanding of principled life and physical health - maintaining youthfulness - measures and methods in five aspects of life

**UNIT I: PHYSICAL HEALTH** **6**

1. Manavalakalai (SKY) Yoga: Introduction - Education as a means for youth empowerment - Greatness of Education - Yoga for youth Empowerment.
2. Simplified Physical Exercises: Hand, Leg, Breathing, Eye exercises - Kapalabathi, Makarasana Part I, Makarasana Part II, Body Massage, Acu pressure, Relaxation exercises - Benefits.
3. Yogasanas: Pranamasana - Hastha Uttanasana - Pada Hasthasana – AswaSanjalana Asana - Thuvipatha asva Sanjalana asana - Astanga Namaskara - Bhujangasana - Atha Muktha Savasana - Aswa Sanjalana Asana - Pada Hasthasana - Hastha Uttanasana - Pranamasana.
4. Pranayama :Naddi suddi - Clearance Practice - Benefits.

**UNIT II: LIFE FORCE** **6**

1. Reasons for Diseases - Natural reasons (Genetic / imprints, Planetary Position, Natural calamities and climatic changes) - Unnatural reasons (Food habits, Thoughts, Deeds)
2. Philosophy of Kaya kalpa - Physical body - Sexual vital fluid - Life force - Bio-Magnetism - Mind.
3. Maintaining youthfulness : Postponing old age - Transformation of food into seven components - Importance of sexual vital fluid –
4. Measure and method in five aspects of life - Controlling undue Passion.
5. Kayakalpa practice - Aswini Mudra - Ojas breath - Benefits of Kaya Kalpa.

**UNIT III: MENTAL HEALTH** **6**

1) Mental Frequencies - Beta, Apha, Theta and Delta wave - Agna Meditation explanation - benefits.
2) Shanthi Meditation explanation - Benefits
3) Thuriya Meditation explanation - Benefits
4) Benefits of Blessing - Self blessing (Auto suggestion) - Family blessing - Blessing the others - World blessing - Divine protection

**UNIT IV: VALUES** **6**

- Human Values:
  1) Self control - Self confidence - Honesty
  2) Contentment - Humility - Modesty
  3) Tolerance - Adjustment - Sacrifice - Forgiveness
  4) Purity (Body, Dress, Environment) - Physical purity - Mental purity - Spiritual purity
- Social Values:
  1) Non violence - Service
  2) Patriotism - Equality
  3) Respect for parents and elders - care and protection - Respect for teacher
  4) Punctuality - Time Management

**UNIT V: MORALITY** (VIRTUES) **6**

1) Importance of Introspection - I - Mine (Ego, Possessiveness).
2) Six Evil Temperaments - Greed - Anger - Miserliness - Immoral sexual passion - Inferiority and superiority Complex – Vengeance.
3) Maneuvering of Six Temperaments - Contentment - Tolerance - Charity - Chastity - Equality - Pardon (Forgiveness).
4) Five essential Qualities acquired through Meditation: Perspicacity - Magnanimity - Receptivity - Adaptability – Creativity.
5) Improved Memory Power - Success in the Examination.

**Total: 30 HOURS.**

**COURSE OUTCOME**

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

CO1: Acquire knowledge about the interconnections between the body, the breath, the mind, and the emotions in the context of maintaining resilience and well-being.

CO2: Utilize skills developed through participation in Manavalakalai (SKY) Yoga to help maintain lifelong health and fitness.

CO3: Demonstrate foundational standing, sitting , balance postures with proper alignment.

CO4: Explore relaxation techniques to observe thoughts and to manage emotions and stress, and reflect on those techniques which are most effective to them.

CO5: Apply the principles of yoga in a personal way outside of yoga practice and Demonstrate an understanding of anatomy and physiology as it applies to the intentional integration of breath, postures, and movement within the practice of yoga.

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**REFERENCE BOOKS:**


1. Vethathiri Maharishi, 16th Edi.2013, Yoga for Modern Age, Vethathiri Publications, Erode.
2. Vethathiri Maharishi, 2014, Simplified Physical Exercises, Vethathiri Publications, Erode.
3. Vethathiri Maharishi, 3rd Edi.2014, Kayakalpam, Vethathiri Publications, Erode.
4. Rev.Dr.G.U.pope, 2016, Thirukkural, Giri Trading Agency,
5. Vethathiri Maharishi, 1994, Mind, Vethathiri Publications, Erode.
6. Chandrasekaran.K, 1999, Sound Health through yoga, Sedapati, Tamilnadu, Premkalyan Publications.
7. Iyengar, B.K.S. 2008, Light on Yoga, Noida, UP India, Harber Collins Publishing India Ltd.,

| HS – 04 | PERSONALITY DEVELOPMENT II | 0 0 2 1 |
|---|---|---|

**COURSE OBJECTIVES:(Skill Development)**

- Socially responsible and ethical citizens.
- Corporate readiness and continuous employability.
- To inculcate the need to lead a healthy lifestyle and manage stress
- To improve leadership quality
- To improve physical aspects of personality/posture & Good team spirit

**UNIT I SOFT SKILLSIII 6**

Basic Etiquette – Email etiquette – Business etiquette – Telephone etiquette – Meeting etiquette – Adjustment of Role & Leadership – Team Management & Development

**UNIT II QUANTITATIVE APTITUDE I 6**

Percentage – Profit Loss -Discount – Ratio Proportion – Time & Work – Time, Speed & Distancel. Problems relating to ages- Permutation & Combination-Probability

**UNIT III QUANTITATIVE APTITUDE II 6**

Mensuration Clocks and Calendars- Boats-Simple Interest –Compound Interest- Fractions and Decimals – Square roots – Functions.

**UNIT IV ANALYTICAL PROBLEMS 6**

Introduction – Linear Sequencing – Seating Arrangements – Distribution/Double Line Up – Selection – Ordering and Sequencing – Binary Logic – Venn Diagrams –Directions.

**UNIT V LOGICAL PROBLEMS 6**

Introduction to Logical problems – Cause and Effect – Course of Action – Statement and Assumption – Letter and Symbol series – Analogies.

**TOTAL: 30 Hours**

**COURSE OUTCOME**

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

CO1: Understand the basic, email, business, telephone and meeting etiquettes.
CO2: Understand the role of leadership in team management and development.
CO3: Solve problems on ratio proportion related to profit and loss, discounts, time and work, Time, speed and distance.
CO4: Solve Analytical problems
CO5: solve logical problems

**REFERENCES:**


1. Personality Enrichment--K R Dhanalakshmi And N S Raghunathan, Margham Publications
2. Personality Development --Dr V M Selvaraj Bhavani Publications
3. Quantitative Aptitude – R. S Aggarwal
4. Logical and Analytical Reasoning (English) 30th Edition – A.K Gupta

| MC – 02 | ENVIRONMENTAL SCIENCE AND ENGINEERING | 3 0 0 3 |
|---|---|---|

**COURSE OBJECTIVE ( Employability)**

- To inculcate the importance of environmental pollution, preservation of nature and environmental management for human welfare.
- The student is expected to understand what constitutes the environment, what are precious resources in the environment, how to conserve these resources, what is the role of a human being in maintaining a clean environment and useful environment for the future generations and how to maintain ecological balance and preserve bio-diversity.
- The role of government and non – governmental organization in environmental managements.

**UNIT I ENVIRONMENT, ECOSYSTEM AND BIODIVERSITY 9**

Definition – Scope and importance – Need for public awareness – Concepts of an Ecosystem – Structure and Function of an Ecosystem –Producers, Consumers and Decomposers – Energy Flow in the Ecosystem – Ecological Succession – Food Chains, Food Webs and Ecological Pyramids – Introduction, Types, Characteristic Features, Structure and Function of the (A) Forest Ecosystem (B) Grassland Ecosystem (C) Desert Ecosystem (D) Aquatic Ecosystems (Ponds, Streams, Lakes, Rivers, Oceans, Estuaries) – Introduction to Biodiversity – Definition: Genetic, Species and Ecosystem Diversity – Biogeographical Classification of India – Value of Biodiversity: Consumptive Use, Productive Use, Social, Ethical, Aesthetic and Option Values – Biodiversity at Global, National and Local Levels – India as a Mega-Diversity Nation – Hot-Spots of Biodiversity – Threats to Biodiversity: Habitat Loss, Poaching of Wildlife, Man-Wildlife Conflicts – endangered and Endemic Species of India – Conservation of Biodiversity: In-Situ and Ex-Situ conservation of Biodiversity.Field Study of Common Plants, Insects and Birds. Field study of simple ecosystems - pond, river, hill slopes, etc.

**UNIT IIENVIRONMENTAL POLLUTION 9**

Definition – Causes, Effects and Control Measures of (A) Air Pollution (B) Water Pollution (C) Soil Pollution (D) Marine Pollution (E) Noise Pollution (F) Thermal Pollution (G) Nuclear Hazards – Solid Waste Management:- Causes, Effects and Control Measures of municipal solid Wastes – Role of an Individual in Prevention of Pollution – Pollution Case Studies – disaster Management - Floods, Earthquake, Cyclone and Landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

**UNIT III NATURAL RESOURCES 9**

Forest resources -Use and over – Exploitation – Deforestation – Case studies – Timber extraction –Mining – Dams and their ground water – Floods – Drought – Conflicts over water –Dams – Benefits and Problems – Mineral Resources- Use and Exploitation, Environmental Effects of Extracting and Using Mineral Resources, Case Studies – Food Resources: World Food Problems, Changes caused by Agriculture and Overgrazing, Effects of Modern Agriculture, Fertilizer- Pesticide Problems, Water Logging, salinity, Case Studies – Energy Resources:- Growing Energy Needs, Renewable and Non Renewable Energy Sources, Use of Alternate Energy Sources, Case Studies – Land Resources - Land as a Resource, Land Degradation, Man Induced Landslides, Soil Erosion and Desertification – Role of an Individual in Conservation of Natural Resources – Equitable use of Resources for Sustainable Lifestyles.Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

**UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 9**

From Unsustainable To Sustainable Development – Urban Problems Related to energy – Water conservation, Rain Water Harvesting, Watershed Management – Resettlement and Rehabilitation of People, its Problems and Concerns, Case Studies Role of non – governmental organization - Environmental Ethics- Issues and Possible Solutions – Climate Change, Global Warming, Acid Rain, Ozone Layer Depletion, Nuclear Accidents and Holocaust, Case Studies –Wasteland Reclamation – Consumerism and Waste Products – Environment Production Act – Air (Prevention and Control of Pollution) Act – Water (Prevention and Control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act –enforcement machinery involved in environmental Legislation – Central and state pollution control boards - Public Awareness.

**UNIT V HUMAN POPULATION AND THE ENVIRONMENT** **9**

Population Growth, Variation among Nations – Population Explosion Family Welfare Programme – environment and Human Health – Human Rights –Value Education – HIV /AIDS – Women and Child Welfare – Role of Information Technology in Environment and Human Health – Case Studies.

**Total: 45 hrs**

**COURSE OUTCOME**

At the end of this course, the Student will be able to

CO1: Understand the nature and facts about environment and implement scientific, technological, economic solutions to environmental problems.

CO2: Understand the integrated themes and biodiversity, natural resources, pollution control and waste management.

CO3: Analyze the importance of environment by assessing its impact on the human world.

CO4: Study the dynamic processes and understand the features of the earth's interior and surface and describe the role of an individual in Conservation of Natural Resources.

CO5: Understand the role of government in solving the environmental problems and also describe about Population Growth and variation among Nations

**Text Books**

1. De AK, Environmental Chemistry, Wiley Eastern Ltd.
2. Bharucha Erach, 2003. The Biodiversity of India, Mapin Publishing Pvt. Ltd, India.
3. Brunner RC, 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480pgs.
4. Clark RS, Marine Pollution, Clanderson Press, Oxofrd (TB).

**Reference Books**

1. Agarwal KC, 2001. Environmental Biology, Nidi Publishers Ltd. Bikaner.
2. Gleick HP, 1993. Water in Crisis, Pacific Institute for Studies in Development, Environment and Security. Stockholm Environmental Institute, Oxford University Press, 473pgs.
3. Heywood VH, and Watson RT, 1995. global Biodiversity Assessment. Cambridge University Press 1140pgs.
4. Jadhav H and Bhosale VM, 1995. Environmental Protection and Laws.Himalaya Publishing House, Delhi 284pgs.
5. Mckinney ML and Schoch RM, 1996. Environmental Science Systems and Solutions. Web enhanced edition, 639pgs.
6. Miller TG, Jr. Environmental Science, Wadsworth Publishing CO. (TB)

| PC – 10 | DIAGNOSTIC INSTRUMENTATION | 3 1 0 4 |
|---|---|---|

**COURSE OBJECTIVES (Employability)**

Students should be made to

- Understand the basics of instrumentation, biopotentials and bio amplifiers
- Illustrate the devices described for the diagnosis of cardiac and muscular abnormalities
- Learn about the neurological devices for analysis and diagnosis
- Describe the measurement techniques for non-electrical parameters.
- Illustrates the recent advancements in the field of diagnostic devices.

**UNIT- I BASICS OF INSTRUMENTATION** **12**

Origin of bio potential and its propagation. Electrode-electrolyte interface, electrode–skin interface, half-cell potential, impedance, polarization effects of electrode – non-polarizable electrodes. Types of electrodes - surface, needle and micro electrodes and their equivalent circuits.Recording problems - measurement with two electrodes.Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier – right leg driven ECG amplifier. Isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier. Chopper amplifier. Power line interference

**UNIT II CARDIAC AND MUSCULAR EQUIPMENT** **12**

Biosignals characteristics – frequency and amplitude ranges. ECG – Einthoven's triangle, standard 12 lead system. Patient Monitoring system. ICU/CCU Equipments, Infusion pumps, bed side monitors, Central consoling controls. Radio Telemetry (single, multi), Portable and Landline Telemetry unit. Generation, recording and analysis of EMG waveforms, fatigue characteristics, Muscle stimulators, EMG Bio Feedback Instrumentation.

**UNIT III NEUROLOGICAL EQUIPMENT** **12**

Clinical significance of EEG, Multi-channel EEG recording system, Epilepsy, Evoked Potential–Visual,Auditory and Somatosensory, MEG (Magneto Encephalo Graph).EEG Bio Feedback Instrumentation. Nerve conduction velocity measurement.

**UNIT IV MEASUREMENT OF NON-ELECTRICAL PARAMETERS** **12**

Temperature, respiration rate and pulse rate measurements. Blood Pressure: indirect methods -auscultatory method, oscillometric method, direct methods: electronic manometer,. Blood flow and cardiac output measurement: Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurement.Blood glucose sensors - Blood gas analyzers, colorimeter, flame photometer, spectrophotometer, blood cell counter, auto analyzer (simplified schematic description).

**UNIT V RECENT TRENDS** **12**

Principles and application of thermography, Detection circuits, **Principles of cryogenic Technique and application** , principles of Fibre optics cables, Endoscopy, Laparoscopy, **ophthalmic equipments- slit Lamp, Tonometer , Retinal response Plotte**r, principles of Bio telemetry, principles of Lithotripsy.

**TOTAL: 60 HOURS**

**COURSE OUTCOMES**

At the end of the courseStudents will be able to

CO1: Understand the basics of instrumentation, biopotentials and design the bio amplifiers
CO2: Illustrate the devices described for the diagnosis of cardiac and muscular abnormalities
CO3: Analyse the neurological devices and diagnosis
CO4: Apply the measurement techniques for non-electrical parameters.
CO5: Illustrates the recent advancements in the field of diagnostic devices.

**TEXT BOOKS:**

1. John G. Webster, "Medical Instrumentation Application and Design", John Wiley and sons, New York, 2004.

2. Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw-Hill, New Delhi, 2003.

**REFERENCES:**

1. Leslie Cromwell, “Biomedical Instrumentation and measurement”, Prentice hall of India, New Delhi, 2007.
2. Myer Kutz, “Standard Handbook of Biomedical Engineering and Design”
3. Joseph J. Carr and John M. Brown, “Introduction to Biomedical Equipment Technology”, Pearson Education, 2004.

| PC – 11 | DIAGNOSTIC INSTRUMENTATION LABORATORY | 0 0 3 1 |
|---|---|---|

**COURSE OBJECTIVES (Employability)**

Students should be made to

- Understand the basics of pre-amplifiers and bio amplifiers
- Illustrate the circuits for ECG detection and driven amplifiers
- Demonstrate the measurements of non-electrical parameters.
- Illustrates the recording of bio signals and blood flow.
- Define the functioning of the diagnostic instrumentation

**LIST OF EXPERIMENTS:**

1. Design of pre amplifiers to acquire bio signals along with impedance matching circuit using suitable IC‘s
2. Design of ECG Amplifiers with appropriate filter to remove power line and other artifacts.
3. Design of EMG amplifier
4. Design a suitable circuit to detect QRS complex and measure heart rate
5. Design of frontal EEG amplifier
6. Design a right leg driven ECG amplifier.
7. Measurement of pulse-rate using Photo transducer.
8. Measurement of pH and conductivity.
9. Measurement of blood pressure using sphygmomanometer.
10. Measurement and recording of peripheral blood flow
11. Design a PCB layout for any bio amplifier using suitable software tool.

**TOTAL: 60 HOURS**

**COURSE OUTCOMES**

Students will be able to

CO1: Understand the basics of pre-amplifiers and bio amplifiers
CO2: Illustrate the circuits for ECG detection and driven amplifiers
CO3: Demonstrate the measurements of non-electrical parameters.
CO4: Illustrates the recording of bio signals and blood flow.
CO5: Illustrates the functioning of the diagnostic instrumentation

| PC – 12 | BIO SIGNAL PROCESSING | 3 0 0 3 |
|---|---|---|

**COURSE OBJECTIVES (Employability)**
Students should be made to

- Illustrates a solid foundation in signal processing and systems including advancements in the field.
- Define the basic analysis and use of spectral estimation in signal processing
- Demonstrate processing, validation, optimization and analysis of different biomedical signals.
- Illustrate the bio signal classification and recognition for diagnosis of different diseases.

**UNIT I SIGNAL, SYSTEM AND SPECTRUM** **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, 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, non-stationary process, fixed segmentation, adaptive segmentation, application in EEG, PCG and HRV signals, model based ECG simulator. Spectral estimation – Blackman Tukey method, periodogram, and model based estimation. Application in Heart rate variability.

**UNIT III ADAPTIVE FILTERING AND WAVELET DETECTION** **9**
Filtering – LMS adaptive filter, adaptive noise cancelling in ECG, improved adaptive filtering in FECG, EEG and other applications in Bio signals, Wavelet detection in ECG – structural features, matched filtering, adaptive wavelet detection, detection of overlapping wavelets.

**UNIT IV BIOSIGNAL CLASSIFICATION AND RECOGNITION** **9**
Signal classification and recognition – Statistical signal classification, linear discriminant function, direct feature selection and ordering, Neural network based classification. Application in Normal versus Ectopic ECG beats and other biomedical applications.

**UNIT V TIME FREQUENCY AND MULTIVARIATE ANALYSIS** **9**
Time frequency representation, spectrogram, 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 HOURS**

**COURSE OUTCOMES**

Students will be able to

CO1: Understand the basics of signal processing, analysis and spectral estimations
CO2: Analyze the filter types and it applications in bio signal processing.
CO3: Apply signal classification and recognition for defining different disease abnormalities.
CO4: Analyze the different compression and optimization techniques.
CO5: Evaluate the analysis techniques in different bio signal processing applications

**REFERENCES**:
1. Arnon Cohen, Bio-Medical Signal Processing Vol I and Vol II, CRC Press Inc., Boca Rato, Florida 1999.
2. Emmanuel C. Ifeachor, Barrie W.Jervis, second edition „Digital Signal processing- A Practical Approach‟ Pearson education Ltd., 2002
3. P.Ramesh Babu, ―Digital Signal Processing‖, Sixth Edition, Scitech publications, Chennai, 2014.
4. Raghuveer M. Rao and AjithS.Bopardikar, Wavelets transform – Introduction to theory and its applications, Pearson Education, India 2000
5. Rangaraj M. Rangayyan, 2nd edition „Biomedical Signal Analysis-A case study approach‟, Wiley, IEEE Press, 2015.
6. Willis J. Tompkins, Biomedical Digital Signal Processing, Prentice Hall of India, New Delhi, 2003.

| PC – 13 | BIO SIGNAL PROCESSING LABORATORY | 0 0 3 1 |
|---|---|---|

**COURSE OBJECTIVES (Employability)**

Students should be made to

- Understand the basics of instrumentation, biopotentials and bio amplifiers
- Illustrate the devices described for the diagnosis of cardiac and muscular abnormalities
- Learn about the neurological devices for analysis and diagnosis
- Describe the measurement techniques for non-electrical parameters.
- Illustrates the recent advancements in the field of diagnostic devices.

1. Generation of sequences (functional & random) & correlation
2. Linear and Circular Convolutions
3. FIR and IIR filter design
4. Equalization
5. Filtering of Bio signals for Analysis (ECG,EEG)
6. Spectrum Analysis for Medical signals (PSD,CSD, Coherence)
7. Transforms (Walsh, Hadamard, Haar)
8. Spectrogram Analysis of Bio signals
9. Data Compression in Bio signal Processing
10. Wavelet detection in ECG

**COURSE OUTCOMES**

Students will be able to

CO1: Write programs for generation of basic signals
CO2: Understand various techniques for signal analysis and filtering
CO3: Apply transforms for bio signals for useful applications
CO4: Analyze signals with various spectrum and compression patterns
CO5: Implement the principles of signal processing and wavelet detection.

| PC – 14 | MEDICAL OPTICS | 3 0 0 3 |
|---|---|---|

**COURSE OBJECTIVES (Employability)**

Students should be made to

- Understand the optical properties and interaction of the light with tissue
- Illustrate the photonics devices and detectors used for optical analysis
- Learn about the applications of laser in surgery
- Describe the applications of laser in non-thermal diagnosis
- Illustrates the photodynamic and other therapeutic applications of laser.

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

Refraction, Scattering, Absorption, Light transport inside the tissue, Tissue properties, LaserCharacteristics 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 andnononcological applications of PDT - Biostimulation effect – applications-Laser Safety Procedures.

**TOTAL: 45 HOURS**

**COURSE OUTCOMES**

Students will be able to

CO1: Distinguish the basic properties of light in tissue.
CO2: Illustration about the Instruments used in optics for measurement of the photonics
CO3: Explain the surgical applications of LASER
CO4: Apply the knowledge about Lasers for non-thermal diagnosis
CO5: Explain the application of lasers in therapy

**TEXT BOOKS:**

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

**REFERENCES:**

1. Tuan Vo Dinh, “Biomedical photonics – Handbook”, CRC Pres LC, 2003.
2. Mark E. Brezinski, “Optical Coherence Tomography: Principles and Applications”, Academic Press, 2006.
3. R. Splinter and B.A. Hoper, “An Introduction to Biomedical Optics”, Taylor and Francis, 2007

| PC – 15 | RADIOLOGICAL EQUIPMENT | 3 0 0 3 |
|---|---|---|

**COURSE OBJECTIVE (Employability)**

Students should be made to

- Understand generation of x-rays and its uses in imaging.
- Learn different types of radio diagnostic techniques.
- Know techniques used for visualizing different sections of the body using resonance imaging
- Illustrate the nuclear medicine system in the field of radiology.
- 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 Techniques in radiation therapy - 3DCRT – IMRT – IGRT and Cyber knife- radiation measuring instruments- Dosimeter, film badges, Thermo Luminescent dosimeters- electronic dosimeter- Radiation protection in medicine- radiation protection principles.

**TOTAL: 45 HOURS**

**COURSE OUTCOMES**

Students will be able to

CO1: Explain the generation of X-rays and its applications.
CO2: Illustrate the principle and working of CT Scan in detail
CO3: Examine the basic fundamentals and working of MRI scan in detail
CO4: Explain the structure of nuclear medicine system
CO5: Explain radiotherapy and radiation safety in detail

**TEXT BOOKS:**

1. Steve Webb, The Physics of Medical Imaging, Adam Hilger, Philadelpia, 1988 (Units I, II, III & IV).
2. R.Hendee and Russell Ritenour "Medical Imaging Physics", Fourth Edition William, Wiley-Liss, 2002.

**REFERENCES:**

1. Gopal B. Saha "Physics and Radiobiology of Nuclear Medicine"- Third edition Springer, 2006.
2. B.H.Brown, PV Lawford, R H Small wood , D R Hose, D C 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.

| HS – 05 | PERSONALITY DEVELOPMENT III | 0 0 2 1 |
|---|---|---|

**COURSE OBJECTIVES: (Skill Development)**

- Verbal and written communication skills.
- Interpersonal and group skills.

**UNIT I VERBAL APPTITUDE I 6**

Phonetics/Neutral Accent/Pronunciation – Speech Mechanism/Mouth & Face Exercise – Vowels & Consonants – Sounds – Syllable and Syllable Stress/ Word Stress – Sentence Stress & Intonation – Articulation Exercise – Rate of Speech / Flow of Speech / Idiomatic Phrases.

**UNIT II VERBAL APTITUDE II 6**

Singular/plural-present tense/past tense—genders - Prepositions-conjunctions-Choice of words—simple sentences—compound sentences- summarising phrases—Synonyms—Antonyms—Analogies—Similar Words

**UNIT III SOFT SKILLS IV 6**

Attitude—Meaning- Features of attitude-Formation-Personality Factors-Types of attitude-change in attitude-Developing Positive attitude.

**UNIT IV TIME MANAGEMENT 6**

Definition –Meaning-Importance, Value of time as an important resource- comparison of Time and Money-Circle of influence and circle of control—Definition of URGENT and IMPORTANT—Time Wasters and how to reduce—Procrastination—meaning and impact- 4 Quadrants.

**UNIT V TEAM BUILDING 6**

Meaning—Aspects of team building—Process of team building—Types of Teams-Team ethics and Understanding-Team trust and commitment

**TOTAL: 30 Hours**

**COURSE OUTCOME**

At the end of this course the students will be able to

| | |
|---|---|
| CO1: | Acquire the personality development techniques and communication skills. |
| CO2: | Possess and apply verbal knowledge |
| CO3: | Develop positive attitude |
| CO4: | Develop time management skill |
| CO5: | Acquire the Team work skills |

**REFERENCES:**


1. Managing Soft Skills And Personality--B N GhoshMcgraw Hill Publications
2. Principles and Practices of Management Shejwalkar and Ghanekar McGraw Hill Latest
3. Time management for Busy people – Roberta roesch, TatamcGraw-Hill Edition
4. Personality Development --Dr V M Selvaraj, Bhavani Publications

| PC – 16 | THERAPEUTIC EQUIPMENTS | 3 0 0 3 |
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**COURSE OBJECTIVES (Employability)**
Students should be made to

- Understand the use of cardiac care devices and safety issues
- Illustrate the devices in the field of physiotherapy and applications of diathermy
- Learn about ventilators and applications of anaesthetic system.
- Describe the extra corporeal devices and safety measures applied for patients.

**UNIT I CARDIAC CARE UNITS** **9**

Pacemakers – Need for pacemaker, different types and their comparison, batteries for pacemakers. Defibrillator- Need, AC defibrillators and demerits, DC Defibrillator, asynchronous and synchronous DC defibrillators, Hazards and safety issues.

**UNIT II PHYSIOTHERAPY AND DIATHERMY EQUIPMENT** **9**

Physiological effects of HF radiation, Depth of Penetration, short wave, Ultrasonic and microwave diathermy, Surgical diathermy, Galvanic, Faradic Stimulators, Interferential therapy, Electrical safety- Leakage current, Micro and macro electric shock, GFI units, Earthing Scheme, Electrical safety Analyser.

**UNIT III VENTILATORS & ANAESTHETIC SYSTEM** **9**

Basic principles of ventilators, different generators, inspiratory phase and expiratory phase, different ventilatory adjuncts, neonatal ventilators, p based ventilator, ventilator testing. Anaesthesia: Need of anaesthesia, gas used and their sources, gas blending and vaporizers, anaesthesia delivery system, breathing circuits, EEG controlled Anesthetic monitor.

**UNIT IV EXTRA CORPOREAL DEVICES AND ELECTRICAL STIMULATORS** **9**

Need for heart lung machine, functioning of bubble, disc type and membrane type oxygenators, finger pump, roller pump, electronic monitoring of functional parameters. Hemo Dialyser unit. Electrical Stimulators- Strength-duration curve, types of stimulators, an electrodiagnostic / therapeuticstimulator. Nerve-muscle stimulator: peripheral nerve stimulator, Ultrasonic stimulators, stimulators for pain andrelief.Transcutaneous nerve stimulator

**UNIT V PATIENT SAFETY** **9**

Physiological effects of electricity – important susceptibility parameters – Macro shock – Micro shock hazards – Patient‘s electrical environment – Isolated Power system – Conductive surfaces – Electrical safety codes and standards – IEC 60601-1 2005 standard, Basic Approaches to Protection against shock, Protection equipment design, Electrical safety analyzer – Testing the Electric system

**TOTAL: 45 HOURS**

**TEXT BOOK:**

1. Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw Hill, New Delhi, 2003.

**REFERENCES:**

1. John Webster. Medical Instrumentation.- Application and Design. John Wiley and Sons. Inc., New York. Thirdedition 2003.
2. Cromwell Leslie, Fred Erich A.Pfeiffer - Biomedical Instrumentation Prentice Hall New Delhi 2000
3. Wolbasrsht . M. L, Laser Application in Medicine and Biology plenum press NewYork 1989.
4. Bronzino, Joseph; Handbook of Biomedical Engineering. 2nd edition, CRC Press, 2000.
5. Welkowitz, Walter & Others Bio-Medical Instruments Theory & Design., 2nd Edition, Academic Press, 1991

**COURSE OUTCOMES**

At the end of the courses, Students will be able to

| | |
|---|---|
| CO1: | Explain the cardiac care unit devices and applications |
| CO2: | Understand various therapeutic devices in physiotherapy. |
| CO3: | Analyse the use of ventilators and anaesthetic systems |
| CO4: | Evaluate the processing of corporeal devices and electrical stimulators |
| CO5: | Describe the working of different therapeutic devices and safety measures |

| PC – 17 | THERAPEUTIC EQUIPMENTS LABORATORY | 0 0 3 1 |
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**COURSE OBJECTIVES (Employability)**

Students should be made to

- Understand the basics measurements of bio signals
- Illustrate the therapeutic and telemetric devices
- Learn about the medical stimulators and surgical units
- Describe the recording of audiogram and electrical safety measures
- Study the functioning of different therapeutic devices.

**LIST OF EXPERIMENTS:**

1. Measurement of visually evoked potential
2. Galvanic skin resistance (GSR) measurement
3. Study of shortwave and ultrasonic diathermy
4. Measurement of various physiological signals using biotelemetry
5. Study of hemodialysis model
6. Electrical safety measurements
7. Measurement of Respiratory parameters using spirometry.
8. Study of medical stimulator
9. Analyze the working of ESU – cutting and coagulation modes
10. Recording of Audiogram
11. Study the working of Defibrillator and pacemakers
12. Analysis of ECG, EEG and EMG signals
13. Study of ventilators
14. Study of Ultrasound Scanners
15. Study of heart lung machine model

**COURSE OUTCOMES**

Students will be able to

| | |
|---|---|
| CO1: | Explain the basics principles of the instrumentation of therapeutic devices. |
| CO2: | Understand the analysis of bio signals |
| CO3: | Analyze the working of surgical diathermy and cardiac units |
| CO4: | Understand the working principles of different therapeutic devices |
| CO5: | Describe about the use of therapeutic devices |

**HOSPITAL VISIT**

Hospital visit is necessary for the students to visualize high tech and advanced equipment's used in the hospitals for the diagnostic and treatment of the patients. Real time functioning of the equipment's can be analysed.

| PC – 18 | MEDICAL IMAGE PROCESSING | 3 0 0 3 |
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**COURSE OBJECTIVES (Employability)**

Students should be made to

- Learn digital image fundamentals.
- Be exposed to simple image processing techniques.
- Be familiar with image compression and segmentation techniques.
- Learn to restore and reconstruct the medical images

**UNIT I FUNDAMENTALS OF DIGITAL IMAGE AND TRANSFORMS 9**

Anatomy of Human Eye- Elements of Visual perception, Image sampling and quantization, Neighborhood pixel Relationships – Basic Image operations – Arithmetic, Geometric and Morphological. Image transform: 2D DFT- Discrete cosine-, Sine-, Haar-, and Hadamard- transform.

**UNIT II IMAGE ENHANCEMENT 9**

Basic gray level transformation, Histogram processing ,Smoothening by spatial filters - Sharpening by spatial filters ,Smoothening- frequency domain filters, Sharpening- frequency domain filters ,Color image Processing- color models- Pseudo color image processing– Color Image Transformation – Smoothening - Sharpening.

**UNIT III IMAGE SEGMENTATION AND OBJECT RECOGNITION 9**

Edge detection- Marr Hidreth edge detector - Canny edge detector, Thresholding foundation- Basic global thresholding - Basic Adaptive thresholding, Region Based segmentation, Watershed segmentation algorithm, Patterns and pattern classes, Recognition based on decision theoretic methods-matching, Optimum statistical classifiers.

**UNIT IV IMAGE COMPRESSION 9**

Image compression- Fundamentals - Image compression standards- Coding: Run length-, Huffman- Arithmetic-, Bit plane-, Transform- and Lossy- and lossless predictive coding.

**UNIT V IMAGE RESTORATION AND RECONSTRUCTION OF MEDICAL IMAGES 9**

Image degradation models, Algebraic approach to restoration, inverse filtering, Least mean square filter, Image reconstruction from projections – Radon transforms - Filter back projection algorithm – Fourier reconstruction of MRI Images

**TOTAL: 45 HOURS**

**COURSE OUTCOMES**

Students will be able to

CO1: Explain the basics of digitisation and transforms
CO2: Determine the various techniques of image enhancement
CO3: Analyse the image segmentation and recognition techniques
CO4: Distinguish and understand the techniques of image compression
CO5: Explain the principles of image reconstruction and restoration

**TEXTBOOKS:**

1. Rafael C, Gonzalez and Richard E Woods, "Digital Image Processing",Pearson Education Asia, Third Edition, 2007.
2. Anil K Jain, "Fundamentals of Digital Image Processing", Prentice Hall of India, 2nd edition 1997.

**REFERENCES:**

1. William K Pratt, "Digital Image Processing", John Wiley NJ, 4th Edition, 2007.
2. Albert Macouski, "Medical Imaging Systems", Prentice Hall, New Jersey 2nd edition 1997.

| PC – 19 | MEDICAL IMAGE PROCESSING LABORATORY | 0 0 3 1 |
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**COURSE OBJECTIVES (Employability)**

Students should be made to

- Learn about the basics and fundamentals of image processing
- Illustrate applications of different transforms
- Demonstrate the different enhancement techniques
- Describe the applications of image segmentation process
- Illustrates the advancements and formatting in image processing

1. Image sampling and quantization
2. Analysis of spatial and intensity resolution of images.
3. Intensity transformation of images.
4. DFT analysis of images
5. Transforms (Walsh, Hadamard, DCT, Haar)
6. Histogram Processing and Basic Thresholding functions
7. Image Enhancement-Spatial filtering
8. Image Enhancement- Filtering in frequency domain
9. Image segmentation – Edge detection, line detection and point detection.
10. Basic Morphological operations.
11. Region based Segmentation
12. Segmentation using watershed transformation
13. Analysis of images with different color models.
14. Study of DICOM standards
15. Image compression techniques
16. Image restoration

**COURSE OUTCOMES**

Students will be able to

CO1: Analyse image sampling and quantization and determine histogram
CO2: Experiment spatial analysis of the image and analyse different color models on the images
CO3: Experiment different transforms and frequency domain filtering on the images
CO4: Examine images with various segmentation techniques
CO5: Examine different filtering in spatial & frequency domain

| PC – 20 | REHABILITATION ENGINEERING | 3 0 0 3 |
|---|---|---|

**COURSE OBJECTIVES (Employability)**
Students should be made to

- Understand the basics of rehabilitation engineering
- Illustrate the devices described for mobility functions
- Learn about the orthotic and prosthetic devices
- Describe the technology assistance for vision and hearing impairments
- Illustrates the advancements in the field of rehabilitation

**UNIT- I INTRODUCTION TO REHABILITATION ENGINEERING 9**

Introduction to Rehabilitation Engineering - PHAATE model - Clinical practice of rehabilitation Engineering - Low technology tools - Service delivery – Universal design - Design based on human ability - Standards for assistive technology - Test for best design.

**UNIT- II MOBILITY AIDS 9**

Electronic Travel Appliances (ETA) : Path Sounder, Laser Cane, Ultrasonic Torch, Sonic Guide, Light Probes, Polarized Ultrasonic Travel aids.Seating Assessment - Interventions in seating system - Biological aspects of tissue health - Support surface classification - Manual wheelchairs – Electric power wheelchairs - Power assisted wheelchairs - Wheel chair standards & tests - Wheel chair transportation.

**UNIT - III ORTHOTIC & PROSTHETIC DEVICES 9**

Anatomy of upper & lower extremities - Classification of amputation types, Prosthesis prescription - Components of upper limb prosthesis - Fabrication of prosthesis - Components of lower limb prosthesis – Orthoses: It"s need and types - Lower extremity- and upper extremity- orthoses - Slints – materials used .

**UNIT- IV ASSISTIVE TECHNOLOGY FOR VISION & HEARING 9**

Anatomy of eye, Categories of visual impairment - Cortical & retinal implants - Auditory Information Display - Blind mobility aids – reading writing & graphics access, Orientation & navigation Aids - Anatomy of ear – hearing functional assessment - Surgical and non surgical hearing aids - Assistive technologysolutions for hearing Tactile - Information Display.

**UNIT -V ADVANCED APPLICATIONS 9**

Functional Electrical stimulation - Robots in rehabilitation - Rehabilitation in sports -Daily living aids - Assistive technology for dyslexia - Computer & internet access for challenged people - Neural engineering in rehabilitation engineering - Role of biomedical engineering in rehabilitation.

**TOTAL: 45 HOURS**

**COURSE OUTCOMES**
Students will be able to

CO1: Explain the introduction and importance of rehabilitation engineering
CO2: Illustrate the principle and working of mobility aids
CO3: Examine the basic fundamentals and working of orthotic and prosthetic devices
CO4: Explain the assistive device for vision and hearing
CO5: Explain advanced applications of Rehabilitation engineering

**TEXTBOOKS:**

1. Rory A, Cooper, Hisaichi Ohnabe, Douglas A, Hodson, "An Introduction to Rehabilitation Engineering", CRC Press, First edition, 2006.

**REFERENCES:**

1. Marion A Hersh, Michael A, Johnson, "Assistive Technology for Visuallyimpaired and blind people", Springer Publications, First edition, 2008.
2. Suzanne Robitaille, "The illustrated guide to Assistive technology and devices–Tools and gadgets for living independently", Demos Health Newyork, First edition, 2010.

| HS – 06 | PERSONALITY DEVELOPMENT IV | 0 0 2 1 |
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**COURSE OBJECTIVES: (Skill development)**

- To develop awareness of different job search techniques, including how to employ practical networking techniques
- To begin to recognize the skills developed during research and analyse how to present these effectively in written applications
- To critique the strengths and weaknesses of their own and colleagues' current CVs
- To understand interview processes and practice being interviewed in a supportive environment.

**UNIT I SOFT SKILLS V** **6**

Assertiveness – Meaning – Importance of assertiveness – Characteristics of Assertive communication – Merits – forms of assertion – Causes of misunderstanding

**UNIT II COMMUNICATION SKILLS** **6**

Meaning – Elements of Communication – Functions of Communication – Principles of Communication Formal and Informal Communication – Barriers in Communication – Characteristics of good – communication – Feedback – Communication systems.

**UNIT III PRESENTATION SKILLS I** **6**

Meaning – Importance of Presentation – Concept of 5 W's and one H – understanding the audience – Types of presentations – How to make effective presentation.

**UNIT IV PRESENTATION SKILLS II** **6**

Use of slide, PPT's and visuals – Rules for slide presentation – precautions – seminars and conferences – Steps to eliminate Stage fear.

**UNIT V CHANGE MANAGEMENT** **6**

Definition – Necessity – Resistance towards Change – 10 Principles of Change Management – Leaders approach – Effective Change management.

**TOTAL: 30 h**

**COURSE OUTCOME**

At the end of this course the students will be able to,
CO1: Understand the characteristics of assertiveness and be assertive in communication.
CO2: Analyse the causes of misunderstanding.
CO3: Differentiate the principles of formal and informal communication.
CO4: Determine and Overcome barriers in the communication process.
CO5: Illustrate an effective presentation by understanding the audience.

**REFERENCE BOOKS:**

1. Helping employees embrace change – LaClair, J. and Rao, R. Helping Employees Embrace Change, McKinsey Quarterly, 2002, Number 4.
2. Who Moved My Cheese by Spencer Johnson published by vermilion first edition
3. Effective Communication. Adair, John. London: Pan Macmillan Ltd., 2003.
4. Business Communication Today: Bovee, Courtland L, John V. Thill & Barbara E. Schatzman. Tenth Edition. New Jersey: Prentice Hall, 2010.

| PC – 21 | INTERNSHIP | 0 0 2 1 |
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## COURSE OBJECTIVES (Skill Development)

- To get real time experience in the field of Biomedical Engineering
- To develop the problem-solving skills
- To train students in preparing real time projects

## Syllabus

The Industrial / Practical Training shall carry 100 marks. At the end of the Industrial / Practical training / internship / Summer Project, the student shall submit a certificate from the organization where the student has undergone training and a brief report about the training. The evaluation will be made based on this report, presentation and a Viva-Voce Examination conducted internally by a three -member Departmental Committee consisting of one co-ordinator and two members constituted by the Head of the Department.

## COURSE OUTCOME

CO1: Express the technical ideas, strategies and methodologies.
CO2: Observe real time problem and implement problem solving ideas.
CO3: Knowledge on various real time instruments, tools, methodologies.
CO4: Prepare report and present the oral demonstrations
CO5: Describe and train the students in designing real time projects

| PC – 22 | VIRTUAL INSTRUMENTATION LABORATORY | 0 0 3 1 |
|---|---|---|

**Course Objective:(Skill development)** To impart adequate knowledge on programming in Virtual Instrumentation for acquisition and analysis of signals in medical system and to impart knowledge on various analysis tools

**LIST OF EXPERIMENTS**

1. Basic arithmetic operations
2. Boolean operations
3. Sum of 'n' numbers using 'for' loop and 'while' loop
4. Factorial of a give number using for and while loop
5. Sorting even numbers using while loop in an array
6. Array maximum and minimum
7. Application using formula node
8. Discrete cosine transform
9. Convolution of two signals
10. Windowing technique
11. Simulating reactor control using Virtual Instrumentation.
12. Real time temperature control using Virtual Instrumentation.
13. Instrumentation of an amplifier to acquire an ECG signal using NI vision acquisition software
14. Acquire, analyse and present an EEG instrumentation using NI ELVIS hardware

**TOTAL: 45 HOURS**

**Course outcome:**

CO1:Apply the operations of Basic arithmetics, Boolean operations, Sum of 'n' numbers using 'for' loop, Sum of 'n' natural numbers using while loop.
CO2:Applying Factorial of a give number using for loop
CO3:Distinguishing and Sorting even numbers using while loop in an array, Array maximum and minimum.
CO4:Comparing Bundle and unbundle cluster, Flat and stacked sequence, Application using formula node and Evaluate filtering and windowing technique.
CO5:Design,Acquire, analyse and present an EEG instrumentation using NI software

| PC – 23 | PROJECT PHASE I | 0 0 3 1 |
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**COURSE OBJECTIVES(Employability)**

- To identify a specific problem for the current need of the society and collecting information related to the same through detailed review of literature.
- To develop the methodology to solve the identified problem.
- To develop skills to analyse and discuss the test results, and make conclusions.
- To train the students in preparing project reports and to face reviews and viva-voce examination.

Syllabus

**T**he student individually works on a specific topic approved by faculty member who is familiar in this area of interest. The student can select any topic which is relevant to his/her specialization of the programme. The topic may be experimental or analytical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

**COURSE OUTCOME**

CO1: Analyze a real-world problem, identify the requirement and develop the design solutions.
CO2: Evaluate the technical ideas, strategies and methodologies.
CO3: Design the new tools, algorithms, techniques that contribute to obtain the solution of the project.
CO4: Estimate and validate through conformance of the developed prototype and analysis the cost Effectiveness.
CO5: Evaluate and present the oral demonstrations

| HS – 07 | INTELLECTUAL PROPERTY RIGHTS | 2 0 0 2 |
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**COURSE OBJECTIVE:(Employability)**

- To disseminate knowledge on patents, patent regime in India and abroad and registration aspects
- To make students aware about current trends in IPR and Govt. supports in promoting IPR
- To classify the role of regulatory committees in controlling the risk

**Unit I: Intellectual Property Rights**: 9

Introduction and the need for intellectual property right (IPR) - Kinds of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design – Genetic Resources and Traditional Knowledge – Trade Secret - IPR in India : Genesis and development – IPR in abroad - Major International Instruments concerning Intellectual Property Rights: Paris Convention, 1883, the Berne Convention, 1886, the Universal Copyright Convention, 1952, the WIPO Convention, 1967,the Patent Co-operation Treaty, 1970, the TRIPS Agreement, 1994 India`s New National IP Policy, 2016 – Govt. of India step towards promoting IPR – Govt. Schemes in IPR – Career Opportunities in IP - IPR in current scenario with case studies.

**Unit II: Biosafety** **12**

Regulatory Framework for GMOs in India & at International Level: Regulatory framework in India governing GMOs-Recombinant DNA Advisory Committee (RDAC), Institutional Biosafety Committee (IBSC), Review Committee on Genetic Manipulation, Genetic Engineering Approval Committee (GEAC), Recombinant DNA Guidelines (1990), Revised Guidelines for Research in Transgenic Plants (1998), Seed Policy (2002), Prevention Food Adulteration Act (1955), The Food Safety and Standards Bill (2005), Plant Quarantine Order (2003), Regulation for Import of GM Products Under Foreign Trade Policy (2006-2007), National Environment Policy (2006). Rules for the manufacture, use/import/export and storage of hazardous microorganisms/genetically engineered organisms or cells (Ministry of Environment and Forests Notification, (1989). Convention of Biological Diversity (1992) – Cartagena Protocol on Biosafety – Objectives and salient features of Cartagena Protocol. Understand the legal steps involved in progressing a new drug to market. Grasping the current regulatory acts and safety norms of the modern pharmaceutical industries

**Unit III: Bioethics**: 9

Patenting live microorganism, Human Genome project and ethical issues, Animal cloning, human cloning and their ethical issues, Public education of producing transgenic organism, legal and socioeconomic impacts of biotechnology, testing drugs on human volunteers, Hazardous materials used in biotechnology, their handling and disposal, experimenting on animals.

**COURSE OUTCOMES:**

CO1: Understand the patents, patent regime in India and abroad and registration aspects
CO2: Identify the role of regulatory committees in controlling the risk.
CO3: Understand the ethical issues linked to research on animal models, transgenics, and clinical trials.
CO4: Understand the procedure and norms to bring the bio product in market.
CO5: Explain the IP Counsel/Patent Examiner/Patent agent.

**TEXT BOOKS/REFERENCES:**

1. Nithyananda, K V. (2019). Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited.
2. Neeraj, P., & Khusdeep, D. (2014). Intellectual Property Rights. India, IN: PHI learning Private Limited.
3. V Sreekrishna, 2017. Bioethics and Biosafety in Biotechnology by New Age International publishers.

**E-RESOURCES:**

1. Subramanian, N., & Sundararaman, M. (2018). Intellectual Property Rights – An Overview. Retrieved from http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf
2. World Intellectual Property Organization. (2004). WIPO Intellectual Property Handbook. (https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf)

| PC – 24 | PROJECT PHASE II | 0 0 3 1 |
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**COURSE OBJECTIVES(Employability)**

- To identify a specific problem for the current need of the society and collecting information related to the same through detailed review of literature.
- To develop the methodology to solve the identified problem.
- To develop skills to analyse and discuss the test results, and make conclusions.
- To train the students in preparing project reports and to face reviews and viva-voce examination.

**Syllabus**

**T**he student individually works on a specific topic approved by faculty member who is familiar in this area of interest. The student can select any topic which is relevant to his/her specialization of the programme. The topic may be experimental or analytical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

**COURSE OUTCOME**

CO1: Describe the problem of the work
CO2: Determine and Identify the literature survey
CO3: Experiment the methodologies and Implementation process
CO4: Proposing the model and its explanation
CO5: Validate the resultant outcomes

# PROFESSIONAL ELECTIVE COURSES

| PE – 01 | MEDICAL PHYSICS | 3 0 0 3 |
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**COURSE OBJECTIVES ( Employability)**

**The student should be made to:**

- To study principles and effects of ionizing and non-ionizing radiation in human body
- To discuss the physics of the senses
- To explore the effects of radiation in matter and how isotopes are produced
- To understand various detectors for detecting the presence of ionizing radiation

**UNIT I NON-IONIZING RADIATION AND ITS MEDICAL APPLICATIONS 9**

Introduction and objectives - Tissue as a leaky dielectric - Relaxation processes, Debye model, Cole–Cole model, Overview of non-ionizing radiation effects-Low Frequency Effects- Higher frequency effects. Physics of light, Measurement of light and its unit- limits of vision and color vision an overview, Ultraviolet

**UNIT II PHYSICS OF THE SENSES 7**

Introduction and objectives - Cutaneous sensation - The chemical senses – Audition –Vision - Psychophysics

**UNIT III PRINCIPLES OF RADIOACTIVE NUCLIDES 10**

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, Target and Its Processing Equation for Production of Radionuclides, radionuclide Generator-Technetium generator.

**UNIT IV RADIOACTIVE DECAY AND INTERACTIONOF RADIATION WITH MATTER 11**

Spontaneous Fission- Isomeric Transition-Alpha Decay-Beta Decay-Positron Decay-Electron Capture-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 V SCINTILLATION, SEMICONDUCTOR AND GAS FILLED DETECTORS 8**

Scintillation Detectors - Solid Scintillation Counters - Gamma-Ray Spectrometry-Liquid Scintillation Counters-Characteristics of Counting Systems-Gamma Well Counters-Thyroid Probe-Principles of Gas-Filled Detectors - Ionization Chambers-Geiger–Müller Counters

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

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

CO1: Interpret - atomic and nuclear structure, nuclear stability, radioactivity, interactions of radiation with matter, nuclear reactions and radionuclide production

CO2: Illustrate the principles and use of ultrasound imaging device and the techniques

CO3: Explain the principles of radioactive nucleotides and generating techniques

CO4: Compare interaction of various radiations with matter

CO5: Evaluate radiation quantities and laws and explain the principles and interaction of radioactivity, principle of sounds and non ionisng radiations

**TEXT BOOKS:**

1. Gopal B. Saha, ―Physics and Radiobiology of Nuclear Medicine‖, 4th Edition, Springer, 2013.

2. B H Brown, R H Smallwood, D C Barber, P V Lawford and D R Hose, ―Medical Physics and Biomedical Engineering‖, 2nd Edition, IOP Publishers.2001.

**REFERENCES:**

1. S.Webb ― The Physics of Medical Imaging‖, Taylor and Francis, 1988

2. J.P.Woodcock, ―Ultrasonic,Medical Physics Handbook series 1‖, Adam Hilger, Bristol, 2002

3. HyltonB.Meire and Pat Farrant ―Basic Ultrasound‖ John Wiley & Sons, 1995

| PE – 02 | ROBOTICS IN MEDICINE | 3 0 0 3 |
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**COURSE OBJECTIVES ( Employability)**

**The student should be made to**

- Understand the basics of Robotics, Kinematics.
- Understand the basics of Inverse Kinematics.
- Explore various kinematic motion planning solutions for various Robotic configurations.
- Explore various applications of Robots in Medicine.

**UNIT – I BASIC CONCEPTS** **9**

Definition and origin of robotics – different types of robotics – various generations of robots – degrees of freedom – Asimov's laws of robotics – dynamic stabilization of robots.

**UNIT – II POWER SOURCES AND SENSORS** **9**

Hydraulic, pneumatic and electric drives determination of HP of motor and gearing ratio variable speed arrangements – path determination – micro machines in robotics – machine vision – ranging – laser – acoustic – magnetic, fiber optic and tactile sensors.

**UNIT – III MANIPULATORS, ACTUATORS AND GRIPPERS** **9**

Construction of manipulators – manipulator dynamics and force control – electronic and pneumatic manipulator control circuits – end effectors – various types of grippers – design considerations.

**UNIT- IV POWER SOURCES AND SENSORS** **9**

Sensors and controllers, Internal and external sensors, position, velocity and acceleration sensors, Proximity sensors, force sensors, laser range finder, variable speed arrangements, Path determination - Machinery vision, Ranging Laser- Acoustic, Magnetic fiber optic and Tactile sensor.

**UNIT - V ROBOTICS IN MEDICINE** **9**

Da Vinci Surgical System, Image guided robotic systems for focal ultrasound based surgical applications, System concept for robotic Tele-surgical system for off-pump CABG surgery, Urologic applications, Cardiac surgery, Neuro-surgery, Pediatric-, and General- Surgery, Gynecologic Surgery, General Surgery and Nano robotics.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

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

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|---|---|
| CO1: | Acquire basic knowledge on designanalysis, control and working principle of robotics |
| CO2: | Understand the basic concept of robots and types of robots |
| CO3: | Acquire information about the manipulators, actuators, grippers and control forces in robotics |
| CO4: | Understand the various types of sensors and power sourcesused in a robot |
| CO5: | applications of robot in the medical field- surgery, rehabilitation and drug deliver |

**TEXT BOOK**

1. Niku Saeed B, Introduction to Robotics: Analysis, System, Applications, PHI Publishers.
2. Tony Hyland, Scientific and Medical Robotics, Smart Apple Media Publishers, 2007.
3. Hari Singh Nalwa, "Nanostructured Materials and Nanotechnology", Academic Press, 2002.

**REFERENCES:**

1. Staugaard, Andrew C,—Robotics and Artificial Intelligence: An Introduction to Applied Machine Learning, Prentice Hall Of India, 1987
2. Grover, Wiess, Nagel, Oderey, —Industrial Robotics: Technology, Programming and Applications‖, McGraw Hill, 1986.
3. Wolfram Stadler, —Analytical Robotics and Mechatronics‖, McGraw Hill, 1995.
4. Saeed B. Niku, —Introduction to Robotics: Analysis, Systems, Applications‖, Prentice Hall, 2001.
5. K. S. Fu, R. C. Gonzales and C. S. G. Lee, —Robotics‖, McGraw Hill, 2008.

| PE – 03 | BIOLOGY FOR ENGINEERS | 3 0 0 3 |
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**COURSE OBJECTIVE ( Skill Development)**

- To understand the essentials of basic biological principles
- To understand the importance of Biomolecules
- To study in detail about human physiology

**UNIT 1 INTRODUCTION TO CELLS** **9**

Cell: Functional unit of living organisms - Cell theory - Prokaryotic and eukaryotic cell – bacterial, plant, animal cells - cell components - functions- cell organization – tissues - basic types -cell division: Mitosis, meiosis, cell cycle regulation

**UNIT 2 SOCIAL IMPORTANCE** **9**

Application of biological sciences and biotechnology to the society - human health care and medicines - pharmaceuticals and nutraceuticals -food and agriculture- pollution management and environment - Biofuels

**UNIT 3INTRODUCTION TO BIOMOLECULES** **9**

Biomolecules - classification, salient features - biological significance - carbohydrates, proteins and amino acids - lipids and fats - nucleic acids - vitamins-Enzymes

**UNIT 4 HUMAN PHYSIOLOGY** **9**

Human Physiology - Different systems associated with humans- Tissues, organ and physiology of the various systems: Digestive, respiratory, circulatory, skeletal, nervous, excretory and reproductive system - Artificial memory and neural network

**UNIT 5 MEDICAL IMPORTANCE** **9**

Infectious and non-infectious diseases- causative agents, epidemiology, pathogenicity, control and prevention, treatment of AIDS, tuberculosis, Pathology of non-infectious and genetic diseases and disorders - cancer, diabetes mellitus, cardiac diseases- neurological disorders-Parkinson's disease Max.

**TOTAL: 45 HOURS**

**COURSE OUTCOMES:**

At the end of the course, the students would

CO1: Understand the basics of cells
CO2: Describe the medical importance of different diseases
CO3: Understand the biomolecules
CO4: Describe the Different systems associated with humans
CO5: Illustrate about infectious and non-infectious diseases

**TEXT / REFERENCE BOOKS**

1. Satyanarayana, U. Biotechnology, 4th Edition, Books and Allied Pvt. Ltd. Kolkata, 2007.
2. Lehninger A.L, Nelson D.L, Cox .M.M, Principles of Biochemistry. CBS Publications 1993

| PE – 04 | PATHOLOGY AND MICROBIOLOGY | 3 0 0 3 |
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**COURSE OBJECTIVES: ( Employability)**

**The student should be made to:**

- Gain a knowledge on the structural and functional aspects of living organisms.
- Gain a knowledge on fluids and disorders.
- Know the etiology and remedy in treating the pathological diseases.
- Empower the importance of public health.

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

Cell injury - Reversible cell injury and Irreversible cell injury and Necrosis, Apoptosis, Intracellular accumulations, Pathological calcification- Dystrophic and Metastatic. 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 DERANGEMENTS** **9**

Edema, Hyperemia/Ischemia, normal hemostasis, thrombosis, disseminated intravascular coagulation, embolism, infarction, shock, Chronic venous congestion. Hematological disorders-Bleeding disorders, Leukaemias, Lymphomas Haemorrhage.

**UNIT III MICROBIOLOGY** **9**

Structure of Bacteria and Virus. Routes of infection and spread; endogenous and exogenous infections, Morphological features and structural organization of bacteria and virus, growth curve, identification of bacteria , culture media and its types , culture techniques and observation of culture. Disease caused by bacteria, fungi, protozoal, virus and helminthes.

**UNIT IV 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 V IMMUNOPATHOLOGY** **9**

Natural and artificial immunity, types of Hypersensitivity, antibody and cell mediated tissue injury: opsonization, phagocytosis, inflammation, Secondary immunodeficiency including HIV infection. Auto-immune disorders: Basic concepts and classification, SLE. Antibodies and its types, antigen and antibody reactions, immunological techniques: immune diffusion, immuno electrophoresis, RIA and ELISA, monoclonal antibodies.

**TOTAL : 45 PERIODS**

**COURSE OUTCOMES:**

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

CO1: Explain the process of cell degeneration repair and neoplasia
CO2: Illustrate the fluid and hemodynamic derangements in human body
CO3: Examine the structure of viruse and bacteria and the disease caused by them
CO4: Explain the various type of microscopy and the staining techniques
CO5: Examine the different types of immunity and autoimmune disorders

**TEXT BOOKS:**

1. Ramzi S Cotran, Vinay Kumar & Stanley L Robbins, ―Pathologic Basis of Diseases‖, 7th edition,WB Saunders Co. 2005 (Units I & II).
2. Ananthanarayanan & Panicker, ―Microbiology‖ Orientblackswan, 2017 10th edition. (Units III,IV and V).

**REFERENCES:**

1. Underwood JCE: General and Systematic Pathology Churchill Livingstone, 3rd edition, 2000.
2. Dubey RC and Maheswari DK. ―A Text Book of Microbiology‖ Chand & Company Ltd, 2007
3. Prescott, Harley and Klein, ―Microbiology‖, 10th edition, McGraw Hill, 2017

| PE – 05 | ANALOG AND DIGITAL COMMUNICATION | 3 0 0 3 |
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**COURSE OBJECTIVES: ( Employability)**

**The student should be made to:**

- Understand analog communication techniques.
- Learn data and pulse communication techniques.
- Learn basics digital communication techniques.
- Be familiarized with source and Error control coding.
- Gain knowledge on multi-user radio communication.

**UNIT I ANALOG COMMUNICATION** **9**

Introduction to Communication Systems - Modulation – Types - Need for Modulation. Theory of Amplitude Modulation - Evolution and Description of SSB Techniques - Theory of Frequency and Phase Modulation – Comparison of Analog Communication Systems (AM – FM – PM).

**UNIT II PULSE AND DATA COMMUNICATION** **9**

**Pulse Communication:** Pulse Amplitude Modulation (PAM) – Pulse Time Modulation (PTM) – Pulse code Modulation (PCM) - Comparison of various Pulse Communication System (PAM – PTM – PCM). **Data Communication:** History of Data Communication - Standards Organizations for Data Communication- Data Communication Circuits - Data Communication Codes - Data communication Hardware - serial and parallel interfaces.

**UNIT III DIGITAL COMMUNICATION** **9**

Amplitude Shift Keying (ASK) – Frequency Shift Keying (FSK)–Phase Shift Keying (PSK) – BPSK – QPSK – Quadrature Amplitude Modulation (QAM) – 8 QAM – 16 QAM – Bandwidth Efficiency– Comparison of various Digital Communication System (ASK – FSK – PSK – QAM).

**UNIT IV SOURCE AND ERROR CONTROL CODING** **9**

Entropy, Source encoding theorem, Shannon fano coding, Huffman coding, mutual information, channel capacity, Error Control Coding, linear block codes, cyclic codes - ARQ Techniques.

**UNIT V MULTI-USER RADIO COMMUNICATION** **9**

Global System for Mobile Communications (GSM) - Code division multiple access (CDMA) – Cellular Concept and Frequency Reuse - Channel Assignment and Handover Techniques - Overview of Multiple Access Schemes - Satellite Communication - Bluetooth.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

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

CO1: Apply the analog communication techniques.
CO2: Apply the digital communication techniques.
CO3: Illustrate data and pulse communication techniques.
CO4: Analyze Source and Error control coding.
CO5: Determine knowledge about multi-user radio communication.

**TEXT BOOK:**

1. Wayne Tomasi, ―Advanced Electronic Communication Systems‖, 6th Edition, Pearson Education, 2009.

**REFERENCES:**

1. Simon Haykin, ―Communication Systems‖, 4th Edition, John Wiley & Sons, 2004
2. Rappaport T.S, "Wireless Communications: Principles and Practice", 2nd Edition, Pearson Education, 2007
3. H.Taub, D L Schilling and G Saha, ―Principles of Communication‖, 3rd Edition, Pearson Education, 2007.
4. B. P.Lathi, ―Modern Analog and Digital Communication Systems‖, 3rd Edition, Oxford University Press, 2007.

| PE – 06 | BIOMEDICAL INFORMATICS | 3 0 0 3 |
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**COURSE OBJECTIVES: ( Employability)**

**The student should be made to:**

- Learn ICT applications in medicine
- Learn health informatics.
- Understand the theories and practices adopted in Hospital Information Systems in the light of medical standards,
- Understand 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 - 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 (Joint Commission on Accreditation of Healthcare Organization) - JCIA (Joint Commission International Accreditation) - Evidence Based Medicine - Bioethics.

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

Representation of Data, Data modeling Techniques, Relational Hierarchical and network Approach, Normalization techniques for Data handling - Plug-in Data Acquisition and Control Boards – Data Acquisition using Serial Interface – Medical Data formats – Signal, Image and Video Formats –Medical Databases - Automation in clinical laboratories - Intelligent Laboratory Information System –PACS.

**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**

**COURSE OUTCOMES:**

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

CO1: Illustrate knowledge about the basics of medical informatics
CO2: Analyse the different medical standards and organisations
CO3: Apply and determine the knowledge about the automated medical data storage
CO4: Explain the categories of health informatics and its applications
CO5: Classify and determine the recent trends and applications in medical informatics

**TEXT BOOKS:**

1. R.D.Lele, “Computers in medicine progress in medical informatics”, Tata McGraw Hill Publishing Ltd, 2005 (Units I, III & IV).
2. Mohan Bansal, “Medical informatics”, Tata McGraw Hill Publishing Ltd, 2003 (Units II, IV & V).

**REFERENCES:**

1. Orpita Bosu and Simminder Kaur Thukral, “Bioinformatics Databases, Tools and Algorithms”, Oxford University press, 2007.
2. Yi Ping Phoebe Chen, “Bioinformatics Technologies”, Springer International Edition, New Delhi, 2007.

| PE – 07 | LASER IN MEDICINE | 3 0 0 3 |
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**COURSE OBJECTIVES: ( Employability)**

**The student should be made to:**

- The optical properties of the tissues
- The interactions of light with tissues.
- The Medical Lasers and their applications
- The optical diagnostic applications
- The emerging optical diagnostic and therapeutic techniques

**UNIT I – INTRODUCTION** **9**

Introduction- Principle of Spontaneous Emission and Stimulated Emission- Einstien's A &B Coefficients-Derivation-Condition For Producing Laser Beam- Population Inversion- Pumping- Resonance Cavity- Types OfLasers- ND-YAG- He-Ne- Co2 Lasers-Industrial Applications- Heat Treatment- Welding-Cutting-Medical Applications-Laser Surgery- Advantages & Disadvantages-problem.

**UNIT II-LASER INTERACTION** **9**

Photochemical Interaction, Thermal Interaction, Photoablation, Plasma Induced Ablation, Photo disruption.

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

Lasers in ophthalmology, Dermatology, Dentistry, Urology, Otolaryngology, Tissue welding and Soldering.

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

Optical coherence tomography, optical Elastography, Laser Induced Fluorescence (LIF)-Imaging, FLIM Raman Spectroscopy and Imaging, FLIM – Holographic and Speckle applications of lasers in biology and medicine.

**UNIT V LASER SAFETY** **9**

Introduction, laser Hazards, Eye hazards, skin hazards, viewing Laser Radiation ,Eye Protection, Laser beam calculation

**COURSE OUTCOMES:**

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

CO1: Understand the fundamentals of optical properties of tissues
CO2: Understand the results of interaction of laser with tissue
CO3: Illustrate surgical applications of lasers.
CO4: Describe photonics and its diagnostic applications.
CO5: Describe the laser safety during medical applications

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Markolf H.Niemz, ―Laser-Tissue Interaction Fundamentals and Applications‖, Springer, 2007
2. G.David Baxter ―Therapeutic Lasers – Theory and practice‖, Churchill Livingstone publications Edition- 2001.

| PE – 08 | PHYSIOLOGICAL MODELING AND SIMULATION | 3 0 0 3 |
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**COURSE OBJECTIVES: ( Employability)**

**The student should be made to:**

- To explain the application of Physiological models and vital organs.
- To Formulate the methods and techniques for analysis and synthesis of dynamic models
- To describe the dynamic models, simulate and visualize, dynamic responses of physiological models using software.
- To describe nonlinear models of physiological systems
- To compute the Simulation of physiological systems

**UNIT I INTRODUCTION TO PHYSIOLOGICAL MODELING** 9

Approaches to modeling: The technique of mathematical modeling, classification of models, characteristics of models. Time invariant and time varying systems for physiological modeling. Introduction to physiology (homeostasis, cell biology) Modeling physical systems, linear models of physiological systems, the Laplace transform, Transfer functions and block diagram analysis Physiology.

**UNIT II MODELING OF DYNAMIC PHYSIOLOGICAL SYSTEM** 9

Dynamic systems and their control, modeling and block diagrams, the pupil control systems(Human Eye), general structure of control systems, the dynamic response characteristics of the pupil control system, open &close loop systems instability, automatic aperture control.

**UNIT III NONLINEAR MODELS OF PHYSIOLOGICAL SYSTEMS** 9

Nonparametric Modeling-Volterra Models.Wiener Models. Efficient Volterra Kernel Estimation.Parametric Modeling- Basic Parametric Model Forms and Estimation ProceduresVolterra Kernels of Nonlinear Differential Equations. Discrete-Time Volterra Kernels of NARMAX Models.

**UNIT IV COMPARTMENTENTAL PHYSIOLOGICAL MODEL** 9

Modeling the body as compartments, behaviour in simple compartmental system, pharmacokinetic model, and multi compartmental system. Physiological modeling: Electrical analogy of blood vessels, model of systematic blood flow and model of coronary circulation.Mathematical modeling of the system: Thermo regulation, Thermoregulation of cold bloodedness& warm bloodedness, the anatomy of thermo regulation, lumping & partial differential equations, heat transfer examples, mathematical model of the controlled process of the body.

**UNIT V SIMULATION OF PHYSIOLOGICAL SYSTEMS** 9

Simulation of physiological systems using Open CV / MATLAB software. Biological receptors: - Introduction, receptor characteristics, transfer function models of receptors, receptor and perceived intensity. Neuromuscular model, Renal System, Drug Delivery Model.

**TOTAL : 45 PERIODS**

**COURSE OUTCOMES:**

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

CO1: Explain the application of Physiological models

CO2: Describe the methods and techniques for analysis and synthesis of Linear and dynamic system

CO3: Examine the methods and techniques for analysis and synthesis of Non linear models

CO4: Deduce differential equations to describe the compartmental physiological model

CO5: Illustrate the Simulation of physiological systems

**TEXT BOOKS:**

1. Michel C Khoo, ―Physiological Control Systems -Analysis, simulation and estimation‖, Prentice Hall of India, 2001.

2. Marmarelis, ―Nonlinear Dynamic Modeling of Physiological Systems‖, Wiley-IEEE Press,2004.

**REFERENCES:**

1. Benjamin C Kuo, ―Automatic control systems‖, Tenth Edition, McGraw-Hill Education, 2017.
2. DavidTWestwick, Robert E. Kearney, Identification of Nonlinear PhysiologicalSystems, WileyIEEE Press, 2003.
3. V.Z. Marmarelis, ―Advanced methods of physiological modeling‖ , Springer, 1989
4. L.Stark,‖ Neurological Control System, Plenum Press‖,1968. 5. John H Milsum , ―Biological control systems‖, McGraw Hill 1966
6. MinruiFei, Shiwei Ma, Xin Li, Xin Sun, Li Jia and Zhou Su,―Advanced Computational Methods in Life System Modeling and Simulation‖, Springer,2017 BM

| PE – 09 | TELEHEALTH TECHNOLOGY | 3 0 0 3 |
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**COURSE OBJECTIVES: ( Employability)**

**The students should be made to**

- Learn the key principles for telemedicine and health
- Understand telemedical technology.
- Understand ethical and legal aspects of Telemedicine.
- Know telemedical standards, mobile telemedicine and it applications.

**UNIT I FUNDAMENTALS OF TELEMEDICINE** **9**

History of telemedicine, definition of telemedicine, tele-health, tele-care, scope, Telemedicine Systems, benefits & limitations of telemedicine.

**UNIT II TYPE OF INFORMATION & COMMUNICATION INFRASTRUCTURE FOR TELEMEDICINE** **9**

Audio, video, still images, text and data, fax-type of communications and network: PSTN, POTS, ANT, ISDN, internet, air/ wireless communications, GSM satellite, micro wave, Mobile health and ubiquitous healthcare.

**UNIT III ETHICAL AND LEGAL ASPECTS OF TELEMEDICINE** 9

Confidentiality, patient rights and consent: confidentiality and the law, the patient-doctor relationship, access to medical records, consent treatment - data protection & security, jurisdictional issues, intellectual property rights.

**UNIT IV PICTURE ARCHIVING AND COMMUNICATION SYSTEM** 9

Introduction to radiology information system and ACS, DICOM, PACS strategic plan and needs assessment, technical Issues, PACS architecture.

**UNIT V APPLICATIONS OF TELEMEDICINE** 9

Teleradiology, telepathology, telecardiology, teleoncology, teledermatology, telesurgery, e Health and Cyber Medicine.

**TOTAL : 45 PERIODS**

**COURSE OUTCOMES:**

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

CO1: Illustrate the fundamentals of Telemedicine
CO2: Explain about the communication infrastructure for telemedicine
CO3: Explain the ethical and legal aspects of telemedicine
CO4: Describe the communication system
CO5: Apply telehealth in healthcare.

**TEXTBOOKS:**

1. Norris A C, ―Essentials of Telemedicine and Telecare‖, John Wiley, New York, 2002.
2. H K Huang, ―PACS and Imaging Informatics: Basic Principles and Applications‖ Wiley, New Jersey, 2010.

**REFERENCES:**

1. Olga Ferrer Roca, Marcelo Sosa Iudicissa, ―Handbook of Telemedicine‖, IOS Press, Netherland, 2002. 2. Khandpur R S, ―Handbook of Biomedical Instrumentation‖, Tata McGraw Hill, New Delhi, 2003.
3. Keith J Dreyer, Amit Mehta, James H Thrall, ―Pacs: A Guide to the Digital Revolution‖, Springer, New York, 2002.
4. Khandpur R S, ―TELEMEDICINE – Technology and Applications‖, PHI Learning Pvt Ltd., New Delhi, 2017.

| PE – 10 | FUNDAMENTALS OF NANOSCIENCE AND NANOTECHNOLOGY | 3 0 0 3 |
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**COURSE OBJECTIVES: ( Employability)**

**The students should be made to**

- Provide a broad view of the nascent field of nanoscience and nanotechnology
- Explore the basics of nanomaterial synthesis and characterization.
- Explore the techniques used for measuring Nanomaterials
- To introduce the applications of nanotechnology

**UNIT I INTRODUCTION** **8**

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

**UNIT II GENERAL METHODS OF PREPARATION** **9**

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

**UNIT III NANOMATERIALS** **11**

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nanometal oxides-ZnO, TiO2,MgO, ZrO2, NiO, nanoalumina, CaO, AgTiO2, Ferrites, Nanoclays-functionalization and applications-Quantum wires, Quantum dots-preparation, properties and applications.

**UNIT IV PROPERTIES AND MEASUREMENT OF NANOMATERIALS AND NANO STRUCTURES** **9**

Optical Properties: Absorption, Fluorescence, and Resonance; Methods for the measurement of nanomaterials; **Microscopy measurements: SEM, TEM, AFM and STM**. Confocal and TIRF imaging. Carbon Nanotubes, Fullerenes, Nanowires, Quantum Dots. Applications of nanostructures. Reinforcement in Ceramics, Drug delivery, Giant magnetoresistance, etc. Cells response to Nanostructures.

**UNIT V APPLICATIONS OF NANOTECHNOLOGY** **8**

Nano electronics, Nanosensors, Nanotechnology in Diagnostics applications, Environmental and Agricultural Applications of nanotechnology, Nano technology for energy systems

**TOTAL : 45 PERIODS**

**COURSE OUTCOMES:**

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

CO1: Describe the basic science behind the properties of materials.

CO2: Deduce various methods of preparation of nanomaterials

CO3: Categorize various types of nanomaterials

CO4: Differentiate various properties of nanomaterials

CO5: Apply their knowledge of nanotechnology to identify how they can be exploited for new applications.

**TEXT BOOKS :**

1. A.S. Edelstein and R.C. Cammearata, eds., ―Nanomaterials: Synthesis, Properties and Applications‖, Institute of Physics Publishing, Bristol and Philadelphia, 1996.

2. N John Dinardo, ―Nanoscale Charecterisation of surfaces & Interfaces‖, 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000.

**REFERENCES:**

1. G Timp, ―Nanotechnology‖, AIP press/Springer, 1999.

2. Akhlesh Lakhtakia,―The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations‖. Prentice-Hall of India (P) Ltd, New Delhi, 2007.

| PE – 11 | CLINICAL ENGINEERING | 3 0 0 3 |
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**COURSE OBJECTIVE ( Employability)**

- To understand the essentials of basic biological principles
- To learn about Hospital Organization and the Role of Clinical Engineering
- To learn about Clinical Engineering Programs
- To clear view of The Health Care Delivery System, Strategic Technology Planning, Technology Assessment,
- To learn about Quality Improvement, Standard Database, Measurement Indicators

**UNIT 1 CLINICAL ENGINEER** **9**

Definition, Evolution of Clinical Engineering – interactions of a clinical engineer , Hospital Organization and the Role of Clinical Engineering, Clinical Engineering Programs

**UNIT -2 MANAGEMENT AND ASSESSMENT OF MEDICAL TECHNOLOGY AND RISK FACTORS** **9**

The Health Care Delivery System, Strategic Technology Planning, Technology Assessment, Equipment Assets Management. Risk Management – Strategies, Risk Management: Application

**UNIT -3 QUALITY OF IMPROVEMENT AND TEAM BUILDING** **9**

Deming's 14 Points, Zero Defects, TQM (Total Quality Management) and Tools Used for Quality Improvement, Standard Database, Measurement Indicators.

**UNIT -4 CLINICAL STANDARDS** **9**

Standards Regulatory and Assessment Agencies, Standards for clinical Engineers, Regulatory Agencies, Technology Assessment Agencies

**UNIT -5 APPLICATIONS OF VIRTUAL INSTRUMENTS IN HEALTH CARE** **9**

Application with Examples , Trending, Relationships, and Interactive Alarms, Data Modeling, Medical Equipment Risk Criteria, Peer Performance Reviews

**TOTAL: 45 HOURS**

**COURSE OUTCOMES:**

At the end of the course, the students would

| | |
|---|---|
| CO1: | Explain about hospital organization and the role of clinical engineering, clinical engineering programs |
| CO2: | Illustrate on the health care delivery system, strategic technology planning, technology assessment |
| CO3: | Interpret Deming's 14 Points, Zero Defects, TQM (Total Quality Management) and tools |
| CO4: | Categorize various health care delivery system, strategic technology planning, technology assessment |
| CO5: | Apply virtual instruments in health care |

**REFERENCES**


1. Handbook of Biomedical Engineering-Joseph Bronzino, 2000
2. Principles of Biomedical Engineering-Joseph Bronzino.

| PE – 12 | NEUROSCIENCE FOR BIOMEDICAL APPLICATIONS | 3 0 0 3 |
|---|---|---|

**COURSE OBJECTIVE ( Employability)**

- This course encompasses a scientific study of human nervous system.
- It Includes different approaches to study the molecular, cellular, developmental, structural, functional, evolutionary, and medical aspects of nervous system
- It addresses the mechanisms of how neurons process signals physiologically and electrochemically.

**UNIT 1 INTRODUCTION TO NEUROSCIENCE. 9**

An overview of neuroscience, Applications of neuroscience, Neurons and Neuroglia, Neurotransmitters

**UNIT 2 NERVOUS SYSTEM 9**

Nervous system: central nervous system, peripheral nervous system, autonomic nervous system; anatomical organization of the nervous system, functional organization of the nervous system, neurons-the nerve cell, CSF.

**UNIT 3 ELECTRICAL PROPERTIES OF NERVOUS SYSTEM 9**

Electrolytes within our neurons; Ion channels, Local signaling, Signal propagation - Action potential, Synapse, Synaptic integration, Modulation of synaptic transmission, Nerve-Muscle interaction

**UNIT 4 NEURAL NETWORKS 9**

Current flow in neurons, Introduction to electro diagnostic signals and their measurement, nerve conduction study, evoked potentials and EEG

**UNIT 5 CHALLENGES 9**

Neuroscience methods and techniques to understand the functions of nervous system – Pathology of Nervous system – Molecular and cellular mechanisms of Parkinson's, Huntington's, Stroke and Alzheimer's diseases.

**TOTAL: 45 HOURS**

**COURSE OUTCOMES:**

At the end of the course, the students would

| | |
|---|---|
| CO1: | Understanding the basics of neuroscience |
| CO2: | Illustrate about the nervous system |
| CO3: | Explain about neural networks and its electrical properties |
| CO4: | Correlate nerve conduction and musle interaction |
| CO5: | Analyse the challenges and mechanisms of different neurological disorders |

**TEXT / REFERENCE BOOKS**


1. Richard S Snell, Clinical Neuro Anatomy, Lippincott Williams & Wikkins,2006
2. W.F Ganang Review of Medical Physiology, Mc Graw Hill Professional, 21st Edition, 2003
3. A Krishnamurti Notes on Nervous System, Janagam Offset Printers, 1999
4. Eric R Sandel, Principles of Neural Science, Elsevier, 4th Edition,2000
5. U.K.Misra, Clinical neurophysiology, Elsevier Health Science, 2006 6. James D Fix, Neuroanatomy, William and Wilkins, 2nd Edition, 1995

| PE – 13 | HOSPITAL MANAGEMENT | 3 0 0 3 |
|---|---|---|

**COURSE OBJECTIVES: ( Employability)**

**The students should be made to**

- Understand the fundamentals of hospital administration and management.
- Know the market related research process
- Explore various information management systems and relative supportive services.

**UNIT I OVERVIEW OF HOSPITAL ADMINISTRATION** **9**

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 IN 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, Communication – nature, scope, barriers, styles and modes of communication.

**UNIT III MARKETING RESEARCH PROCESS** **9**

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 - The buyer decision process - Model of business buyer behavior – Major types of buying situations - WTO and its implications.

**UNIT IV HOSPITAL INFORMATION SYSTEMS & SUPPORTIVE SERVICES** **9**

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 – Environmental Management Systems. NABA, JCI, NABL. 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 in detail about the administration of a hospital |
| CO2: Analyze the importance of human resource management, procedures for recruiting, training, staffing and leadership in hospitals. |
| CO3: Illustrate in detail about marketing research & consumer behavior. |
| CO4: Articulate the services and systems in hospitals. |
| CO5: Explain in detail about the quality and safety standards in a hospital. |

**TEXT BOOKS:**

1. R.C.Goyal, ―Hospital Administration and Human Resource Management‖, PHI – Fourth Edition, 2006.
2. G.D.Kunders, ―Hospitals – Facilities Planning and Management – TMH, New Delhi – Fifth 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‖, 2nd edition Aspen Publication Inc. Rockville, Maryland, USA, 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

| PE – 14 | BIOPHOTONICS | 3 0 0 3 |
|---|---|---|

**COURSE OBJECTIVES: ( Employability)**

**The students should be made to**

- Impart adequate knowledge on various optical systems used in sensing and imaging of biological elements.
- Educate about the various interaction mechanisms of light with matter
- Understand the working principles of optical imaging systems
- Gain knowledge biosensors
- Understand the photodynamic therapy

**UNIT- I LIGHT - MATTER INTERACTION & PRINCIPLE OF OPTICS 9**

Light matter interaction: Interaction of light with bulk matter- Types of spectroscopy: Electronic absorption-, Electronic luminescence-, Vibration-, and Fluorescence spectroscopy.

**UNIT- II BIO-IMAGING: PRINCIPLES AND TECHNIQUES 9**

Introduction of optical imaging, Types of microscopy: Transmission-,Fluorescence-,Scanning- and Multi-photon-microscopy- Advantages and disadvantages of optical imaging-Applications of optical imaging.

**.UNIT – III OPTICAL BIOSENSORS 9**

Principles of Optical biosensing, Immobilization of bio-recognition elements, Types of optical biosensor: Fiber optic-, Planar waveguide-, Evanescent-,Interferometric-, and Surface plasmon resonance- biosensor- Advantages and disadvantages- Applications.

**UNIT- IV FLOW CYTOMETRY 9**

Flow cytometry: Basis, Components, and Flourochromes- Data manipulation and Presentation.

**UNIT- V PHOTODYNAMIC THERAPY 9**

Photodynamic therapy: Mechanism, and light irradiation- Photo-hemotheraphy- PUVA Technique- Applications.

**TOTAL: 45 HOURS**

**COURSE OUTCOMES:**

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

| | |
|---|---|
| CO1: | Explain about light matter interaction. |
| CO2: | Articulate the knowledge regarding bio imaging and its techniques. |
| CO3: | Analyze the use of optical biosensors. |
| CO4: | Explain about flow cytometry and its applications. |
| CO5: | Explain about the principles and techniques of photo therapy. |

**TEXTBOOKS:**

1. Jurgen Popp, Valery V, Techin, Arthur Chiou, Stefen Heinemann, "Handbook of Biophotonics Vol 2: Photonics for Health Care", John Wiley & Sons, First Edition, 2012.
2. Paras N, Prasad, "Introduction to Biophotonics", John Wiley & Sons, First Edition, 2003.

**REFERENCES:**

1. Harold Sackman, Brian Wilson, Valeri Viktorovich Tuchin, S. Tanev, Harold Sackman "Advances in Biophotonics", IOS Press, 2005.
2. Paras N Prasad, "Nanophotonics", John Wiley & Sons, First Edition, 2004.

| PE – 15 | BIO MEMS AND NANOTECHNOLOGY | 3 0 0 3 |
|---|---|---|

**COURSE OBJECTIVES: ( Employability)**

**The students should be made to**

- Acquire knowledge about the principles of BioMEMS & Biomedical Nanotechnology.
- Understand the working principle of MEMS & Microsystems.
- Understand the application of BioMEMS.

**UNIT – I MEMS & MICROSYSTEM** **9**

MEMS and Microsystems- Introduction - Typical MEMS and Microsystem Products - Application of Micro-system in Healthcare Industry – Working Principles of Microsystems Micro-sensors – Micro-actuation - MEMS with Microactuation – Micro-accelerators & Micro-fluidics - Materials for MEMS & Microsystems

**UNIT - II MICRO-OPTO ELECTROMECHANICAL SYSTEMS & MICROFLUIDICS** **9**

Fundamental principle of MOEMS Technology - Light Modulators, Beam splitter – Microlens, Micro-mirrors - Digital Micro-mirror Device, Light detectors - Important Consideration on Micro-scale fluid, Properties of fluid - Fluid Actuation Methods – Micro-pumps – Typical Micro-fluidic Channel, Micro-fluid Dispenser.

**UNIT- III BIOMEMS** **9**

BIOMEMS-Introduction, the driving force behind the biomedical Application - Principle of Biosensor, Ampero-metric Biosensor - Multi-analyte measurement, Micro-dialysis - BioMEMS for Clinical Monitoring - Multi-parameter monitoring - Monitoring of Glucose & Lactate with a micro-dialysis probe – Ammonia Monitoring - Electronic Nose, DNA Sensors.

**UNIT- IV DNA BASED BIOMEMS** **9**

Introduction, Unique features of Nucleic Acids,Lab on the Chip, Electrophoresis, Polymerase Chain Reaction (PCR), Biochemical reaction chains for integration: Biosensors & the "lab biochip", Typical Microarray experiment, Manufacturing of Microarrays, Synthesis on the chip, Spotting Techniques, PCR on the chip, Microchamber Chips, Micro-fluidics Chips, Emerging BioMEMS Technology.

**UNIT –V BIOMEDICAL NANOTECHNOLOGY** **9**

Introduction to nanoscale phenomena, Nanoparticles- Nanomaterial characterization – XRD, SAXS, TEM, SEM, Scanning Tunneling microscopy, AFM, SPM technique, Biomolecular sensing for cancer diagnostics using carbon nanotubes, Carbon nanotube biosensors, Magnetic nanoparticles for MR Imaging, Nano-devices in biomedical applications.

**TOTAL: 45 HOURS**

**COURSE OUTCOME:**

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

CO1: Apply the integration of mechanical and electrical elements and also the techniques involved in the fabrication of biomems and nanotechnology.

CO2: Analyse the fabrication of microfluidic devices,surface functionalization and the limitations of surface micromachining.

CO3: Examine the basic design and operation of BioMEMS sensors and transducers, and Biochips

CO4: Apply knowledge to design solutions to probe biomedical and biology systems.

CO5: Apply the fundamental principles of nanotechnology and their application to biomedical engineering.

**TEXTBOOKS:**

1. Steven S, Saliterman, "Fundamentals of BioMEMS & Medical Microdevices*",*International Society for Optical Engineering, First Edition 2006.

2. Nitaigour Premchand Mahalik, "MEMS", Tata McGraw Hill, 2nd Reprint 2008.

3. Wanjun Wang & Steven A.Soper , "BioMEMS- Technologies and applications", CRC Press, First edition 2007.

**REFERENCES:**

1. Tai-Ran Hsu, "MEMS & Microsystems- Design, Manufacture and Nanoscale Engineering*",* John Wiley & Sons, 2nd Edition 2008.

2. Gerald A Urban, "BioMEMS*",* Springer, First Edition 2006.

3. Abraham P. Lee and James L. Lee, "BioMEMS and Biomedical Nanotechnology",Volume I, Springer, First Edition 2006.

4. Paul C.H. Li, "Introduction to Microfluids and BioMEMS: A Design and Problem-SolvingTextbook", CRC Press, First Edition 2009.

5. Hari Singh Nalwa, "Nanostructured Materials and Nanotechnology", Academic Press, First Edition 2002.

6. Guozhong Cao & Ying Wang, "Nanostructures and Nanomaterials-Synthesis, Propertiesand Applications*",* World Scientific, 2nd Edition 2011.

| PE – 16 | HUMAN ASSIST DEVICES | 3 0 0 3 |
|---|---|---|

**COURSE OBJECTIVES: ( Employability)**

**The student should be made to:**

- Study various mechanical techniques that will help failing heart.
- Learn the functioning of the unit which does the clearance of urea from the blood
- Understand the tests to assess the hearing loss and development of electronic devices to compensate for the loss.
- Know the various orthodic devices and prosthetic devices to overcome orthopaedic problems.
- Understand electrical stimulation techniques used in clinical applications.

**UNIT I HEART LUNG MACHINE AND ARTIFICIAL HEART** 9

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

**UNIT II CARDIAC ASSIST DEVICES** 9

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

**UNIT III ARTIFICIAL KIDNEY** 9

Indication and Principle of Haemodialysis, Membrane, Dialysate, Different types of heamodialysers, Monitoring Systems, Wearable Artificial Kidney, Implanting Type.

**UNIT IV PROSTHETIC AND ORTHOTIC DEVICES** 9

Hand and Arm Replacement - Different Types of Models Externally Powered Limb Prosthesis, Lower Limb and Upper limb orthotic devices, Functional Electrical Stimulation, Sensory Assist Devices, Materials for Prosthetic and orthotic devices, Haptic Devices.

**UNIT V RESPIRATORY AND HEARING AIDS** 9

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

**TOTAL:45 HOURS**

**COURSE OUTCOME:**

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

CO1: Explain all types of cardiac assist device and its operations.
CO2: Understand biocompatibility and the properties and classification of different types of Biomaterials
CO3: Determine the artificial kidneys and assist devices for impaired kidneys
CO4: Understand the designing of orthotics devices and prosthetic devices to overcome mobility problems
CO5: Analyze about tests to assess the hearing loss and development of electronic devices to compensate for the loss and respiratory system

**REFERENCES:**

1. Andreas.F.Von racum, Hand book of bio material evalution, Mc-Millan publishers, 1980.
2. Albert M.Cook and Webster J.G., Therapeutic Medical Devices, Prentice Hall Inc.,New Jersey,1982
3. Gray E Wnek, Gray L Browlin – Encyclopedia of Biomaterials and Biomedical Engineering –Marcel Dekker Inc New York 2004.
4. John. G . Webster – Bioinstrumentation - John Wiley & Sons (Asia) Pvt Ltd - 2004.
5. Kolff W.J., Artificial Organs, John Wiley and Sons, New York, 1979.

| PE – 17 | PATTERN RECOGNITION AND NEURAL NETWORKS | 3 0 0 3 |
|---|---|---|

**COURSE OBJECTIVES: ( Employability)**

**The student should be made to:**

- The course will introduce the student to the fundamentals of pattern recognition and its application.
- The course will discuss several supervised and unsupervised algorithms suitable for pattern classification
- Particular emphasis will be given to computational methods such as linear discriminant functions and nearest neighbor rule.
- The course also covers basic neural network architectures and learning algorithms, for applications in pattern recognition, image processing, and computer vision.
- The major focus of this course will be on the use of Pattern and Neural Classifiers for classification applications.

**UNIT I INTRODUCTION AND SUPERVISED LEARNING** **9**

Overview of Pattern recognition, 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- Hierarchial 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

**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

**TOTAL: 45 PERIODS**

**COURSE OUTCOME**

| | |
|---|---|
| CO1: | Apply the basic concepts in pattern recognition and its type. It clearly understands pattern recognition theories, such as Bayes classifier and linear discriminant analysis. |
| CO2: | Utilize Unsupervised learning algorithms to solve problems. |
| CO3: | Apply the concepts and techniques of neural networks through the study of the most important neural network models. |
| CO4: | Construct and develop neural network based on Backpropogation Algorithm and Associative memory. |
| CO5: | Solve neural network based on competition. |

**TEXT BOOKS:**

1. Duda R.O. Hart P.G, "Pattern Classification and scene analysis", Wiley Edition 2000 .
2. Hagan, Demuth and Beale, "Neural network design", Vikas Publishing House Pvt Ltd., New Delhi, 2002.

**REFERENCES:**

1.Freeman J.A., and Skapura B.M, "Neural Networks, Algorithms, Applications and Programming Techniques", Addison - Wesley, 2003.
2.Earl Gose, Richard Johnsonbaugh Steve Jost, "Pattern Recognition and Image Analysis", Prentice Hall of India Pvt Ltd., New Delhi, 1999.
3.Robert Schalkoff, "Pattern recognition, Statistical, Structural and neural approaches" John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2005.
4.Laurene Fausett, "Fundamentals of neural networks- Architectures, algorithms and applications",Prentice Hall, 1994

| PE – 18 | BIOMETRIC SYSTEMS | 3 0 0 3 |
|---|---|---|

**COURSE OBJECTIVES: ( Employability)**

**The student should be made to:**

- To understand the technologies of fingerprint, iris, face and speech recognition
- To understand the general principles of design of biometric systems and the underlying trade-offs.
- To recognize personal privacy and security implications of biometrics based identification technology.
- To identify issues in the realistic evaluation of biometrics based systems.

**UNIT I INTRODUCTION TO BIOMETRICS** **9**

Introduction and back ground – biometric technologies – passive biometrics – active biometrics -Biometric systems – Enrollment – templates – algorithm – verification – Biometric applications –biometric characteristics- Authentication technologies –Need for strong authentication – Protecting privacy and biometrics and policy – Biometric applications – biometric characteristics

**UNIT II FINGERPRINT TECHNOLOGY** **9**

History of fingerprint pattern recognition - General description of fingerprints - Finger print feature processing techniques - fingerprint sensors using RF imaging techniques – fingerprint quality assessment – computer enhancement and modeling of fingerprint images – fingerprint enhancement– Feature extraction – fingerprint classification – fingerprint matching

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

Introduction to face recognition, Neural networks for face recognition – face recognition from correspondence maps – Hand geometry – scanning – Feature Extraction - Adaptive Classifiers -Visual-Based Feature Extraction and Pattern Classification - feature extraction – types of algorithm –Biometric fusion.

**UNIT IV MULTIMODAL BIOMETRICS AND PERFORMANCE EVALUATION** **9**

Voice Scan – physiological biometrics –Behavioral Biometrics - Introduction to multimodal biometric system – Integration strategies – Architecture – level of fusion – combination strategy –training and adaptability – examples of multimodal biometric systems – Performance evaluation- Statistical Measures of Biometrics – FAR – FRR – FTE – EER – Memory requirement and allocation.

**UNIT V BIOMETRIC AUTHENTICATION** **9**

Introduction - Biometric Authentication Methods - Biometric Authentication Systems – Biometric authentication by fingerprint -Biometric Authentication by Face Recognition. -. Expectation- Maximization theory - Support Vector Machines. Biometric authentication by fingerprint –biometric authentication by hand geometry- Securing and trusting a biometric transaction – matching location –local host - authentication server – match on card (MOC) – Multibiometrics and Two-Factor Authentication

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

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

| | |
|---|---|
| CO1: | Determine the knowledge engineering principles underlying in biometric systems |
| CO2: | Analyze the Fingerprint Technology |
| CO3: | Describe Face recognition and hand geometry |
| CO4: | Evaluate the performance of biometric systems. |
| CO5: | Analyze design basic biometric system authentication |

**TEXT BOOKS:**

1. James Wayman, Anil Jain, Davide Maltoni, Dario Maio, “Biometric Systems, Technology Design and Performance Evaluation”, Springer, 2005 (Units I, II, III & IV)
2. S.Y. Kung, S.H. Lin, M.W.Mak, “Biometric Authentication: A Machine Learning Approach” Prentice Hall, 2005(Unit V)

**REFERENCES:**

1. Paul Reid, “Biometrics for Network Security”, Pearson Education, 2004.
2. Nalini K Ratha, Ruud Bolle, “Automatic fingerprint Recognition System”, Springer, 2003
3. L C Jain, I Hayashi, S B Lee, U Halici, “Intelligent Biometric Techniques in Fingerprint and Face Recognition” CRC Press, 1999.
4. John Chirillo, Scott Blaul, “Implementing Biometric Security”, John Wiley, 2003.
5. Arun A. Ross, Karthik Nanda Kumar, Anil K. Jain, “Handbook of Multibiometrics”, Springer, 2006.

| PE – 19 | ADVANCED BIOANALYTICAL AND THERAPEUTIC TECHNIQUES | 3 0 0 3 |
|---|---|---|

**COURSE OBJECTIVES: ( Employability)**

**The student should be made to:**

- Gain knowledge about the Light spectrum, Absoprtion, Fluorescence,
- Gain knowledge about the NMR, Mass spectroscopy
- Gain knowledge on the different chromotographic methods for separation of biological products.

**UNIT I INTRODUCTION TO SPECTROMETRY** **9**

Properties of electromagnetic radiation- wave properties – components of optical instruments – Sources of radiation – wavelength selectors – sample containers – radiation transducers – Signal process and read outs – signal to noise ratio - sources of noise – Enhancement of signal to noise - types of optical instruments – Principle of Fourier Transform optical Measurements.

**UNIT II MOLECULAR SPECTROSCOPY** **9**

Molecular absorption spectrometry – Measurement of Transmittance and Absorbance – Beer's law– Instrumentation - Applications -Theory of fluorescence and Phosphorescence – Instrumentation– Applications – Theory of Infrared absorption spectrometry – IR instrumentation – Applications –Theory of Raman spectroscopy – Instrumentation – applications.

**UNIT III MAGNETIC RESONANCE SPECTROSCOPY AND MASS SPECTROMETRY** **9**

Theory of NMR – environmental effects on NMR spectra – chemical shift- NMR-spectrometers –applications of 1H and 13C NMR- Molecular mass spectra – ion sources – Mass spectrometer. Applications of molecular mass - Electron paramagnetic resonance- g values –instrumentation.

**UNIT IV SEPARATION METHODS** **9**

General description of chromatography – Band broadening and optimization of column performance- Liquid chromatography – Partition chromatography – Adsorption chromatography – Ion exchange chromatography -size exclusion chromatography- Affinity chromatography principles of GC and applications – HPLC- Capillary electrophoresis – Applications.

**UNIT V ELECTRO ANALYSIS AND SURFACE MICROSCOPY** **9**

Electrochemical cells- Electrode potential cell potentials – potentiometry- reference electrode – ion selective and molecular selective electrodes – Instrument for potentiometric studies – Voltametry –Cyclic and pulse voltametry- Applications of voltametry . Study of surfaces – Scanning probe microscopes – AFM and STM.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

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

CO1:Explain the introduction and importance of spectrometry
CO2:Illustrate the principle and working of molecular spectroscopy
CO3:Examine the basic fundamentals and working of magnetic resonance spectroscopy and mass spectroscopy
CO4:Explain the separation methods of chromatography
CO5:Explain electroanalysis and surface microscopy

**TEXT BOOKS:**

1. Skoog, D.A. F. James Holler, and Stanky, R.Crouch "Instrumental Methods of Analysis". Cengage Learning , 2007.

| PE – 20 | BIOPROCESS TECHNOLOGY | 3 0 0 3 |
|---|---|---|

**COURSE OBJECTIVE: ( Employability)**

- To learn introduction` and technology of bioprocess, screening,preservation.
- To clear view of Bioreactor design. Batch, fed batch and continuous cultivation. Growth rate parameters : Specific growth rate, doubling time
- To learn the Kinetics and thermodynamics of enzyme-catalyzed reactions, techniques of enzyme immobilisation

**UNIT-1 INTRODUCTION OF BIOPROCESS TECHNOLOGY 9**

Introduction to bioprocess technology, Screening, preservation and improvement of industrially important microorganisms, Raw material and media formulation for fermentation process, Influence of environmental factors on growth and product formation.

**UNIT-2 BIOREACTORS 9**

Bioreactor design.Batch, fed batch and continuous cultivation.Solid state cultivation.Sterilization of media reactor and air.Agitation and aeration and mass transfer of oxygen.Inoculum development, addition and sampling.

**UNIT-3 GROWTH RATE ANALYSIS 9**

Growth rate parameters : Specific growth rate, doubling time, validity of exponential growth law, growth yield, metabolic quotient, Effect of substrate concentration, Monod Kinetics, Determination of Ks, Definition of lag period.

**UNIT-4 ENZYME TECHNOLOGY 9**

Kinetics and thermodynamics of enzyme-catalyzed reactions, techniques of enzyme immobilisation, basic design and configuration of immobilised enzyme reactors, applications of immobilised enzyme technology.

**UNIT-5 BIOPROCESS ESTIMATIONS 9**

Methods of on-line and off-line biomass estimation; Flow injection analysis for measurement of substrates.Product and other metabolites; State and parameter estimation techniques for biochemical processes; Computer-based data acquisition, monitoring and control-LABVIEW Software.

**TOTAL: 45 HOURS**

**COURSE OUTCOMES**

At the end of the course, the students would be able to

CO1: Explain the introduction of bioprocess technology
CO2: Illustrate the design of bioreactors
CO3: Analyze the basic parameters of growth rate analysis
CO4: Explain the structure of enzyme technology
CO5: Explain the working of bioprocess estimation

**REFERENCE BOOKS :**

1. Principles of Fermentation Technology : Whitekar & Stanbury
2. Industrial Microbiology – Casida 3. Shule and Kargi, " Bioprocess Engineering ", Prentice Hall, 1992

| PE – 21 | VIRTUAL INSTRUMENTATION IN MEDICINE | 3 0 0 3 |
|---|---|---|

**COURSE OBJECTIVES: ( Employability)**

**The student should be made to:**

- Impart adequate knowledge on Virtual Instrumentation for acquisition and analysis of signals in medical system.
- Educate about the Basic concepts of VI,programming concepts of VI
- Enable to implement VI in medical systems

**UNIT I - INTRODUCTION TO VIRTUAL INSTRUMENTATION** 8

Virtual instrumentation (VI): Evolution, Definition, Architecture- Conventional-, and, Comparison of VI with traditional Instruments, Need of VI, advantages, block diagram, data flow techniques, graphical programming, Comparison between graphical programming and conventional programming.

**UNIT II - PROGRAMMING MODES IN VI** 10

front panel, Block diagram, LABVIEW Environment: Startup-, Shortcut-, and Pull down menu, Palletes, Control structures: FOR loop, WHILE loop, Shift Registers, feedback nodes, Selection Structures: Case and sequence structures, Formulae nodes, Arrays, Clusters, Waveform Chart and graph, XY Graph, Strings, Tables, File I/O functions.

**UNIT III - HARDWARE ASPECTS OF VI SYSTEM** 9

Digital I/O Techniques: pull-up and pull down resistors, TTL to solid state Relays, Voltage dividers, data acquisition in LABVIEW, hardware installation and configuration, Data acquisition (DAQ): Components, Accessories, Hardware, and Software.

**UNIT IV - COMMON INSTRUMENT INTERFACE** 10

Current loop:4-20mA,60mA, RS232, RS422, RS485, General purpose interface bus(GIPB) ,Virtual Instrument Software Architecture (VISA), Universal serial port bus(USB), Peripheral computer interface (PCI), VME extensions for instrumentation (VXI), PCI extensions for Instrumentation (PXI), Personal Computer Memory Card International Association (PCMCIA), Signal conditioning extension for instrumentation (SCXI).

**UNIT V - ANALYSIS TOOLS AND APPLICATIONS OF VI** 8

Fourier transform, Power spectrum, Correlation, Windowing, filtering, Oscilloscope, Waveform generator, Multi-channel data acquisition using LABVIEW, Biomedical applications.

**COURSE OUTCOMES:**

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

CO1: Explain in detail about the basic concepts involved in Virtual instrumentation

CO2: Articulate the different modes in VI

CO3: Examine about the hardware aspects of a system

CO4: Explain about the common instrument interface

CO5: Experiment the tools and applications of VI

**TEXT BOOKS**

1. Gary Jonson, “Labview Graphical Programming”, Second Edition, McGraw Hill, New York, Fourth edition 2006.
2. Lisa K. wells & Jeffrey Travis, “Labview for everyone”, Prentice Hall Inc., New Jersey;First edition 1997.

**REFERENCES**

1. Gupta S, Gupta J P, “PC interfacing for Data Acquisition & Process Control”, Instrument Society of America, Second Edition, 1994
2. Technical Manuals for DAS Modules of Advantech and National Instruments

| PE – 22 | TISSUE ENGINEERING | 3 0 0 3 |
|---|---|---|

**COURSE OBJECTIVES: ( Employability)**

- To learn about the basic mechanics of Tissue Engineering, model of artificial organs and it process.
- To have a clear view about tissue growth mechanism
- To learn in detail about implants

**UNIT 1 FUNDAMENTAL OF TISSUE ENGINEERING 9**

Tissue Exchange and Tissue Development, objectives of Tissue engineering, Element of Tissue development.

**UNIT 2 CELLULAR STUDIES 9**

Cell growth and differentiation, Cell and tissue mechanism, cell adhesion, cell migration, cell aggregation and tissue equivalent.

**UNIT 3 TISSUE BARRIERS TO MOLECULAR AND CELLULAR TRANSPORT 9**

Cell delivery and recirculation, Delivery molecular agents in tissue engineering, control releaser agents in time and space.

**UNIT 4 TISSUE REPLACEMENT IMPLANTS 9**

Soft-tissue replacements, sutures, surgical tapes, adhesive, percutaneous and skin implants, maxillofacial augmentation, blood interfacing implants, hard tissue replacement implants, internal fracture fixation devices, joint replacements.

**UNIT 5 ARTIFICIAL ORGANS 9**

Artificial Heart, Prosthetic Cardiac Valves, Limb prosthesis, Externally Powered limb Prosthesis, Dental Implants.

**TOTAL: 45 HOURS**

**COURSE OUTCOMES**

At the end of the course, the students would

| | |
|---|---|
| CO1: | Examine the fundamentals of tissue engineering |
| CO2: | Describe cellular studies in detail |
| CO3: | Explain tissue barriers to molecular and cellular transport |
| CO4: | Explain in detail about tissue replacements |
| CO5: | Explain in detail about artificial organs |

**REFERENCES:**

1. PARK J.B., “Biomaterials Science and Engineering”, Plenum Press, 1984.

2. W Mark Saltzman Tissue Engineering – Engineering principles for design of replacement organs and tissue –- Oxford University Press Inc New York 2004.

3. Gray E Wnek, Gray L Browlin – Encyclopaedia of Biomaterials and Biomedical Engineering – Marcel Dekker Inc New York 2004.

| PE – 23 | BRAIN COMPUTER INTERFACE AND ITS APPLICATIONS | 3 0 0 3 |
|---|---|---|

**COURSE OBJECTIVE ( Employability)**

- To learn the basics of brain computer interfacing and to study different BCI approach methods with basic examples.
- To study the EEG feature extraction and transformation.
- To help acquire Having knowledge about MATLAB tools for BCI.

**UNIT 1 INTRODUCTION** **9**

Introduction to Brain computer interfaces, The Evolution of BCIs, Brain signals for BCIs: Neuronal Activity in motor cortex and related areas, Electrical and Magnetic fields produced by the brain, Signals reflecting brain metabolic activity, Concept of BCI, Invasive and Non-invasive Types, EEG Standards, Signal Features, Spectral Components, EEG Data Acquisition, Pre-processing, Hardware and Software , Artifacts, Methods to Remove , Near Infrared BCI.

**UNIT 2 BCI APPROACH METHODS** **9**

Mu Rhythm – Movement Related EEG Potentials – Mental States – Visual Evoked Potential Based – P300 component.

**UNIT 3 EEG FEATURE EXTRACTION METHODS** **9**

Time/Space Methods – Fourier Transform – Wavelets – AR models – Band pass filtering PCA – Laplacian Filters – Linear and Non-linear Features.

**UNIT 4 EEG FEATURE TRANSLATION METHODS** **9**

LDA – Regression – Memory Based – Vector Quantization – Gaussian Mixture Modeling – Hidden Markov Modeling.

**UNIT 5 MATLAB-BASED TOOLS FOR BCI** **9**

Introduction, Data Streaming: Field Trip, DataSuite: DataRiver and MatRiver, EEGLAB Online Data Processing: A minimalistic BCI script using native MATLAB code, Other MATLAB BCI Classification tools, BCILAB

**TOTAL: 45 HOURS**

**COURSE OUTCOMES**

| | |
|---|---|
| CO1: | Determine knowledge about the introduction of brain computer interface |
| CO2: | Explain the BCI approach methods |
| CO3: | Describe in detail about BCI approach methods |
| CO4: | Describe in detail about BCI approach methods |
| CO5: | Describe the mat lab based tools for brain computer interface |

**TEXT / REFERENCE BOOKS**

1. Jonathan R. Wolpaw, Elizabeth Winter Wolpaw, Brain computer interfaces principles and practice, Oxford University Press-2012.
2. Desney S, Tan & Anton Nijholt, Brain Computer interfaces: Applying our minds to human computer interaction, Springer Science and Business Media, 2010.
3. References: Bernhard Graimann, Brendan Allison, Gert Pfurtscheller, Brain computer interfaces Revolutionizing Human – Computer interaction, Springer-2010.
4. Special Issue on Brain Control Interfaces, IEEE Transactions on Neural Systems and Rehabilitation Engineering, Vol 14, June 2006.
5. Andrew Webb, Statistical Pattern Recognition, Wiley International, Second Edition, 2002. 6. R.Spehlmann, EEG Primer, Elsevier Biomedical Press, 1981

| PE – 24 | BODY AREA NETWORKS | 3 0 0 3 |
|---|---|---|

**COURSE OBJECTIVES:(Employability)**

**The student should be made to:**

- Learn about body area networks' and different hardwares related to it
- Learn about wireless communication
- Provide knowledge in the applications of Body Area Networks.

**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, BSN Architecture –Introduction

**UNIT II HARDWARE FOR BAN** **9**

Processor-Low Power MCUs, Mobile Computing MCUs ,Integrated processor with radio transceiver, 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-Network topology-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 arrhymias 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 should be able to:**

CO1: Explain about working of Body Area Network
CO2: Describe and analyse the Hardware for BAN
CO3: Explain wireless communication and network systems
CO4: Apply and define the coexistence issues of BAN.
CO5: Analyse the applications of BAN.

**TEXT BOOK:**

1. Annalisa Bonfiglio, Danilo De Rossi ,"Wearable Monitoring Systems", Springer, 2011.(Unit I, II, III & V).
2. Sandeep K.S. Gupta,Tridib Mukherjee,Krishna Kumar Venkatasubramanian, "Body Area Networks Safety, Security, and Sustainability," Cambridge University Press, 2013. (Unit IV).

**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

| PE – 25 | BIOLOGICAL EFFECTS OF RADIATION | 3 0 0 3 |
|---|---|---|

**COURSE OBJECTIVES**: **( Employability)**

- To learn about effects of radiation in the biological system.
- To learn about protocols of different human tissues
- To learn in detail about microwave ,UV, RF transmitters

**UNIT – 1 ACTION OF RADIATION IN LIVING CELLS 9**

Various theories related to radiation at cellular level. DNA and chromosomal damages.

**UNIT – 2 SOMATIC APPLICATION OF RADIATION 9**

Radio sensitivity protocols of different tissues of human. LD50/30 effective radiation on skin. Bone marrow, eye, endocrine glands, and basis of radio therapy.

**UNIT – 3 GENETIC EFFECTS OF RADIATION 9**

Threshold and linear dose, gene control hereditary diseases effect of dose.

**UNIT – 4 EFFECT OF MICROWAVE AND RF WITH MATTERS 9**

Effects of various human organs and systems, Wavelength in tissue, non thermal interaction.Standards of protection, national, and international standards and precautions.

**UNIT – 5 UV RADIATION 9**

Classification of sources, measurement, photo medicine, UV radiation, safety visible and infrared Radiation.

**TOTAL: 45 HOURS**

**COURSE OUTCOMES:**

At the end of the course, the students would

| | |
|---|---|
| CO1: | Develop understanding of active radiation in living cells |
| CO2: | Explain somatic applications of radiation |
| CO3: | Describe the genetic effects of radiation |
| CO4: | Analyse the effects of microwave and RF with matters |
| CO5: | Analyse the effects of UV Radiation |

**REFERENCE:**

1. Paul Fryer, Duncan Ward, Radiatiom, White Cube Publishers (2008).
2. Steve Forshier, Essential of Radiation Biology and Protection, Delmar Publishers (2008).

| PE – 26 | GENETIC ENGINEERING | 3 0 0 3 |
|---|---|---|

**COURSE OBJECTIVES ( Employability)**

- To introduce a fascinating and controversial area of contemporary science
- To present basic terms, principles, and research methods used in the study of genetics.
- To learn about the transmission, distribution, arrangement, and alteration of genetic information
- To learn how it functions in populations.

**UNIT 1 MENDELIAN PRINCIPLE. 9**

DNA as hereditary material, Mendel and his experiments, laws of inheritance, variations in Mendel's Theme: incomplete dominance, co-dominance and multiple allele, Gene interactions; Epistasis, Duplicate, Complementary, Supplementary and Lethal genes

**UNIT 2 CHROMOSOMES 9**

Structural organization, variation in the number and structure of chromosome; Haploids, missing and extra chromosome (Euploid and aneuploid); Deletion, Duplication, Translocation and other structural rearrangements.Chromosomal studies - karyotyping.Chromosomal theory of inheritance; clues from inheritance of sex, linkage, crossing over.

**UNIT 3 GENETIC MATERIAL AND MUTATION 9**

Evidence for DNA and RNA as genetic material; Mutations - types and causes of mutation, DNA repair Mechanisms. Physiochemical properties of DNA: Denaturation, Annealing and C-value paradox.

**UNIT 4 BACTERIAL GENETICS 9**

Bacterial gene transfer; conjugation, transformation, transduction - general, restricted and abortive transductions; Bacterial plasmids: structure, properties and its types; transposons, types of transposons.

**UNIT 5 HUMAN GENETICS 9**

Human Chromosomes, Dosage Compensation, Chromosomal abnormalities - sex chromosomal and autosomal.Inherited disorders, Genetic engineering, gene therapy, inborn errors of metabolism and Genetic counseling. Knock down and gene silencing.

**TOTAL: 45 HOURS**

**COURSE OUTCOMES:**

At the end of the course, the students would

| |
|---|
| CO1: Describe Knowledge about DNA and principles of inheritence |
| CO2: Illustrate a well-founded knowledge about chromosomes |
| CO3: Analyse the fundamental knowledge of genetic materials |
| CO4: Determine deep knowledge about bacterial genetics |
| CO5: Determine knowledge about genetic engineering and gene therapy |

**TEXT / REFERENCE BOOKS**


1. David Friefelder, Molecular Genetics, Narosa publishing house, India, 2006.
2. Kavita B Ahluwalia, Genetics, New age international publishers, India. 2008.
3. Gardner, E.J, Simmons, Snustad, Principles of Genetics, 8th Edition John Wiby & Sons ltd, 1991.
4. Griffith, Fundamentals of Genetics analysis, 7th Edition, W.H. Freeman & Company, Newyork, 2000.
5. Robert Tamarin, Principles of Genetics, 7th Edition, Tata McGraw-Hill Edition, New York.2002. 6. Molecular Biology of Genes - Watson, 7th Edition, Benjamin Cummings, 2013

| PE – 27 | EFFECTS OF RADIATION AND RADIATION SAFETY | 3 0 0 3 |
|---|---|---|

**COURSE OBJECTIVE ( Employability)**

- To provide a broad knowledge on the interaction of Non-Ionizing radiation
- To learn about affects of ultrasound in tissues and their use in medicine.
- To have a better understanding about radiation monitoring instruments

**UNIT I REVIEW OF NONIONISING RADIATIONPHYSICS IN MEDICINE 9**

Different sources of Non Ionising radiation-their physical; properties-first law of photochemistry-Law of reciprocity- - Electrical Impedance and Biological Impedance - Principle and theory of thermography - applications

**UNIT 2 TISSUE OPTICS 9**

Various types of optical radiations - UV, visible and IR sources - Lasers: Theory and mechanism- Laser Surgical Systems-Measurement of fluence from optical sources - Optical properties of tissues – theory and experimental techniques-interaction of laser radiation with tissues – photothermal -photochemical – photoablation – electromechanical effect

**UNIT 3 PRINCIPLES OF RADIATION DETECTION AND DOSIMETERS 9**

Principles of Radiation detection – properties of dosimeters - Theory of gas filled detectors – Ion chamber dosimetry systems - free air ion chamber – parallel plate chamber - ionization chamber – proportional chamber - GM counter – condenser type chambers and thimble chambers working and different applications – film dosimetery Luminescence dosimetry – semiconductor dosimetry – Gel dosimetry - – radiographic and radiochromic films – scintillation detections.

**UNIT 4 RADIATION MONITORING INSTRUMENTS 9**

Introduction – operational quantities for Radiation monitoring – Area survey meters – Ionization chambers – proportional counters – neutron area survey meters – GM survey meters – scintillation detectors – Personal monitoring – film badge – TLD – Properties of personal monitors - Radiophtoluminesce glass dosimetry system – OSLD

**UNIT 5 RADIATION TREATMENT PLANNING PARAMETERS 9**

Build-up, central axis depth doses for different energies and their determination - Tissue Air Ratio, Tissue Maximum Ratio and Tissue Phantom Ratio - their relationship - back scatter factor –phantom scatter factor – collimator scatter factor - source to surface distance –dependence of SSD

**TOTAL: 45 HOURS**

**COURSE OUTCOME:**

At the end the Students will be able

| | |
|---|---|
| CO1: | Explain the understanding of non-ionising radiation physics in medicine |
| CO2: | Explain tissue optics |
| CO3: | Describe the radiation detection and dosimeters |
| CO4: | Analyse the radiation monitoring instruments |
| CO5: | Analyse radiation treatment planning parameters |

**TEXT BOOKS:**

1. F M Khan-Physics of Radiation Therapy, 3rd Edition,Liippincott Williams & Wilkins,USA, 2003.
2. W. R. Hendee, Medical Radiation Physics, Year Book Medical Publishers Inc., London, 2003.
3. Radiation oncology physics : A Handbook for teachers and students. IAEA publications 2005.
4. F.M.Khan,The Physics of Radiation Therapy,Third Edition,Lippincott Williams and Wilkins,U.S.A.,2003.

| PE – 28 | ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY | 3 0 0 3 |
|---|---|---|

**COURSE OBJECTIVE ( Employability)**

- 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 1 BASIC THEORY** **9**

Introduction to EMI and EMC, Intra and inter system EMI, Elements of Interference, Sources and Victims of EMI, Conducted and Radiated EMI emission and susceptibility, Case Histories, Radiation hazards to humans, Various issues of EMC, EMC Testing categories, EMC Engineering Application.

**UNIT 2 COUPLING MECHANISM** **9**

Electromagnetic field sources and Coupling paths, Coupling via the supply network, Common mode coupling, Differential mode coupling, Impedance coupling, Inductive and Capacitive coupling, Radiative coupling, Ground loop coupling, Cable related emissions and coupling, Transient sources, Automotive transients.

**UNIT 3 EMI MITIGATION TECHNIQUES** **9**

Working principle of Shielding and Murphy"s Law, LF Magnetic shielding, Apertures and shielding effectiveness, Choice of Materials for H, E, and free space fields, Gasketting and sealing, PCB Level shielding, Principle of Grounding, Isolated grounds, Grounding strategies for Large systems, Grounding for mixed signal systems, Filter types and operation, Surge protection devices, Transient protection.

**UNIT 4 STANDARDS AND REGULATION** **9**

Need for Standards, Generic/General Standards for Residential and Industrial environment, Basic Standards, Product Standards, National and International EMI Standardizing Organizations; IEC, ANSI, FCC, AS/NZS, CISPR, BSI, CENELEC, ACEC. Electro Magnetic Emission and susceptibility standards and specifications, MIL461E Standards.

**UNIT 5 EMI TEST METHODS AND INSTRUMENTATION** **9**

Fundamental considerations, EMI Shielding effectiveness tests, Open field test, TEM cell for immunity test, Shielded chamber , Shielded anechoic chamber, EMI test receivers, Spectrum analyzer, EMI test wave simulators, EMI coupling networks, Line impedance stabilization networks, Feed through capacitors, Antennas, Current probes, MIL -STD test methods, Civilian STD test methods.

**TOTAL: 45 HOURS**

**COURSE OUTCOMES:**

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

CO1: Determine solution to EMI Sources, EMI problems in PCB level / Subsystem and system level design.
CO2: Analyse emission immunity level from different systems to couple with the prescribed EMC standard
CO3: Illustrate about EMI standardizing organizations
CO4: Determine knowledge about different mitigation techniques
CO5: Determine a good understanding about EMI test methods

**TEXT BOOK:**

1. Clayton Paul, "Introduction to Electromagnetic Compatibility", Wiley Interscience, 2006

**REFERENCES:**

1. V Prasad Kodali, "Engineering Electromagnetic Compatibility", IEEE Press, Newyork, 2001.
2. Henry W. Ott, "Electromagnetic Compatibility Engineering", John Wiley & Sons Inc, Newyork, 2009
3.Daryl Gerke and William Kimmel, "EDN"s Designer"s Guide to Electromagnetic Compatibility", Elsevier Science & Technology Books, 2002
4.W Scott Bennett, "Control and Measurement of Unintentional Electromagnetic Radiation", John Wiley & Sons Inc., (Wiley Interscience Series) 1997.
5. Dr Kenneth L Kaiser, "The Electromagnetic Compatibility Handbook", CRC Press 2005.

| PE – 29 | ULTRASOUND PRINCIPLES AND APPLICATIONS IN MEDICINE | 3 0 0 3 |
|---|---|---|

**COURSE OBJECTIVE: ( Employability)**

- To teach the principles of ultrasonic's and its interaction with tissue.
- To know about the scanning techniques and real time scanners
- To understand the principles and application of these principles in health care settings

**UNIT 1 PRINCIPLES OF ULTRASONICS 9**

Introduction, Piezo Electric Devices, The Fields of 'simple', CW excited sources, The PulsedAcoustic field, Effects of human body on Beam Propagation, Beam formation by transducer arrays,Magnitudes of Acoustic Field variables, Displacement detectors Thermal mechanisms, Cavitation,Radiation Pressure

**UNIT 2 TISSUE-ULTRASOUND INTERACTION 9**

Introduction, Absorption in biological tissues, Tissue-Ultrasound interaction cross sections, Theoryof mechanisms for the absorption of ultrasonic longitudinal waves, Measurement of attenuationand Absorption Coefficients in tissues, Acoustic properties reflecting different levels of tissueorganization, Molecular aspects of soft tissue mechanics, Structural contribution to bulk and shearacoustic properties of tissues. Relevance to tissue characterization, Ultrasound quantitation andtissue characterization

**UNIT 3 SCANNING TECHNIQUES 9**

Ultrasound transducers, Construction of ultrasonic probe, Measurement of ultrasonic energy, pulseecho imaging, Pulse echo equation, Transducer motion, Transmit steering and focusing, Beamforming and Dynamic focusing, Transmitter, Receiver, Positional information, Scan converterAnalog, Digital. Image display, Image position, Transducer output, signal processing, adjustment of controls. Scanning Techniques- Acoustic windows, Scanning motion, Transducer Selection, Scan Indexing.Basic Image Interpretation-Contour, Internal Echo pattern, Attenuation, Classification, Artifacts.

**UNIT 4 REAL TIME ULTRASONIC SCANNERS 9**

Different modes of display-A mode, B mode, M mode, B-scan System, The Principles of Ultrasound Motion Detection, Techniques for Measuring Target Velocity, Phase Fluctuation (Doppler Methods), Envelope Fluctuation Methods, Phase Tracking Methods, Envelope Tracking Techniques, Ultrasound Imaging Systems, Considerations Specific To Color Flow Imaging, Angle Independent Velocity Motion Imaging, Tissue Elasticity & Echo Strain Imaging, Performance Criteria, Use of Contrast Media, Real Time Echo, 2-D and 3-D Scanners, Color Doppler.

**UNIT 5 ULTRASONIC APPLICATIONS 9**

Ultrasonic diagnosis in Abdomen, Breast, Thyroid, Heart, Chest, Eye, Kidney, Skull, Pregnant and Non Pregnant uterus, 3-Dimensional Ultrasonic Imaging of The Fetus, Advantages And Limitations
of 3-Dimensional Ultrasound.

**TOTAL: 45 HOURS**

**COURSE OUTCOMES**

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

| | |
|---|---|
| CO1: | Develop knowledge about the principles of Ultrasound and the imaging systems. |
| CO2: | Analyse the interaction of tissues with ultrasound and the effects |
| CO3: | Determine knowledge about the scanning techniques in Ultrasound imaging |
| CO4: | Classify and understand the real time scanners in ultrasound |
| CO5: | Categorise the different applications of ultrasound imaging systems |

**REFERENCES:**

1. Shirley Blackwell Cusick, Farman and Vicary, A User's Guide to Diagnostic Ultrasound; Pitman Medical Publishing Co Ltd; Kent, England. (1978).
2. C.R.Hill, Jeff C.Bamber, Gail Haa, Physical Principles of medical Ultrasonics; John Wiley & Sons Ltd; 2nd Edition, 2004.
3. W.N.McDicken, Churchill Livingstone, Diagnostic Ultrasonics – Principles and use instruments New York, 3rd Edition, 1991.
4. Timothy J.Hall, AAPM/RSNA, "Physics Tutorial For Residents: Elasticity Imaging With Ultrasound", Radio Graphics, Vol.23, No.6, Nov-Dec 2003. (RSNA 2003)

5. T.Rago, F.Santini, M.Scutari, A. Pinchera and P.Vitti, "Elastography: New developments in Ultrasound for Predicting Malignancy in Thyroid Nodules", Journal of Clinical Endocrinology and Metabolism, August 2007, 92(8) : 2917 – 2922.

| PE – 30 | MEDICAL ELECTRONICS | 3 0 0 3 |
|---|---|---|

**COURSE OBJECTIVES ( Employability)**

- To acquire the knowledge related to bio-electric potentials.
- To design bio-amplifiers
- To study the physiological functions of the human body

**UNIT I: PHYSIOLOGICAL SIGNALS AND ITS CHARACTERISTICS 9**

Physiological systems of the body: cardiovascular system, respiratory system and nervous system ,Sources of biomedical signals, medical instrumentation system ,Origin of bioelectric signals: ECG, EEG and EMG ,Electrode-tissue interface , Electrodes for ECG: Limb, floating, disposable, EEG, EMG, Pressure transducer, thermistor, photoelectric transducer , optical fibre sensors ,Biosensor and smart sensor

**UNIT 2: CARDIAC PACEMAKERS AND DEFIBRILLATORS 9**

Basics of cardiac pacemaker, external pacemaker ,Implantable pacemaker : types, programmable pacemaker, power sources ,DC Defibrillator ,DC Defibrillator with synchronizer,Automatic external defibrillator, Implantable defibrillator and pacer-cardioverter-defibrillator

**UNIT 3: MEDICAL IMAGING SYSTEMS AND BIOMEDICAL TELEMETRY 9**

Nature of X-rays, stationary anode tube and X-ray machine ,Digital Radiography and computed tomography, Emission computed tomography ,Principle of NMR and its imaging system ,Single channel ECG telemetry system, obstetrical telemetry system

**UNIT 4: THERAPEUTIC EQUIPMENTS 9**

Basic principle of lasers and its application in medicine ,Helium neon laser and ruby laser ,CO2 laser, Nd:YAG laser and Excimer laser ,Electrotherapy equipments: short wave diathermy and microwave diathermy, Electro-diagnostic therapeutic stimulator

**UNIT 5: INSTRUMENTS FOR SURGERY AND PATIENT SAFETY** 9

Principle of surgical diathermy machine and safety aspects in ESU,Surgical diathermy analyzer, Electric shock hazards, micro and macro shock ,Leakage current and its types. Safety codes for electro medical equipment and electrical safety analyzer ,Testing of biomedical equipment

**TOTAL: 45 HOURS**

**COURSE OUTCOMES**

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

| | |
|---|---|
| CO1: | Describe the knowledge about the physiological signals of the human body |
| CO2: | Differentiate various therapeutic equipments used to revive cardiological functions |
| CO3: | Distinguish the various imaging systems and telemetry system for vital parameters |
| CO4: | Analyse the different therapeutic equipments including lasers and electrotherapy equipments |
| CO5: | Evaluate the instruments in surgery and analyse the safety of the patients |

**TEXT BOOKS**

1. Khandpur R.S, "Hand-book of Biomedical Instrumentation", McGraw Hill Education, 3rd edition, 2014.
2. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, "Biomedical Instrumentation and Measurements", Prentice-Hall India, 2nd edition, 2007.
3. Joseph J Carr and John M Brown., "Introduction to Biomedical equipment technology", Pearson education, New Delhi, 4th edition, 2004.

| PE – 31 | ARTIFICIAL INTELLIGENCE AND FUZZY LOGIC | 3 0 0 3 |
|---|---|---|

**COURSE OBJECTIVE ( Employability)**

- To imPART Adequate knowledge on the representation and structures of artificial intelligence
- To study in depth about the expert systems and its tools
- To gain in depth knowledge of fuzzy logic systems and its applications in biomedical field
- To study about the fundamentals of biological neurons to design various artificial neural networks.

**UNIT 1 AI & INTERNAL REPRESENTATION** **9**

The AI problem – What is AI technology – Level of the Model – Criteria for Success problems, Problem Spaces & Searches & Heuristic Search Technology Problem as a State Space Search – Production Systems – Production System Characteristics – Generate & Test – Hill Climbing – Best First Search – Constraint Satisfaction – Means End Analysis.

**UNIT 2 KNOWLEDGE REPRESENTATION** **9**

Issues in Knowledge Representation – Using Predicate Logic – Representing Simple Facts in Logic, Representing Instance & Is a Relationship – Computable Functions & I Predicates – Representing Knowledge Using Rules: Procedural Vs. Declarative Knowledge – Forward Vs. Backward Reasoning.

**UNIT 3 EXPERT SYSTEMS** **9**

What are Expert Systems – Knowledge Representation in Expert Systems – Symbolic Computation – Rule based Systems

**UNIT 4 INTRODUCTION TO FUZZY SET THEORY** **9**

Introduction to Fuzzy Set Theory – Basic Concepts of Fuzzy Sets – Classical Set Vs Fuzzy Set – Properties of Fuzzy Set – Fuzzy Logic Operation on Fuzzy Sets – Fuzzy Logic Control Principles –Fuzzy Relations – Fuzzy Rules – Defuzzification.

**UNIT 5 FUZZY APPLICATIONS** **9**

Logic Controller – Fuzzification Interface – Knowledge Base – Decision Making Logic – Defuzzification Interface – Application Of Fuzzy Logic To Control Of Blood Pressure During Anaesthesia – Cardio Vascular Signals – Fuzzy Logic Decision By Fuzzifying Boolean Rule, Fuzzy Logic Patient Deterioration Index.

**TOTAL: 45 HOURS**

**COURSE OUTCOMES**

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

| | |
|---|---|
| CO1: | Develop knowledge about artificial intelligence and internet representation |
| CO2: | Explain the basics of knowledge representation |
| CO3: | Evaluate and analyse the expert systems and functions |
| CO4: | Differentiate and illustrate the basics of fuzzy logics |
| CO5: | Apply and determine the knowledge about fuzzy logic applications |

**TEXT / REFERENCE BOOKS**

- 1. Elaine Rich, Kevin Knight, Artifical Intelligence, 2nd Edition, Tata McGraw Hill, 1992.
- 2. Peter Jackson, Introduction to Expert Systems, 3rd Edition, Addison Wesley, 1st Indian Reprint 2000


| PE – 32 | TROUBLESHOOTING OF MEDICAL INSTRUMENTS | 3 0 0 3 |
|---|---|---|

**COURSE OBJECTIVE: ( Employability)**

- To provide knowledge to students to enable them to troubleshoot the various equipments used in hospitals.
- To provide adequate technical information on operating principles of medical instruments
- To attain mastery in fault detection and corrective measures.
-

**UNIT- 1 FUNDAMENTAL TROUBLESHOOTING PROCEDURES 9**

Making of an Electronic Equipment, causes of Equipment Failure, Troubleshooting Process & Fault finding Aids, Troubleshooting Techniques, Grounding Systems in Electronic Equipment, Temperature Sensitive Intermittent Problems, and Correction Action to repair the Equipment.

**UNIT- 2 TESTING OF PASSIVE COMPONENTS & SEMICONDUCTOR DEVICES 9**

Testing: resistors, capacitors & inductors, causes of failure for electronic components, testing procedure for semiconductor devices: special diodes, bipolar transistors, field effect transistor (FET), and thyristor.

**UNIT- 3 FAULT DIAGNOSIS IN ANALOG& DIGITAL INTEGRATED CIRCUITS 9**

Fault Diagnosis in Op-Amp Circuits, Digital Troubleshooting Methods, Digital IC Troubleshooters, Circuit board Troubleshooting.

**UNIT- 4 BIOMEDICAL EQUIPMENT TROUBLESHOOTING –I 9**

Trouble shooting of ECG Machine, EEG Machine, Defibrillator Electrosurgical unit, Anaesthesia machine, Autoclaves & sterilizers, Endoscope.

**UNIT -5 BIOMEDICAL EQUIPMENT TROUBLESHOOTING –II 9**

Troubleshooting of Incubators, Nebulizer, Oxygen Concentrators, Oxygen cylinders & flow meters, PulseOximeter, Sphygmomanometers, SuctionMachine, X-RayMachine .

**TOTAL: 45 HOURS**

**COURSE OUTCOMES**

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

| | |
|---|---|
| CO1: | Explain the basic equipment failure and troubleshooting techniques. |
| CO2: | Develop knowledge about the concept of resistor, capacitor, inductor, semi conductor troubleshooting. |
| CO3: | Apply and illustrate the knowledge on Digital IC troubleshooting. |
| CO4: | Apply the knowledge of Biomedical Equipment Troubleshooting Procedures. |
| CO5: | Distinguish the reason for failure & evaluating the procedure for troubleshooting of biomedical instruments. |

**TEXTBOOKS:**


1. Khandpur R S, "Troubleshooting Electronic Equipment- Includes Repair &Maintenance", Tata McGraw-Hill, Second Edition 2009.
2. Dan Tomal& Neal Widmer, "ElectronicTroubleshooting", McGraw Hill, 3rd Edition 2004.


**REFERENCES:**


1 Nicholas Cram & Selby Holder, "Basic Electronic Troubleshooting forBiomedical Technicians", TSTC Publishing, 2nd Edition 2010.
2 World Health Organisation, "Maintenance & Repair of Laboratory, Diagnostic imaging & Hospital Equipment", Geneva,1994.
3 Ian R, McClelland , "X-ray Equipment maintenance & repairs workbook for Radiographers& Radiological Technologists", World Health Organisation, Geneva, 2004.

4 Ministry of Health & Family Welfare, "Medical Equipment Maintenance Manual- A first line maintenance guide for end users", New Delhi, October 2010.
5 Joseph.J, Panichello, "X-Ray Repair: A Comprehensive Guide to the Installation & Servicing of Radiographic Equipment", Charles C Thomas Publisher Ltd, 2nd Edition 2005.

| PE – 33 | PROSTHETIC ENGINEERING | 3 0 0 3 |
|---|---|---|

**COURSE OBJECTIVE**: **( Employability)**

- To provide knowledge to students to enable them to understand about designing of prosthetics
- To provide adequate technical information on operating principles of orthotics and prosthetics
- To have a strong understanding about recent trends in prosthetic engineering
-

**UNIT 1 INTRODUCTION TO PROSTHETICS 9**

Principles involved in the study of Prosthetic Engineering, HAAT – Human Activity Assistive Technology.

**UNIT 2 REHABILITATION ENGINEERING SCIENCE & TECHNOLOGY 9**

Rehabilitation engineering concepts in motor rehabilitation engineering concepts in communication disorders.Wheel chairs: Categories of Wheelchairs, Wheelchair structure and Component design, Ergonomics of Wheelchair Propulsion, Power Wheelchair Electrical Systems. Personal Transportation for the Handicap: Vehicle Selection, Lift Mechanisms, Hand Controls, Wheelchair restraint Mechanisms.

**UNIT 3 ORTHOPEDIC PROSTHETICS & ORTHOTICS IN REHABILITATION TECHNOLOGY9**

Fundamentals, Function, Structure and Cosmesis of Orthotic or Prosthetic device. ComputerAided engineering in customized component design, Example- Intelligent prosthetic knee, hierarchically controlled Prosthetic Hand, Myoelectric hand and arm prosthesis – block diagram, signal flow diagram and functions.

**UNIT 4 SENSORY REHABILITATION SYSTEMS 9**

Engineering concepts in sensory rehabilitation, Sensory Augmentation & substitution: Visual System, Auditory system, Tactual system.

**UNIT 5 RÉHABILITATION ENGINEERING TECHNOLOGIES 9**

Principles of Application: Conceptual frameworks, Education and Quality Assurance, Specific Impairments and Related technologies, Future Developments – Rehabilitation Robotics, and Brain computer interface systems.

**TOTAL: 45 HOURS**

**COURSE OUTCOMES**

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

| | |
|---|---|
| CO1: | Explain the engineering concepts and principles in prosthetics |
| CO2: | Illustrate various wheel chair types and it's working |
| CO3: | Examine about orthotic devices and understand their functions |
| CO4: | Explain the various systems in sensory rehabilitation |
| CO5: | Examine the principles of rehabilitation technologies and engineering concepts |

**TEXT BOOK:**

1. Robinson C.J Rehabilitation Engineering, Handbook of Electrical Engineering, CRC Press, Bocaration 1993.

**REFERENCE:**

1. Reswick. J, What is Rehabilitation Engineering, Annual Reviews of Rehabilitaion – Volume.
2. Springer – veriag, New York, 1982.
3. Leon Goldman m.d.r James Rockwell. J.r. Lasers in medicine.
4. K.Wolbarsht M. L. Laser application in Medicine and biology, Plenum Press, New York.

| PE – 34 | CRYPTOGRAPHY AND NETWORK SECURITY | 3 0 0 3 |
|---|---|---|

**COURSE OBJECTIVE: ( Employability)**

- To learn the fundamental principles of computer and network security by studying attacks on computer systems, network, and the Web.
- To learn how those attacks work and how to prevent and detect them.
- To have a good understanding about Smartphone technology

**UNIT-1 INTRODUCTION AND BASICS** **9**

Class Introduction (syllabus, policies, and projects),An Overview of Computer Security,Course projects (labs),Unix Security Basics

**UNIT- 2 DATA SECURITY AND STANDARDS** **9**

Encryption, Cryptography, Mechanisms of encryption, phases of Encryption. Protocols: TCP/IP, ISO-OSI, Standards to followed DICOM, HL7, H. 320 series (Video phone based ISBN) T. 120, H.324 (Video phone based PSTN), Video Conferencing,

**UNIT-3 SOFTWARE SECURITY** **9**

Vulnerabilities, Attacks, and Countermeasures, Privileged programs (Set-UID programs) and vulnerabilities ,Buffer Overflow vulnerability and attack,, Return-to-libc attack ,Race Condition vulnerability and attack ,Format String vulnerability and attack ,Input validation,Shellshock attack

**UNIT- 4 WEB SECURITY: VULNERABILITIES, ATTACKS, AND COUNTERMEASURES** **9**

Same Origin Policy, Cross-Site Scripting Attack, Cross-Site Request Forgerty Attack ,SQL-Injection Attack ,Click-Jacking Attack ,Web Tracking,Web Proxy and Firewall

**UNIT 5 SMARTPHONE SECURITY** **9**

Access control in Android operating system ,Rooting Android devices,Repackaging attacks ,Attacks on apps ,Whole-disk encryption,Hardware protection: TrustZone

**TOTAL: 45 HOURS**

**COURSE OUTCOMES:**

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

| | |
|---|---|
| CO1: | Develop knowledge about the basics of computer security |
| CO2: | Explain the standards and security of data |
| CO3: | Analyse the security of the software and its attack systems |
| CO4: | Examine the functional actions of the web security |
| CO5: | Analyse the smartphone security and fucntions |

| PE – 35 | WEARABLE MEDICAL SYSTEMS | 3 0 0 3 |
|---|---|---|

**COURSE OBJECTIVE ( Employability)**

- To Learn about challenges and research issues related to wearable sensors
- To design wireless sensor networks
- To learn about Humanistic intelligence
- To have an understanding about IoT
-

**UNIT 1 – FUNDAMENTALS OF SENSOR NETWORKS** **9**

Introduction to computer and wireless sensor networks and Overview of the syllabus ,Motivation for a network of Wireless Sensor nodes- Sensing and sensors-challenges and constraints - node architecture-sensing subsystem, processor subsystem communication interfaces- prototypes, Application of Wireless sensors- Introduction of Tiny OS Programming and TOSSIM Simulator.

**UNIT 2- COMMUNICATION CHARACTERISTICS AND DEPLOYMENT MECHANISMS** **9**

Wireless Transmission Technology and systems-Radio Technology Primer-Available Wireless Technologies - Hardware- Telosb, Micaz motes- Time SynchronizationClock and the Synchronization Problem - Basics of time synchronization-Time synchronization protocols - Localization- Ranging Techniques- Range based Localization- Range Free Localization- Event driven Localization

**UNIT 3 - CYBERNETICS AND HUMANISTIC INTELLIGENCE** **9**

Wearables - Augmented Reality – Mixed Reality.Case studies, Oculus Rift , AR versus VR - IoT and Wearables: Smart Cites and Wearable Computing as a form of urban design - Advanced I/O – open Frameworks:Live Network feeds (push and pull) - Data persistence (saving data and preferences) - Database interface (MySQL, sqLite, XML, PHP/Web) - Arduino:Wired/Wireless Networking (hardware vs. USB proxy) - Software serial (RS-232) talking to other devices - Advanced sensor/device communication SPI - Advance IC interfacing / Bitbanging (bitwise operators) - Linux – GPIO

**UNIT 4 - THE WORLD OF THE FUTURE – INTERNET OF EVERYTHING** **9**

Humanistic Intelligence,. Wearable Computing and IoT (Internet of Things) The scalespace theory; sur/sousveillance; integrity; VeillanceContract; Humanistic Intelligence; MedialityAxis , Overview of Mobile and Wearable Computing, Augmented Reality, and Internet of Things. The fundamental axes of the Wearables + IoT + AR space - Freeroaming AR: Wearable Computing, Wireless, Sensing, and Metasensing with light bulbs Phenomenal Augmented Reality: Real world physical phenomena as the fundamental basis of mobile and wearable AR.

**UNIT 5 - FUTURE AND PERSPECTIVES** **9**

Internet of Everything – The Future and perspectives - Challenges

**TOTAL: 45 HOURS**

**COURSE OUTCOMES:**

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

| | |
|---|---|
| CO1: | Develop knowledge about the sensor networks in advanced and emerging technologies |
| CO2: | Explain the mechanisms and characteristics of communication and deployment |
| CO3: | Categorise the systems in complex tasks for illustrating the cyberntics and humanistic intelligence |
| CO4: | Differentiate the wearable technology and illustrates knowledge about internet of things |
| CO5: | Apply and illustrate the future challenges |

**REFERENCES**

1. “Practical Electronics for Inventors, Third Edition,” by Paul ScherzandSimon Monk. 2016

2. Intel Galileo and Intel Galileo Gen 2API Features and Arduino Projects for Linux Programmers, Ramon, Manoel 2014 (Open Access)
3. Fundamentals of Wearable Computers and Augmented Reality, Second Edition by Woodrow Barfield 2015
4. Making Sense of Sensors: End-to-End Algorithms and Infrastructure Design By OmeshTickoo, Ravi Iyer 2016
5. Programming Interactivity, Second Edition By Josha Noble, 2012
6. Programming the Raspberry Pi: Getting Started with Python 2E, 2016

# OPEN ELECTIVE COURSES

| OE – 01 | INTERNET OF MEDICAL THINGS | 3 0 0 3 |
|---|---|---|

**COURSE OBJECTIVES (Employability)**

Assess the genesis and impact of IoT applications, architectures in real world.

- Illustrate diverse methods of deploying smart objects and connect them to network.
- Compare different Application protocols for IoT.
- Infer the role of Data Analytics and Security in IoT.
- Identify sensor technologies for sensing real world entities and understand the role of IoT in various domains of Industry.

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

Internet of Things Promises–Definition– Scope–Sensors for IoT Applications–Structure of IoT– IoT Map Device

**UNIT II IoT SENSORS** **9**

Industrial sensors – Description & Characteristics–First Generation – Description & Characteristics–Advanced Generation – Description & Characteristics–Integrated IoT Sensors – Description & Characteristics– Polytronics Systems – Description & Characteristics–Sensors' Swarm – Description & Characteristics–Printed Electronics – Description & Characteristics–IoT Generation Roadmap

**UNIT III NETWORK& COMMUNICATION ASPECTS** **9**

Wireless medium access issues, MAC protocol survey, Survey routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination

**UNIT IV CHALLENGES IN IOT** **9**

Design challenges, Development challenges, Security challenges, Other challenges

**UNIT V APPLICATIONS OF IoMT** **9**

Chronic disease management, Remote assisted living (Tele health), Wellness and preventive care (Lifestyle assessment), Remote intervention, Improved drug management.

**COURSE OUTCOMES: (Employability)**

After studying this course, students will be able to

| | |
|---|---|
| CO1: | Explain the introduction and importance of internet of things |
| CO2: | Illustrate the principle and working of IOT sensors |
| CO3: | Examine the basic fundamentals and working of network and communication aspects |
| CO4: | Explain the challenges faced in IOT |
| CO5: | Explain advanced applications of IOMT |

**TEXT BOOK:**

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1stEdition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 978- 9386873743)

2. Srinivasa K G, "Internet of Things",CENGAGE Leaning India, 2017

**REFERENCE BOOKS:**
1. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1stEdition, VPT, 2014. (ISBN: 978-8173719547)
2. Raj Kamal, "Internet of Things: Architecture and Design Principles", 1st Edition, McGraw Hill Education, 2017. (ISBN: 978-9352605224)

| OE – 02 | BASICS OF PYTHON AND MATLAB SOFTWARES | 3 0 0 3 |
|---|---|---|

**COURSE OBJECTIVES: (Skill Development)**

- To know the basics of algorithmic problem solving in python and MATLAB
- To read and write simple Python programs.

**UNIT I BASICS OF PYTHON** **9**

Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion), Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs

**UNIT II CONTROL FLOW, FUNCTIONS** **9**

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

**UNIT III LISTS, TUPLES, DICTIONARIES** **9**

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: selection sort, insertion sort, mergesort, histogram.

**UNIT IV MATLAB – BASICS** **9**

Introduction to MATLAB, Variables and Assignment Statements - Initializing, Incrementing, and Decrementing, Expressions, Characters and Encoding, Vectors and Matrices – creating rows, coloumns, matrix,

**UNIT V MATLAB PROGRAMMING** **9**

MATLAB Scripts, Input and output, Scripts to Produce and Customize Simple Plots, Introduction to File Input/Output (Load and Save), User-Defined Functions, Selection Statements – if, else if, switch, menu. Looping – for, while, Vectorsing, Illustrative programs.

**COURSE OUTCOMES:(Skill Development)**

Upon completion of the course, students will be able to

CO1: Develop knowledge about basics of python and algorithmic solutions to simple computational problems
CO2: Determine knowledge about the controls , flows and execute simple Python programs.

CO3: Analyse the various additional features in python
CO4: Develop knwoledge about basics of MATLAB software
CO5: Determine and execute knowledge about MATLAB programming

**TEXT BOOKS.**


1. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist‘‘, 2nd edition, Updated for Python 3, Shroff/O‘Reilly Publishers, 2016 (http://greenteapress.com/wp/thinkpython/) 2. Stromy Attaaway, “Matlab: A Practical Introduction to Programmingf and Problem Solving”, Elsevier, 2009.


| OE – 03 | FORENSIC SCIENCES | 3 0 0 3 |
|---|---|---|

**COURSE OBJECTIVE (Employability)**

- The syllabus is designed to provide a brief and basic knowledge to understand the forensic science particularly to the biomedical student. The main aim is to provide reasonable coverage of subject to know the basic concepts of the science so that the student can implement their knowledge in higher studies.

**UNIT 1 ANIMAL CELL STRUCTURE** **9**

Cell and its inclusions – structure and function – types of cells: Blood & Body fluids – forensic significance – morphological identification of bones – forensic importance.

**UNIT 2 BLOTTING TECHNIQUES** **9**

Identification of Human remains – methods of reconstruction – personal identity in the living and the dead – DNA fingerprinting – PCR - Blotting types (Southern, Northern and Western)

**UNIT 3 FINGERPRINTS** **9**

FingerPrints – importance of plastic and visible finger prints – transfer methods of finger prints – fingerprint patterns – their classification – ridge characteristics – foot prints – importance – gait patterns and their characteristics – photography of foot prints – sunken and surface foot prints.

**UNIT 4 TOXINS** **9**

Forensic toxicology – poison and drugs, classifications, Source, nature, Actions and diagnosis of poisoning cases, postmortem findings and examination, treatment of poisoning cases, medico legal aspects; corrosive agents, irritants – mechanical and animal.

**UNIT 5 SEROLOGICAL AND CHROMOSOMAL TECHNIQUES** **9**

Serology – basic principles of serology – concept of antigen and antibody and their reaction – application of serology in forensic science. Karyotyping – banding patterns - chromosomal abnormalities – sex determination – sex linked inheritance.

**Total Periods: 45 Hours**

**COURSE OUTCOMES: (Employability)**

The students will be able to

| | |
|---|---|
| CO1: | Determine knowledge on the cell structure, functions, about blood and body fluids. |
| CO2: | Explain the blotting techniques and reconstruction of human remains |
| CO3: | Distinguish the importance of finger prints and the identification of finger prints. |
| CO4: | Analyse the toxins involved and the nature of poisonous conditions. |
| CO5: | Describe the principle of serology and concepts of antigen/antibody. |

**TEXT / REFERENCE BOOKS**

1. De Robertis, General Cytology, Sannders, 6th Edition, 2008
2. Apurba Nandy ,Principles of Forensic Medicine, New Central Book Agency, 2nd Edition, 2001
3. M. Krawczak and J. Schmidtke, DNA Finger printing, BIOS Scientific Publisher,2nd Edition, 1995
4. Richard Saferstein Ed, Forensic Science Hand Book, Prentice Hall, 2010
5. P L Carpenter, Immunology and Serology, W B Saunders Company, 2nd Edition, 1965
6. David Friedfielder, Molecular Biology, Narosa, 4th Edition, 1995
7. Narayan Reddy, The Essential of Forensic Medicine and Toxicology, 31st Edition, 2012

| OE – 04 | FOUNDATIONS FOR NANO ELECTRONICS | 3 0 0 3 |
|---|---|---|

**COURSE OBJECTIVES: (Employability)**

- 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 objectives of the course is to introduce quantum mechanics concepts, approximations and statistical mechanics for understanding nano systems

**UNIT I 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 metals and semiconductors

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

Hydrogen and Helium atoms, electronic states, Atomic force microscope, Nuclear Magnetic Resonance, carbon nanotube properties and applications

**TOTAL : 45 PERIODS**

**COURSE OUTCOMES: (Employability)**

The student will be able to

| | |
|---|---|
| CO1: | Develop the knowlegde in significant role in the present contemporary world and quantam mechanics |
| CO2: | Examine the simple harmonic oscillations and variational methods |
| CO3: | Explain the technology involved in nano electronics involving various degrees of freedom |
| CO4: | Describe the statistical models and systems in mechanics |
| CO5: | Apply the concepts of nanotechnology in various fields. |

**TEXT BOOKS:**

1. Hagelstein, Peter L., Stephen D. Senturia, and Terry P. Orlando, ―Introduction toApplied Quantum and Statistical Physics.‖, New York, NY: Wiley, 2004.
2. Rainer Waser, ―Nanoelectronics and Information Technology‖, Wiley 2005

3. Michael A. Nielsen and Isaac L. Chuang, ―Quantum Computation and Quantum Information‖, Cambridge University Press, 2000.

**REFERENCES BOOKS:**

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.

| OE – 05 | HEALTH POLICY AND EQUIPMENT MANAGEMENT | 3 0 0 3 |
|---|---|---|

**COURSE OBJECTIVES: (Entrepreneurship)**

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

**UNIT I HEALTH SYSTEM** **9**

Health organization of the country, the state and cities, health financial system, teaching cum research hospitals, General Hospital, PHC reference system.

**UNIT II NATIONAL HEALTH POLICY** **9**

Need for evaluating a health policy, need for providing primary health care, Health education, health insurance, health legislation, inter sectoral cooperation.

**UNIT III EQUIPMENT MAINTENANCE MANAGEMENT** **9**

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

**UNIT IV LOGISTIC SUPPORT & RELIABILITY** **9**

Maintenance equipment and Tools, failure analysis, spare parts and maintenance materials.Reliability fundamentals.

**UNIT V EMI TO HOSPITAL EQUIPMENTS** **9**

Principles of EMI, computation of EMI, Method of suppressing and isolating the unit from interference.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES: (Entrepreneurship)**

The student becomes an expert in

| | |
|---|---|
| CO1: | Develop understanding of the various health organisations and policies |
| CO2: | Explain the Planning activities at health care centres. |
| CO3: | Describe the healthcare Equipment installation, service & calibration needs |
| CO4: | Analyse the logistics of equipments and tools for maintenance. |
| CO5: | Analyse the principles, computation and methods of EMI. |

**TEXT/REFERENCES BOOKS:**

1. Antony Kelly, `Maintenance Planning & control' Butterworth, London 1984.
2. Hans Pleiff veradammann (ed) `Hospital Engineering in developing countries, GTZ report Eschborn, 1986.
3. R.C.Goyal `Human Resource Management in Hospitals' Prentice Hall of India, New Delhi, 2000.

| OE – 06 | LIFESTYLE MODIFICATION AND HEALTH CARE | 3 0 0 3 |
|---|---|---|

**COURSE OBJECTIVES: (Entrepreneurship)**

- To demonstrate the significance of nutrients, immunisation, food habits and balancing hormones.

**UNIT I IMPORTANCE OF MICRONUTRIENTS 9**

Millets and fibre rich foods –Their high nutritive value –Dangers of consumption of refined foods – Iron protein combination –Micronutrients–Their importance in upkeep of good health –Overcoming their deficiency –Foods rich in micronutrients –Glycemicindex -Its importance –Comparative glycemic index of various foods.

**UNIT II IMMUNIZATION SCHEDULING – NEED FOR ADHERENCE 9**

Protein calorie malnutrition –Importance of intake of folic acid supplements to prevent genital abnormalities – Necessity to avoid early marriage –Need for various immunizations their dosage schedules-Need to immunize adolescent girl children to prevent cervical cancer.

**UNIT III LIFE SAVING CHILD SURVIVAL STRATEGIES 9**

Drastically cutting down mortality and morbidity –Causative factors of dehydration –Warning symptoms - Need to administer lifesaving Oral Rehydration Salt solution (ORS) Methodology of preparing ORS solution-Importance of zinc as an additive.

**UNIT IV STRATEGIES FOR INCREASING HDL AND LOWERING LDL CHOLESTEROL 9**

Healthy fats –Need to avoid saturated and trans fats - Optimum value of HDL and LDL cholesterols –Need to lower triglycerides - Ways of reducing bad LDL cholesterol –Role of Thyroid Simulating Hormone (TSH) - Importance of mental health –Positive and optimistic outlook on life – Pranic breathing as a stress relief mechanism.

**UNIT V DRINKING WATER STANDARDS 9**

WHO Standards of drinking water – Importance of dissolved oxygen – Effect of biodegradable organic particulate matter on dissolved oxygen – Estimation of sulphate in water – air pollution hazards – Domestic air pollutants.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES: (Entrepreneurship)**

The students will be able to

| | |
|---|---|
| CO1: | Describe the basics of micronutrients |
| CO2: | Understand the concepts of immunization and its adherence |

| | |
|---|---|
| CO3: | Acquire knowledge on survival strategies |
| CO4: | Understand the importance of fats and cholestrol |
| CO5: | Describe the standards of drinking water and pollution hazards |

**TEXT/ REFERENCE BOOKS:**

1.Kedar N.Prasad, Micronutrients in Health and Disease, CRC Press, 1st Edition, 2010

| OE – 07 | TOTAL QUALITY MANAGEMENT | 3 0 0 3 |
|---|---|---|

**COURSE OBJECTIVE: (Entrepreneurship)**

To facilitate the understanding of Quality Management principles and process.

**UNIT I INTRODUCTION TO TQM 9**

Introduction – Need for quality – Evolution of quality – Definitions of quality – Dimensions of product and service quality – Basic concepts of TQM – TQM Framework – Contributions of Deming, Juran and Crosby – Barriers to TQM – Customer focus – Customer orientation, Customer satisfaction, Customer complaints, Customer retention.

**UNIT II TQM PRINCIPLES 9**

Leadership – Quality Statements, Strategic quality planning, Quality Councils – Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal – Continuous process improvement – PDCA cycle, 5S, Kaizen – Supplier partnership – Partnering, Supplier selection, Supplier Rating.

**UNIT III TQM TOOLS AND TECHNIQUES I 9**

The seven traditional tools of quality – New management tools – Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT – Bench marking – Reason to bench mark, Bench marking process – FMEA – Stages, Types.

**UNIT IV TQM TOOLS AND TECHNIQUES II 9**

Quality Circles – Cost of Quality – Quality Function Deployment (QFD) – Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures.

**UNIT V QUALITY MANAGEMENT SYSTEM 9**

Introduction—Benefits of ISO Registration—ISO 9000 Series of Standards—Sector-Specific Standards—AS 9100, TS16949 and TL 9000– ISO 9001 Requirements—Implementation—Documentation—Internal Audits—Registration- ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001—Benefits of EMS

**TOTAL: 45 PERIODS**

**COURSE OUTCOME: (Entrepreneurship)**

The student would be able to

| | |
|---|---|
| CO1: | Understand the basics of quality management |
| CO2: | Acquire the knowledge on strategic quality planning |
| CO3: | Determine and identify tools techniques and methodologies |
| CO4: | Explain the quality function development |

| | |
|---|---|
| CO5: | Illustrate the benefits of standards and their registration process |

**TEXT BOOK:**

1. Dale H.Besterfiled, Carol B.Michna,Glen H. Besterfield,Mary B.Sacre,Hemant Urdhwareshe and Rashmi Urdhwareshe, ―Total Quality Management, Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.

**REFERENCES BOOKS:**

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
2. Janakiraman. B and Gopal .R.K., "Total Quality Management – Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
3. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006. ISO9001-2015 standards

| | | |
|---|---|---|
| **OE – 08** | **FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT AND DESIGN** | **3 0 0 3** |

**COURSE OBJECTIVE: (Employability)**

- To gain knowledge about the skills involved in the development of product and the requirments to design product.

**UNIT I FUNDAMENTALS OF PRODUCT DEVELOPMENT** **9**

Global Trends Analysis and Product decision - Social Trends - Technical Trends- Economical Trends - Environmental Trends - Political/Policy Trends - Introduction to Product Development Methodologies and Management - Overview of Products and Services - Types of Product Development - Overview of Product Development methodologies - Product Life Cycle – Product Development Planning and Management.

**UNIT II REQUIREMENTS AND SYSTEM DESIGN** **9**

Requirement Engineering - Types of Requirements - Requirement Engineering - traceability Matrix and Analysis - Requirement Management - System Design & Modeling - Introduction to System Modeling - System Optimization - System Specification - Sub-System Design - Interface Design.

**UNIT III DESIGN AND TESTING** **9**

Conceptualization - Industrial Design and User Interface Design - Introduction to Concept generation Techniques – Challenges in Integration of Engineering Disciplines - Concept Screening & Evaluation - Detailed Design - Component Design and Verification – Mechanical, Electronics and Software Subsystems - High Level Design/Low Level Design of S/W Program - Types of Prototypes, S/W Testing- Hardware Schematic, Component design, Layout and Hardware Testing – Prototyping - Introduction to Rapid Prototyping and Rapid Manufacturing - System Integration, Testing, Certification and Documentation

**UNIT IV SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT** **9**

Introduction to Product verification processes and stages - Introduction to Product Validation processes and stages - Product Testing Standards and Certification - Product Documentation - Sustenance -Maintenance and Repair – Enhancements - Product EoL - Obsolescence Management – Configuration Management - EoL Disposal

**UNIT V BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY** **9**

The Industry - Engineering Services Industry - Product Development in Industry versus Academia –The IPD Essentials - Introduction to Vertical Specific Product Development processes -Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical, Embedded and Software Systems – Product Development Trade-offs - Intellectual Property Rights and Confidentiality – Security and Configuration Management.

**COURSE OUTCOMES: (Employability)**

The students will be able to

| | |
|---|---|
| CO1: | Develop knowledge about fundamentals of product development |
| CO2: | Explain the requirements and system design concepts |

| | |
|---|---|
| CO3: | Categorise the process of screening evaluation and testing |
| CO4: | Differentiate the product verification processes and stages |
| CO5: | Apply and illustrate the business dynamics |

**TEXTBOOKS:**

1. Book specially prepared by NASSCOM as per the MoU.
2. Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", Tata McGraw Hill, Fifth Edition, 2011.
3. John W Newstorm and Keith Davis, "Organizational Behavior", Tata McGraw Hill, Eleventh Edition, 2005.

**REFERENCE BOOKS:**

1. Hiriyappa B,- Corporate Strategy Managing the Business, Author House, 2013.
2. Peter F Drucker, People and Performance Butterworth – Heinemann [Elsevier], Oxford, 2004.
3. Vinod Kumar Garg and Venkita Krishnan N K, ―Enterprise Resource Planning – Concepts, Second Edition, Prentice Hall, 2003.
4. Mark S Sanders and Ernest J McCormick, "Human Factors in Engineering and Design", McGraw Hill Education, Seventh Edition, 2013.

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| **OE – 09** | **VIRTUAL REALITY** | **3 0 0 3** |

**COURSE OBJECTIVES: ( Employability)**

- To impart the fundamental aspects, principles of virtual reality technology
- To gain knowledge about applications of virtual reality

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

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** **9**

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** **9**

Introducing Java 3D-loading and manipulating external models-using a lathe to make shapes. 3D Sprites- animated 3D sprites-particle systems.

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

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 should be able to

| | |
|---|---|
| CO1: | Explain the importance of virtual reality |

| | |
|---|---|
| CO2: | Illustrate various modelling techniques involved in VR |
| CO3: | Examine the side effects of exposure to virtual reality |
| CO4: | Explain the VR programming techniques |
| CO5: | Examine the medical applications of VR in various fields |

**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 BOOKS:**

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.

| OE – 10 | HOSPITAL FINANCE MANAGEMENT | 3 0 0 3 |
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**COURSE OBJECTIVES : ( Employability)**

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

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

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

**UNIT II ACCOUNTING TECHNIQUES** **9**

Types of Accounting, Hospital accounting - Financial book Keeping, Book keeping obligations. Accounting Concepts & Conventions – Final Accounts :Trading – Profit & Loss Accounts – Balance Sheet.

**UNIT III COSTING IN HOSPITALS** **9**

Nature & Scope of Cost Accounting – Cost analysis & Classification - Cost Calculation, significance of internal billing in Hospital -Necessary for internal & external controlling cost, cost unit calculation.

**UNIT IV MANAGEMENT ACCOUNTING** **9**

Budgeting & Budgetary control – Cost – Volume – Profit analysis.

**UNIT V FINANCING DECISIONS** **9**

Cost of capital & Capital Structure – Sources of Short term finance: Management of Working Capital –Sources of Long term finance: share capital, debentures - corporate debit capacity.

**TOTAL: 45 PERIODS**

**COURSE OUTCOME:**
The students will be able to

| | |
|---|---|
| CO1: | Explain in detail about the scope and goal of finance management in hospitals |
| CO2: | Analyze the importance of types of accounting |
| CO3: | Illustrate in detail about nature and scope of cost accounting in hospitals |
| CO4: | Articulate the budget control in hospitals |
| CO5: | Explain in detail about the management of working capital in hospitals |

**REFERENCES:**

1. James C. Vanhorne, Fundamentals of Financial Management, Prentice Hall of India Pvt. Ltd., New Delhi, 8th Edition, 1993.
2. James C.Vanhorne, Financial Management and Policy, Prentice Hall of India Pvt. Ltd., New Delhi, 9th Edition, 1995.
3. Prasannachandra, Financial Management, Tata McGraw Hill Publishing Co. Ltd., New Delhi, First Revised edition
4. Financial Management IM Pandey Vikas Publishing Co. 1999.

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| **OE – 11** | **HUMAN RIGHTS AND VALUES** | **3 0 0 3** |

**COURSE OBJECTIVES: ( Employability)**

- To explain about the human rights and human values pertaining to the morals and law.

**UNIT I OVERVIEW OF HUMAN RIGHTS** **9**

Human Rights – Meaning, origin and Development. Notion and classification of Rights – Natural, Moral and Legal Rights.Civil and Political Rights, Economic, Social and Cultural Rights; collective / Solidarity Rights.

**UNIT II EVOLUTION OF HUMAN RIGHTS** **9**

Evolution of the concept of Human Rights Magana carta – Geneva convention of 1864. Universal Declaration of Human Rights, 1948.Theories of Human Rights.Human Rights in India – Constitutional Provisions / Guarantees.

**UNIT III LAWS IN HUMAN RIGHTS** **9**

Theories and perspectives of UN Laws – UN Agencies to monitor and compliance.

**UNIT IV IMPLEMENTATION OF HUMAN RIGHTS** **9**

Human Rights of Disadvantaged People – Women, Children, Displaced persons and Disabled persons, including Aged and HIV Infected People. Implementation of Human Rights – National and State Human Rights Commission – Judiciary – Role of NGO's, Media, Educational Institutions, Social Movements.

**UNIT V MORALS AND HUMAN VALUES** **9**

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self-confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

**COURSE OUTCOMES:**

The student would be able to

| | |
|---|---|
| CO1: | Explain the origin and importance of human rights |
| CO2: | Illustrate various convensions and provisions related to human rights |
| CO3: | Examine the laws in human rights |
| CO4: | Explain the implementation of human rights |
| CO5: | Examine the ethics of human rights |

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| **OE – 12** | **MEDICAL NANOTECHNOLOGY** | **3 0 0 3** |

**COURSE OBJECTIVE: ( Employability)**

The student should be made to:

- Know basic nano technological principles and characterization methods
- Understand the essential features of biology and nanotechnology that are converging to create the new areas of bionanotechnology and nano medicine.

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

What is Nano Technology, Nano Technology Products and Applications, Future Applications of Nanotechnology, Fields of Study That Influence Nanotechnology, Risks of Nanotechnology, Science of Nanotechnology, Matter, Properties of Matter, Atom and Molecules, Polymers and Nanotechnology.

**UNIT II CARBON NANOTUBES, NANOWIRES, AND NANOCRYSTALS** **9**

The Element Carbon, Fullerenes and Nanotechnology, Buckyballs, Carbon Nanotubes, Manufacturing of Carbon Nanotubes, Applications of Carbon Nanotubes AFM Probe Tips, Nanowires, Nanocrystals, and Quantum Dots, Nanoshells

**UNIT III NANOTECHNOLOGY IN MEDICINE AND HEALTH** **9**

Cardiovascular Diseases, Cancer Detection and Diagnosis, Diabetes and Nanotechnology, Implants and Prosthetics Nanotechnology and Burn Victims, Diagnosis and Therapy, Drug Delivery Using Nanoparticles, Nanotechnology Fights Infections, Pharmaceutical Nanotechnology Research.

**UNIT IV NANOMATERIALS AND NANOSYSTEMS FOR BIOMEDICAL APPLICATIONS** **9**

Micro and Nano Systems in Biomedicine and Drug Delivery, Artificial Implants – New Developments and Associated Problems, Niosomes as Nanocarrier Systems, Alternative Applications for Drug Delivery: Nasal and Pulmonary Routes.

**UNIT V RISKS, ETHICS AND LAWS** **9**

Microsystems and Nanoscience for Biomedical Applications, Nanotechnoscience and Complex Systems, From Biotechnology to Nanotechnology, Risk Management and Regulation in an Emerging Technology, Nanotechnology and Nanoparticle Toxicity, The Global Ethics of Nanotechnology, Risk, Trust and Public Understanding of Nanotechnologies, Nanotechnologies and the Law of Patents, Nanotechnologies and Civil Liability, Nanotechnologies and the Ethical Conduct of Research Involving Human Subjects

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

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

| | |
|---|---|
| CO1: | Apply the principles of nanotechnology in its products and applications |
| CO2: | Analyse the fabrication of carbon nanotubes, nanowires and crystals |
| CO3: | Examine the basic importance of nanotechnology in medicine and health |
| CO4: | Apply knowledge in medical and drug delivery applications |
| CO5: | Apply the fundamental principles of nanotechnology and their application to biomedical engineering. |

**TEXT BOOK:**

1. M. Reza Mozafari, "Nanomaterials and Nanosystems for Biomedical Applications", Springer, Edition – 2007.

**REFERENCES BOOKS:**

1. John Mongillo, "Nanotechnology", Greenwood Press, United States of America, Edition, 2007.
2. Geoffrey Hunt and Michael D. Mehta, "Nanotechnology - Risks, Ethics and Laws" James and James- Earthscan Edition, 2005
3. Jones, Richard A.L., "Soft Machines: Nanotechnology and Life", Oxford University Press, Edition, 2004.
4. Charles P.Poole and Frank J Owens."Introduction to Nanotechnology", Wiley Interscience, Edition, 2003.

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| **OE – 13** | **INNOVATION, TECHNOLOGY AND INTELLECTUAL PROPERTY RIGHTS** | **3 0 0 3** |

**COURSE OBJECTIVES: ( Employability)**

- To get a detail knowledge about the rules and laws involved in intellectual property rights.

**UNIT I TECHNOLOGY AND INNOVATION** **9**

The process of technological innovation – factors contributing to successful technological innovation – the need for creativity and innovation – creativity and problem solving – brain storming – different techniques

**UNIT II INTELLECTUAL PROPERTY RIGHTS – AN OVERVIEW** **9**

Introduction to IPRs, Basic concepts and need for Intellectual Property – Patents, Copyrights, Geographical Indications, IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO –TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR.

**UNIT III REGISTRATION AGREEMENTS AND LEGISLATIONS OF IPRs** **9**

Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad, International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act.

**UNIT IV DIGITAL PRODUCTS AND LAW** **9**

Digital Innovations and Developments as Knowledge Assets – IP Laws, Cyber Law and Digital Content Protection – Unfair Competition – Meaning and Relationship between Unfair Competition and IP Laws – Case Studies.

**UNIT V ENFORCEMENT OF IPRs** **9**

Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies.

**TOTAL: 45 PERIODS**

**COURSE OUTCOME:**

The students will be able to

| | |
|---|---|
| CO1: | Explain the basics of technology and innovation |
| CO2: | Describe the importance of IPR and its examples |
| CO3: | Describe the methods for registrations, agreements and legislations of IPR |
| CO4: | Develop digital products as an example |
| CO5: | Illustrate the enforcement of IPR |

**TEXT BOOKS:**

1. Twiss, Brian. "Managing Technological Innovation", Pitman Publishing Ltd., 1992.
2. V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012
3. S. V. Satakar, ―Intellectual Property Rights and Copy Rights, Ess Ess Publications, New Delhi, 2002

**REFERENCES BOOKS:**

1. Deborah E. Bouchoux, ―Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets, Cengage Learning, Third Edition, 2012.
2. Prabuddha Ganguli,Intellectual Property Rights: Unleashing the Knowledge Economy, McGraw Hill Education, 2011.
3. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.

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| **OE – 14** | **EFFECTS OF INDUSTRIAL POLLUTION, PREVENTION AND CONTROL** | **3 0 0 3** |

**COURSE OBJECTIVES: (Employability)**

- To understand the effects of pollution in industries,its prevention and control.

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

Industrial activity and environment, Fates of Industrial Contaminants, Industrialization and sustainable development, Sustainability strategies, Barriers to sustainability, Pollution prevention in achieving sustainability

**UNIT II ENVIRONMENTAL REGULATIONS** **9**

Prevention vs control of industrial pollution, Environment policies and Regulations to encourage pollution prevention, Environment friendly chemical processes, Regulations for clean environment and implication for industries

**UNIT III POLLUTION** **9**

Definition of pollutant, types of pollution, Air, water, land, noise- adverse effects of pollutants eco system and human health, Need for effluent treatment and toxicity, control, Water standards for portable, agricultural and left-off streams- air Standards for cities, industrial areas, resorts.

**UNIT IV AIR POLLUTION CONTROL METHODS** **9**

Introduction to particulate emission control, Gravitational settling chambers- cyclone separators, fabric filters, Electrostatic precipitators, wet scrubbers, absorbers, Control of sulphur dioxide, oxides of nitrogen, carbon monoxide and hydrocarbons. Noise pollution measurements and its control.

**UNIT V: PRINCIPLES OF WATER TREATMENT**

Primary, secondary and tertiary treatments, Advanced waste water treatments, Recovery of metals from process effluents

**TOTAL : 45 PERIODS**

**COURSE OUTCOME: (Employability)**

| | |
|---|---|
| CO1: | Differentiate the types of industrial contaminants and its effects |
| CO2: | Assess the environmental regulations and implications for industries |
| CO3: | Understand the relation between various types of pollution |
| CO4: | Understand the noise pollution management |
| CO5: | Understand the principles of water treatment |

**TEXT BOOK:**

1. Bishop.P, "Pollution Prevention: Fundamentals and Practice", McGraw Hill International Edn., McGraw Hill Book Co., Singapore, 2000

**REFERENCES BOOKS:**

1. Freeman.H.M, "Industrial Pollution Prevention Hand Book", McGraw Hill, 1995
2. James. G. Mann and Liu.Y.A, "Industrial Water Reuse and Waste Water Minimization", McGraw Hill, 1999
3.Rose.G.R.D, “Air pollution and Industry”, Van Nostrand Reinhold Co., NewYork 1972
4. Pandey.G.N and Carney.G.C, “Environmental Engineering”, Tata McGraw Hill, New Delhi,1989
5. Kapoor.B.S, “Environmental Engineering”, 3rd Edn., Khanna publishers,1997

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| **OE – 15** | **INDUSTRIAL INSTRUMENTATION, AUTOMATION AND CONTROL** | **3 0 0 3** |

**COURSE OBJECTIVES (Employability)**

- To give an adequate knowledge about various techniques used for various parameters of measurement in Industries.
- To provide exposure to four important process variables namely level, pressure, flow and temperature.

**UNIT I LEVEL AND PRESSURE MEASUREMENT** **9**

Level Measurements: Float gauge – Displacer – D/P method – Load cell – Capacitive sensor – Ultrasonic sensor. Pressure Measurements: Manometer – Bourdon tube – Capacitive type pressure gauge – Piezo resistive pressure sensor – McLeod gauge – Thermal conductivity gauge.

**UNIT II TEMPERATURE MEASUREMENT** **9**

Thermometers – RTD characteristics and signal conditioning – Thermistors – Thermocouples: Laws – signal conditioning – cold junction compensation. Radiation and optical pyrometers.

**UNIT III FLOW MEASUREMENT** **9**

Orifice plate – venturi tube – Turbine flow meter – Rotameter – Coriolis mass flow meter – Thermal mass flow meter - Electromagnetic flow meter – Ultrasonic flow meter – Introduction to Calibration methods.

**UNIT IV PROCESS CONTROL** **9**

Need for process control – Continuous and Batch processes – servo and regulatory operations – Control valve - Examples: Level process – Flow process - Heat Exchanger. Controller: ON/OFF – PID controller – Electronic PID controller – Introduction to controller tuning.

**UNIT V ADVANCED CONTROL SCHEMES** **9**

Ratio Control – Feed forward control - Cascade control – Model predictive control – Examples from boiler systems and distillation column.

**COURSE OUTCOME : (Employability)**

| | |
|---|---|
| CO1: | Determine knowledge about the introduction of level and pressure measurements |
| CO2: | Explain the temperature measurement sysytems |
| CO3: | Describe in detail about calibration methods |
| CO4: | Describe in detail about process controls and its tuning |
| CO5: | Describe the advanced control schemes |

**TEXT BOOKS:**

1. Doebelin. E.O and Manik D.N.," Measurement Systems: Application and Design", Special Edition, Tata McGraw Hill Education Pvt. Ltd, 2007
2. Bequette. B. W.," Process Control Modeling, Design and Simulation", Prentice Hall of India, 2004

**REFERENCES:**

1. Liptak B.G., "Instrument and Automation Engineers' Handbook: Process Measurement and Analysis", Fifth Edition, CRC Press, 2016.
2. Patranabis. D., "Principles of Industrial Instrumentation", 3rd Edition, Tata McGraw Hill, New Delhi, 2010.
3. Stephanopoulos," Chemical Process Control – An Introduction to Theory and Practice", Prentice Hall of India, 2005.

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| **OE – 16** | **ENGINEERING ETHICS AND HUMAN VALUES** | **3 0 0 3** |

**COURSE OBJECTIVES: ( Employability)**

- To emphasis into awareness on Engineering Ethics and Human Values.
- To understand social responsibility of an engineer.
- To appreciate ethical dilemma while discharging duties in professional life.

**UNIT I HUMAN VALUES** **9**

Morals, Values and Ethics – Integrity – Work Ethic – Honesty – Courage –Empathy – Self-Confidence – Discrimination- Character.

**UNIT II ENGINEERING ETHICS** **9**

Senses of 'Engineering Ethics' - variety of moral issues - types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy – Models of Professional Roles - theories about right action - Self-interest –Professional Ideals and Virtues - uses of ethical theories. Valuing Time – Co-operation – Commitment –

**UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION** **9**

Engineering as experimentation - engineers as responsible experimenters - codes of ethics –Importance of Industrial Standards - a balanced outlook on law – anticorruption- occupational crime -the challenger case study.

**UNIT IV ENGINEER'S RIGHTS AND RESPONSIBILITIESON SAFETY** **9**

Collegiality and loyalty – Respect for authority – Collective Bargaining – Confidentiality- Conflict of interest – Occupational Crime – Professional Rights – IPR- Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - the Three Mile Island, Bhopal Gas plant and Chernobyl as case studies.

**UNIT V GLOBAL ISSUES** **9**

Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers-consulting engineers-engineers as expert witnesses and advisors -moral leadership-Sample code of conduct.

**TOTAL : 45 PERIODS**

**COURSE OUTCOMES:**

Students will have the ability to

| | |
|---|---|
| CO1: | Understand the Professionalism |
| CO2: | understand their rights, legal, ethical issues |

| | |
|---|---|
| CO3: | Apply human values in their professional life. |
| CO4: | Acquire knowledge about the engineering ethics and rules |
| CO5: | Achieve their responsibilities as it pertains to engineering profession with engaging in life-long learning with knowledge of contemporary issues. |

**TEXT BOOKS:**

1. Mike Martin and Roland Schinzinger, ―Ethics in Engineering‖, McGraw-Hill, New York 2005.
2. Charles E Harris, Michael S. Protchard and Michael J Rabins, ―Engineering Ethics –Concepts and Cases‖, Wadsworth Thompson Leatning, United States, 2000 (Indian
3. Govindarajan M, Natarajan S, Senthil Kumar V. S, ―Engineering Ethics‖, Prentice Hall of India, New Delhi, 2004.

**REFERENCES BOOKS:**

1. Charles D. Fleddermann, ―Engineering Ethics‖, Pearson Education / Prentice Hall, New Jersey, 2004
2. Charles E Harris, Michael S. Protchard and Michael J Rabins, ―Engineering Ethics – Concepts and Cases‖, Wadsworth Thompson Leatning, United States, 2000
3. John R Boatright, ―Ethics and the Conduct of Business‖, Pearson Education, New Delhi, 2003.
4. Edmund G Seebauer and Robert L Barry, ―Fundamentals of Ethics for Scientists and Engineers‖, Oxford Press , 2000
5. R.Subramanian , ―Professional Ethics ―,Oxford University Press ,Reprint ,2015.

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| **OE – 17** | **PRODUCT DESIGN AND ENGINEERING** | **3 0 0 3** |

**COURSE OBJECTIVE ( Employability)**

The course aims at providing the basic concepts of product design, product features and its architecture so that student can have a basic knowledge in the common features a product has and how to incorporate them suitably in product.

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

Need for IPPD-Strategic importance of Product development - integration of customer, designer, material supplier and process planner, Competitor and customer – behaviour analysis. Understanding customer-promoting customer understanding-involve customer in development and managing requirements - Organization process management and improvement

**UNIT II CONCEPT GENERATION, SELECTION AND TESTING** **9**

Plan and establish product specifications. Task - Structured approaches - clarification - search-externally and internally-Explore systematically - reflect on the solutions and processes - concept selection - methodology - benefits. Implications - Product change - variety - component standardization - product performance - manufacturability – Concept Testing Methodologies.

**UNIT III PRODUCT ARCHITECTURE** **9**

Product development management - establishing the architecture - creation - clustering -geometric layout development - Fundamental and incidental interactions - related system level design issues - secondary systems - architecture of the chunks - creating detailed interface specifications-Portfolio Architecture.

**UNIT IV INDUSTRIAL DESIGN** **9**

Integrate process design - Managing costs - Robust design - Integrating CAE, CAD, CAM tools – Simulating product performance and manufacturing processes electronically – Need for industrial design-impact – design process - investigation of customer needs - conceptualization - refinement - management of the industrial design process – technology driven products - user - driven products - assessing the quality of industrial design.

**UNIT V DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT** **9**

Definition - Estimation of Manufacturing cost-reducing the component costs and assembly costs – Minimize system complexity - Prototype basics - Principles of prototyping – Planning for prototypes - Economic Analysis - Understanding and representing tasks-baseline project planning - accelerating the project-project execution.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

On completion of the course the student will be able to

CO1: Understand the integration of customer requirements in product design
CO2: Apply structural approach to concept generation, selection and testing
CO3: Understand various aspects of design such as industrial design, design for manufacture
CO4: Analyse the concepts in product architecture
CO5: Implement the designs in manufacturing and product development.

**TEXT BOOK:**

1. Product Design and Development, Karl T.Ulrich and Steven D.Eppinger, McGraw –Hill International Edns.1999

**REFERENCES BOOKS:**

1. Concurrent Engg./Integrated Product Development. Kemnneth Crow, DRM Associates, 6/3, Via Olivera, Palos Verdes, CA 90274(310) 377-569, Workshop Book
2. Effective Product Design and Development, Stephen Rosenthal, Business One Orwin, Homewood, 1992, ISBN, 1-55623-603-4
3. Tool Design – Integrated Methods for successful Product Engineering, Stuart Pugh, Addison Wesley Publishing, Neyourk, NY, 1991, ISBN 0-202-41639-5

| OE – 18 | PRINCIPLES OF CAD AND 3D PRINTING TECHNOLOGY | 3 0 0 3 |
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**COURSE OBJECTIVES ( Employability)**

- To acquire knowledge about CAD software for modeling and 3D printing

**UNIT I FUNDAMENTALS OF CAD** **9**

Product cycle- Design process- sequential and concurrent engineering- Computer aided design – CAD system architecture- Computer graphics – co-ordinate systems- 2D and 3D transformations

**UNIT II GEOMETRIC MODELLING** **9**

Representation of curves- Hermite curve- Bezier curve- B-spline curves-rational curves-Techniques for surface modeling – surface patch- Coons and bicubic patches- Bezier and B-spline surfaces. Solid modeling techniques- CSG and B-rep

**UNIT III CAD STANDARDS** **9**

Standards for computer graphics- Graphical Kernel System (GKS) – standards for exchange images- Open Graphics Library (OpenGL) – Data exchange standards – IGES, STEP, CALS etc. – communication standards.

**UNIT IV 3D PRINTING – INTRODUCTION** **9**

Introduction; Design considerations – Material, Size, Resolution, Process; Modelling and viewing - 3D; Scanning; Model preparation – Digital; Slicing; Software; File formats

**UNIT V PRINCIPLE AND APPLICATION OF 3D PRINTING** **9**

Processes – Extrusion, Wire, Granular, Lamination, Photopolymerisation; Materials – Paper, Plastics, Metals, Ceramics, Glass, Wood, Fiber, Sand, Biological Tissues, Hydrogels, Graphene; Material Selection – Processes,

applications, limitations; Product Models, manufacturing – Printed electronics, Biopolymers, Packaging, Healthcare, Food, Medical, Biotechnology, Displays; Opensource; Future trends;

**TOTAL : 45 PERIODS**

**COURSE OUTCOMES:**

Upon completion of this course, the students can able to

| | |
|---|---|
| CO1: | Understand CAD software for modelling of mechanical components |
| CO2: | Experiment modelling of various designs using CAD |
| CO3: | Understand and Apply 3D printing workflow |
| CO4: | Understand the basic types of 3D Printing, materials used and their applications |
| CO5: | select, apply and analyze appropriate method for designing and modelling applications |

**TEXT BOOKS**

1. Chris McMahon and Jimmie Browne "CAD/CAM Principles", "Practice and Manufacturing management " Second Edition, Pearson Education, 1999.
2. Christopher Barnatt, "3D Printing: The Next Industrial Revolution", CreateSpace Independent Publishing Platform, 2013.

**REFERENCE BOOKS**

1. William M Neumann and Robert F.Sproul "Principles of Computer Graphics", McGraw Hill Book Co. Singapore, 1989.
2. Ibrahim Zeid, "Mastering CAD CAM" Tata McGraw-Hill Publishing Co.2007
3.Joan Horvath, "Mastering 3D Printing", APress, 2014

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| **OE – 19** | **RAPID PROTOTYPING** | **3 0 0 3** |

**COURSE OBJECTIVES: ( Employability)**

Generating a good understanding of RP history, its development and applications.. To expose the students to different types of Rapid prototyping processes, materials used in RP systems and reverse engineering.

**UNIT I INTRODUCTION TO RAPID PROTOTYPING 9**

History – Development of RP systems – Applications in Product Development, Reverse Engineering, Rapid Tooling, Rapid Manufacturing- Principle – Fundamental – File format – Other translators – medical applications of RP – On demand manufacturing – Direct material deposition – Shape Deposition Manufacturing.

**UNIT II LIQUID BASED AND SOLID BASED RAPID PROTOTYPING SYSTEMS 9**

Classification – Liquid based system – Stereolithography Apparatus (SLA), details of SL process, products, Advantages, Limitations, Applications and Uses. Solid based system – Fused Deposition Modeling, principle, process, products, advantages, applications and uses – Laminated Object Manufacturing

**UNIT III POWDER BASED RAPID PROTOTYPING SYSTEMS 9**

Selective Laser Sintering – principles of SLS process, principle of sinter bonding process, Laser sintering materials, products, advantages, limitations, applications and uses. Three Dimensional Printing – process, major applications, research and development. Direct shell production casting – key strengths, process, applications and uses, case studies, research and development. Laser Sintering System, e-manufacturing using Laser sintering, customized plastic parts, customized metal parts, e-manufacturing – Laser Engineered Net Shaping (LENS).

**UNIT IV MATERIALS FOR RAPID PROTOTYPING SYSTEMS 9**

Nature of material – type of material – polymers, metals, ceramics and composites- liquid based materials, photo polymer development – solid based materials, powder based materials – case study.

**UNIT V REVERSE ENGINEERING AND NEW TECHNOLOGIES 9**

Introduction, measuring device- contact type and non-contact type, CAD model creation from point clouds- preprocessing, point clouds to surface model creation, medical data processing – types of medical imaging, software for making medical models, medical materials, other applications – Case study.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES**

The students will be able to

| | |
|---|---|
| CO1: | Acquire knowledge on different types of Rapid Prototyping systems and its applications in various fields |
| CO2: | Understand and Analyse the solid and liquid based prototyping. |
| CO3: | Analyse the materials for rapid prototyping. |
| CO4: | Understand the power based prototyping |
| CO5: | Design models using CAD |

**TEXT BOOKS**

1. Rafiq I. Noorani, Rapid Prototyping, "Principles and Applications", Wiley & Sons, 2006.
2. Chua C.K, Leong K.F and Lim C.S, "Rapid Prototyping: Principles and Applications", Second Edition, World Scientific, 2003.

**REFERENCES BOOKS**

1. N.Hopkinson, R.J.M, Hauge, P M, Dickens, "Rapid Manufacturing – An Industrial revolution for the digital age", Wiley, 2006
2. Ian Gibson, "Advanced Manufacturing Technology for Medical applications: Reverse Engineering, Software conversion and Rapid Prototying", Wiley, 2006
3. Paul F. Jacobs, "Rapid Prototyping and Manufacturing: Fundamentals of Stereolithography", McGraw Hill 1993.
3. Pham. D.T., and Dimov. S.S., "Rapid Manufacturing", Springer Verlog, 2001.

| OE – 20 | RESEARCH AND PATENT DEVELOPMENT | 3 0 0 3 |
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**UNIT I FUNCTION OF RESEARCH** **9**

Meaning of Research - Function of Research – Characteristics of Research – Steps involved in Research – Research in Pure and Applied Sciences - Inter Disciplinary Research.Factors which hinder Research – Significance of Research - Research and scientific methods – Research Process– Criteria of good Research – Problems encountered by Researchers – Literature review.

**UNIT II IDENTIFICATION OF RESEARCH PROBLEM AND DESIGNING** **9**

Selecting the Research problem – Necessity of defining the problem – Goals and Criteria for identifying problems for research. Perception of Research problem – Techniques involved in defining the problem – Source of problems – Personal consideration. Formulation of Research design – Need for Research design – Features of a good design – Important concepts related to Research design

**UNIT III PATENT AND PATENTIBILITY** **9**

Concept of Patent – Historical view of Patent system in India and International Scenario – Evolution of Patent Laws in India – Legal basis of Patent Protection. Patentable Inventions - Process and Product (Biotechnology / Pharmaceutical Products / Software programme) – Patent protection of computer programme – Inventions NOT patentable.

**UNIT IV PROCEDURE OF PATENTING** **9**

Process of Obtaining a Patent – Application - Examination – Acceptance - Opposition – Sealing of Patents – Preservation of Patents- Documentation – Register of Patents.

**UNIT V RIGHTS AND OBLIGATIONS OF A PATENTEE** **9**

Duration of Patents – Rights of Patentee – Limitation of rights - Use and exercise of Rights – Right to Secrecy – Compulsory Licenses – Special Categories.

**COURSE OUTCOMES ( Skill Development)**

The students will be able to

CO1: Acquire knowledge on different functions of research
CO2: Describe the source of problem and formulation
CO3: Analyse the concepts of patents and patentibility
CO4: Understand the procedure of patenting
CO5: Explain the process to obtain patent and the limitations

**REFERENCE BOOKS**

1. Fisher, Matthew (ed.), Fundamentals of Patent Law: Interpretation and Scope of Protection, (2010), New Delhi, Mohan law House.

2. Miller, Joseph Scott (ed.), Patents, (2010), UK, Edward Elgar.

3. Kankanala, Kalyan C., Indian Patent Law and Practice, (2010), India, Oxford University Press

4. Dr. Bhandari, M.K. Law relating to IPR, Central Law Publication, (4th Edition 2015)

| OE – 21 | ELECTRONICS IN HEALTH CARE INDUSTRY | 3 0 0 3 |
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**COURSE OBJECTIVES ( Employability)**

Assess the genesis and impact of IoT applications, architectures in real world.

- Illustrate diverse applications of electronics in cardiology
- Explain about the electronic equipments used in diagnosis and treatment
- Infer the role of electronics in various health care industry
- Identify technologies in medical instruments in health care Industry.

**UNIT I ELECTRONICS IN CARDIOLOGY** **9**

Physiology of Heart and its abnormalities, Cardiac Monitoring and Recording Devices- ECG, Pacemaker, Defibrillators, Counter pulsation technique, Intra aortic balloon pumping and prosthetic heart valves and Imaging for cardiovascular system.

**UNIT II ELECTRONICS IN NEUROLOGY** **9**

Neurons and its abnormalities, EEG, Evoked response – Auditory and Visual sensory, Polysomnography, nerve stimulator and Imaging for brain disorders.

**UNIT III ELECTRONICS IN NEPHROLOGY** **9**

Nephrons and its abnormalities, Principle of Haemodialysis, Membrane, Dialysate, Different types of heamodialysers, Artificial kidney, Lithotripsy.

**UNIT IV ELECTRONICS IN CIRCULATORY SYSTEM** **9**

Interrelationships among Pressure, Flow, and Resistance, Blood and blood components, blood cell counters, Methods for blood flow meter, EM and ultrasonic blood flow meters, Blood Pressure, Plethysmography technique, Heart Lung machine, Respiration rate, Respiratory volume measurement, spirometer, Ventilators.

**UNIT V ELECTRONICS IN VISUAL AND AUDITORY SYSTEM** **9**

Anatomy of eye and its abnormalities, Laser in ophthalmology, Ear and it abnormalities Types of Deafness, Audiometer, Hearing Aids and cochlear implants.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

The student would be able to

CO1: Apply the electronics in medical field.
CO2: Explain the application of electronics in the field of diagnosis and treatment
CO3: Understand the role of technology in cardiology, neurology, nephrology
CO4: Establish the knowledge about instruments involved for health care management.
CO5: Describe the development required to improve the diagnosis or treatment in healthcare industry

**TEXT/ REFERENCES BOOKS:**

1. Guyton, Arthur C & John E. Hall, Text book of Medical Physiology – WB Jaunder company Philadelphia – 11th edition 2006.
2. Webster J.G Medical Instrumentation application and design – John Wiley and sons New York 4th edition 2010.
3. Khandpur R.S Hand Book of Biomedical Instrumentation – Tata Mc Graw Hill publication , New Delhi 3rd edition 2014.
4. Joseph J Carr and John m Brown – Introduction to Biomedical equipment Technology-

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| **OE – 22** | **ARCHITECTURE OF COMPUTER AND NETWORKS** | **3 0 0 3** |

**COURSE OBJECTIVES: ( Employability)**

The student should be made to:

- Understand the division of network functionalities into layers.
- Be familiar with the components required to build different types of networks
- Be exposed to the required functionality at each layer
- Learn the flow control and congestion control algorithms

**UNIT I FUNDAMENTALS & LINK LAYER** **9**

Building a network – Requirements – Layering and protocols – Internet Architecture – Network software – Performance ; Link layer Services – Framing – Error Detection – Flow control

**UNIT II MEDIA ACCESS & INTERNETWORKING** **9**

Media access control – Ethernet (802.3) – Wireless LANs – 802.11 – Bluetooth – Switching and bridging – Basic Internetworking (IP, CIDR, ARP, DHCP,ICMP )

**UNIT III ROUTING** **9**

Routing (RIP, OSPF, metrics) – Switch basics – Global Internet (Areas, BGP, IPv6), Multicast – addresses – multicast routing (DVMRP, PIM)

**UNIT IV TRANSPORT LAYER** **9**

Overview of Transport layer – UDP – Reliable byte stream (TCP) – Connection management – Flow control – Retransmission – TCP Congestion control – Congestion avoidance (DECbit, RED) – QoS – Application requirements

**UNIT V APPLICATION LAYER 9**

Traditional applications -Electronic Mail (SMTP, POP3, IMAP, MIME) – HTTP – Web Services – DNS – SNMP

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

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

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|---|---|
| CO1: | Understand and Identify the components required to build different types of networks |
| CO2: | Illustrate and Investigate the required functionality at each layer for given application |
| CO3: | Identify and Apply solution for each functionality at each layer |
| CO4: | Analyse and Trace the flow of information from one node to another node in the network |
| CO5: | Analyze and Implement the web services. |

**TEXT BOOK:**

1. Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", Fifth Edition, Morgan Kaufmann Publishers, 2011.

**REFERENCES BOOKS:**

1. James F. Kurose, Keith W. Ross, "Computer Networking – A Top-Down Approach Featuring the Internet", Fifth Edition, Pearson Education, 2009.
2. Nader. F. Mir, "Computer and Communication Networks", Pearson Prentice Hall Publishers, 2010.
3 Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, "Computer Networks: An Open Source Approach", Mc Graw Hill Publisher, 2011.
4. Behrouz A. Forouzan, "Data communication and Networking", Fourth Edition, Tata McGraw – Hill, 2011.

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| **OE – 23** | **HUMAN RESOURCES MANAGEMENT IN HOSPITAL** | **3 0 0 3** |

**COURSE OBJECTIVES: ( Employability)**

- This subject acquaints the students with major functions of HRM aligned with the business strategy.
- The subject encompasses the concept of best fit employee, training & executive development,sustaining employee interest and performance appraisal.

**UNIT I PERSPECTIVES OF HUMAN RESOURCE MANAGEMENT 9**

Evolution of Human Resource Management - Importance of Human factor, Objectives of Human resource Management - Human Resource Policies - Need for HRD/HRM in Healthcare Organisation - Computer Applications In Human Resource Management.

**UNIT II THE CONCEPT OF BEST FIT EMPLOYEE 9**

Organisational Job Design - job description - job analysis - job rotation-job evaluation- Man-power planning-Importance of Human Resource Planning, Forecasting of Human Resource Requirements - Selection procedures - test, Validation, Interviews, Recruitment, Medical Examination.

**UNIT III TRAINING & EXECUTIVE DEVELOPMENT 9**

Types of Training methods and their benefits - Executive development Programme – common practices - Benefits, self-development - knowledge Management.

**UNIT IV SUSTAINING EMPLOYEE INTEREST** **9**

Wage and Salary Administration – concept of incentives and its operational implications – Participative decision making – Concept of Collective Bargaining – Compensation plans – Rewards –Motivation – Theories of motivation - Grievances and redressal methods.

**UNIT V PERFORMANCE APPRAISAL** **9**

Importance of Performance Appraisal - Methods of Performance Evaluation, - Traditional methods –Modern methods – Feedback – Promotion – Demotion – transfer. Implications of jobs change. The control process, Methods and Requirements of Effective control system.

**TOTAL : 45 PERIODS**

**COURSE OUTCOME:**

Upon the completion of this course, the student well be able to

| | |
|---|---|
| CO1: | Gain with the knowledge about the significance and role in effective and efficient management of human resources in health care organizations |
| CO2: | Analyse the job and human resource planning. |
| CO3: | Analyse the training methods and its benefits. |
| CO4: | Understand and apply the salary and concepts of incentives. |
| CO5: | Understand the importance of performance appraisal. |

**REFERENCE BOOKS:**

1. R.C.Goyal, Human Resource Management in Hospitals, Prentice Hall of India, 2000.
2. Mamoria C.B. and Mamoria S.Personnel Management, Himalaya Publishing Company, 1997.
3. Decenzo and Robbins, Human Resource Management, Wiley & Sons, Singapore, 1999.

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| **OE – 24** | **INTERNET AND JAVA** | **3 0 0 3** |

**COURSE OBJECTIVES: ( Employability)**

- 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, Web design

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

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

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| CO1: Understand the Internet working with TCP/IP |
| CO2: Understand the concept of WWW and Apply the knowledge to create a basic website using HTML and Cascading Style Sheets. |
| CO3: Design and implement dynamic web page with validation using JavaScript objects and by applying different event handling mechanisms. |
| CO4: Design and implement simple web page in PHP, and to present data in XML format. |
| CO5: Design and implement server side programs using Servlets and JSP. |

**TEXT BOOKS:**

1. Deitel, Internet and World Wide Web, Pearson Education / PHI, 2007
2. Deitel, ―Java How to Program‖, Pearson Education / PHI, 2006.

**REFERENCE BOOKS:**

1. Herbert Schildt, The complete Reference JAVA 2, Fifth Edition, Tata McGRaw Hill Publishing Com.Ltd, New Delhi.
2. A S Godbole A Kahate, ―Web Technoligies, TCP/IP to Internet Application Archtiectures‖, TMH 2007
3. Margaret Levine Young, ―Internet The Complete Reference‖, Tata McGraw Hill, 1999
4. Balagurusamy.E.`Programming with Java, A premier` Second Edition, Tata McGraw Hill,2006
5. Douglas E.Comer,‖Internetworking with TCP/IP‖, Vol 1: 3rd edition, Prentice Hall of India, 1999.
6. Cay S. Horstmann & Gary Cornell, Core Javatm Volume – I & II, Pearson Education, 2006

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| **OE – 25** | **DISASTER MANAGEMENT** | **3 0 0 3** |

**COURSE OBJECTIVES: ( Employability)**

- To provide students an exposure to disasters, their significance and type To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional processes in the country and
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

**UNIT I INTRODUCTION TO DISASTERS 9**

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters –Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don‘ts during various types of Disasters.

**UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR) 9**

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayat Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders-institutional Processes and Framework at State

and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

**UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT 9**

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

**UNIT IV DISASTER RISK MANAGEMENT IN INDIA 9**

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

**UNIT V DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS 9**

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

The students will be able to

| | |
|---|---|
| CO1: | Differentiate the types of disasters, causes and their impact on environment |
| CO2: | Assess vulnerability and Apply various methods of risk reduction measures |
| CO3: | Understant Inter-relationship between Disaster and Development |
| CO4: | Understant Disaster Risk Management in India |
| CO5: | Understand the Field work and Case studies of Disaster Management |

**TEXT BOOKS:**

1. Singhal J.P. ―Disaster Management‖, Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN- 13: 978-9380386423
2. Tushar Bhattacharya, ―Disaster Science and Management‖, McGraw Hill India EducationPvt.Ltd., 2012. ISBN-10: 1259007367, ISBN-13: 978-1259007361]
3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
4. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010.

**REFERENCES:**

1. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy, 2009.

# VALUE ADDED COURSE

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| | **BIOMEDICAL WASTE MANAGEMENT** | |

**COURSE OBJECTIVES:**

The student should be made to:

- Understand the hazardous materials used in hospital and its impact on health
- Understand various waste disposal procedures and management.
- To explore the types of biomedical wastes and waste handling &
- To know the safety procedures in hospitals and health care sectors.
- To learn accident analysis and accident prevention.

**UNIT I HEALTHCARE HAZARD CONTROL AND UNDERSTANDING ACCIDENTS 9**

Healthcare Hazard Control: Introduction, Hazard Control, Hazard Control Management, Hazard Control Responsibilities, Addressing Behaviors, Hazard Control Practice, Understanding Hazards, Hazard Analysis, Hazard Control and Correction, Personal Protective Equipment, Hazard Control Committees, Hazard Control Evaluation,

Hazards, System Safety, Ergonomics. Understanding Accidents: Accident Causation Theories, Human Factors, Accident Deviation Models, Accident Reporting, Accident Investigations, Accident Analysis, Organizational Functions That Support Accident Prevention, Workers' Compensation, Orientation, Education, and Training.

**UNIT II BIOMEDICAL WASTE MANAGEMENT** **9**

Biomedical Waste Management: Types of wastes, major and minor sources of biomedical waste, Categories and classification of biomedical waste, hazard of biomedical waste, need for disposal of biomedical waste, waste minimization, waste segregation and labeling, waste handling, collection, storage and transportation, treatment and disposal.

**UNIT III HAZARDOUS MATERIALS** **9**

Hazardous Materials : Hazardous Substance Safety, OSHA Hazard Communication Standard, DOT Hazardous Material Regulations, Healthcare Hazardous Materials, Medical Gas Systems, Hazardous Waste Operations and Emergency Response Standard, Respiratory Protection.

**UNIT IV FACILITY SAFETY** **9**

Facility Safety : Introduction, Facility Guidelines Institute, Administrative Area Safety, Slip, Trip, and Fall Prevention, Safety Signs, Colors, and Marking Requirements, Scaffolding, Fall Protection, Tool Safety, Machine Guarding, Compressed Air Safety, Electrical Safety, Control of Hazardous Energy, Permit Confined Spaces, OSHA Hearing Conservation Standard, Heating, Ventilating, and Air-Conditioning Systems, Assessing IAQ, Landscape and Grounds Maintenance, Fleet and Vehicle Safety.

**UNIT V INFECTION CONTROL, PREVENTION AND PATIENT SAFETY** **9**

Healthcare Immunizations, Centers for Disease Control and Prevention, Disinfectants, Sterilants, and Antiseptics, OSHA Bloodborne Pathogens Standard, Tuberculosis, Healthcare Opportunistic Infections, Medical Waste. Patient Safety: An Organizational Function, Errors and Adverse Events, Safety Cultures, Patient-Centered Healthcare, Quality Improvement Tools and Strategies, Healthcare-Associated Infections, Medication Safety.

**TOTAL : 45 PERIODS**

**COURSE OUTCOMES:**

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

CO1: Analyse various hazards, accidents and its control
CO2: Design waste disposal procedures for different biowastes
CO3: Categorise different biowastes based on its properties
CO4: Design safety facility in hospitals
CO5: Propose various regulations and safety norms

**TEXT BOOKS:**

1. Tweedy, James T., Healthcare hazard control and safety management-CRC Press_Taylor and Francis (2014).
2. Anantpreet Singh, Sukhjit Kaur, Biomedical Waste Disposal, Jaypee Brothers Medical Publishers (P) Ltd (2012).

**REFERENCE:**

1. R.C.Goyal, ―Hospital Administration and Human Resource Management‖, PHI – Fourth Edition, 2006
2. V.J. Landrum, ―Medical Waste Management and disposal‖, Elsevier, 1991

**PRACTICAL:**

**List of Experiments:**

1. Study of Autoclave.
2. Study of Waste segregation in Hospitals
3. Study of Safety signs in Hospitals
4. Study of Hazardous waste disposal in Hospitals
5. Study of Non-Hazardous waste disposal in Hospitals
6. Study of Sterlents in hospitals