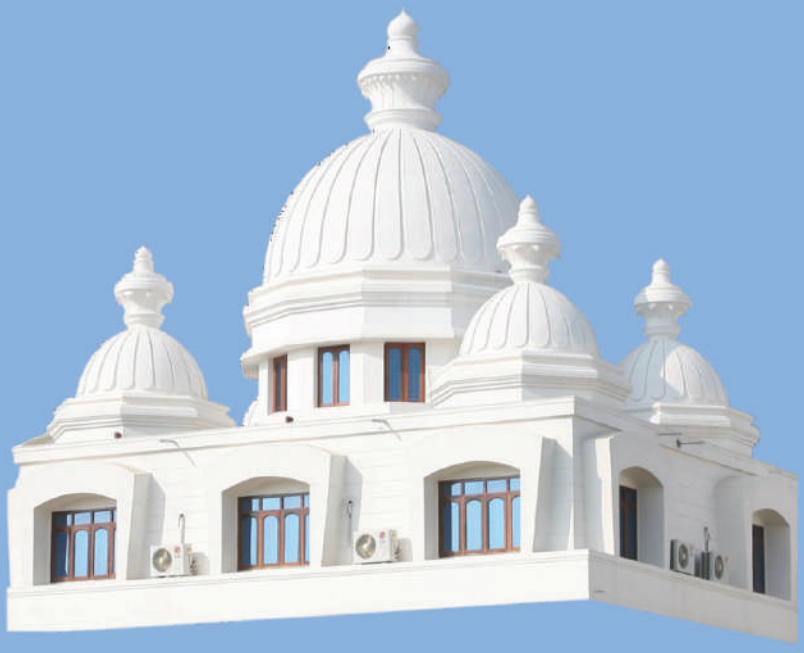
# B.E. Biomedical Engineering

## CURRICULUM AND SYLLABI

### BME ALL 4 YEARS - I To VIII Semesters

### Regulation – 2020 (Version 1.0)



## ENGINEERING COLLEGE

(Autonomous)

Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai
Accredited by NBA and NAAC with "A+"and Recognized by UGC (2f&12B)
KOMARAPALAYAM – 637303

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# EXCEL ENGINEERING COLLEGE

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**KOMARAPALAYAM - 637303**

## B.E. BIOMEDICAL ENGINEERING REGULATION - 2020
## CHIOCE BASED CREDIT SYSTEM
## I TO VIII SEMESTERS CURRICULUM AND SYLLABI

| I SEMESTER | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Code No.** | **Course** | **Category** | **Periods / Week** | | | **C** | **Maximum Marks** | | |
| | | | **L** | **T** | **P** | | **CA** | **FE** | **Total** |
| **Theory Course(s)** | | | | | | | | | |
| 20MA101 | Mathematics – I for Electrical Sciences | BS | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| 20BM101 | Basics of Electrical and Biomedical Engineering | ES | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| **Theory with Practical Course(s)** | | | | | | | | | |
| 20ENEXX | Language Elective – I | HSS | 2 | 0 | 2 | 3 | 50 | 50 | 100 |
| 20PH102 | Physics for Electrical Sciences | BS | 3 | 0 | 2 | 4 | 50 | 50 | 100 |
| 20CS102 | Problem Solving using Python | ES | 3 | 0 | 2 | 4 | 50 | 50 | 100 |
| **Practical Course** | | | | | | | | | |
| 20BM102 | Biomedical Engineering Practices Laboratory | ES | 0 | 0 | 2 | 1 | 50 | 50 | 100 |
| **Mandatory Course** | | | | | | | | | |
| 20MC101 | Induction Programme | MC | 2 Weeks | | | 0 | 100 | - | 100 |
| **TOTAL** | | | **14** | **1** | **8** | **19** | **380** | **320** | **700** |

| Language Electives – I | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Code No.** | **Course** | **Category** | **Periods / Week** | | | **C** | **Maximum Marks** | | |
| | | | **L** | **T** | **P** | | **CA** | **FE** | **Total** |
| 20ENE01 | Communicative English | HSS | 2 | 0 | 2 | 3 | 50 | 50 | 100 |
| 20ENE02 | Advanced Communicative English 1 | HSS | 2 | 0 | 2 | 3 | 50 | 50 | 100 |

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| II SEMESTER | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Code No.** | **Course** | **Category** | **Periods / Week** | | | **C** | **Maximum Marks** | | |
| | | | **L** | **T** | **P** | | **CA** | **FE** | **Total** |
| **Theory Course (s)** | | | | | | | | | |
| 20MA201 | Mathematics – II for Electrical Sciences | BS | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| 20BM201 | Biochemistry | ES | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| **Theory with Practical Course (s)** | | | | | | | | | |
| 20ENEXX | Language Elective – II | HSS | 2 | 0 | 2 | 3 | 50 | 50 | 100 |
| 20CH202 | Chemistry for Electrical Sciences | BS | 3 | 0 | 2 | 4 | 50 | 50 | 100 |
| 20ME203 | Engineering Graphics | ES | 3 | 0 | 2 | 3 | 50 | 50 | 100 |
| **Practical Course** | | | | | | | | | |
| 20BM202 | Biochemistry Laboratory | ES | 0 | 0 | 4 | 2 | 50 | 50 | 100 |
| **Mandatory Course** | | | | | | | | | |
| 20MC202 | Interpersonal Skills | MC | 0 | 0 | 2 | 0 | 100 | - | 100 |
| **Total** | | | **14** | **1** | **14** | **19** | **380** | **320** | **700** |

| Language Electives – II | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Code No.** | **Course** | **Category** | **Periods / Week** | | | **C** | **Maximum Marks** | | |
| | | | **L** | **T** | **P** | | **CA** | **FE** | **Total** |
| 20ENE03 | Advanced Communicative English-II | HSS | 2 | 0 | 2 | 3 | 50 | 50 | 100 |
| 20ENE04 | Hindi | HSS | 2 | 0 | 2 | 3 | 50 | 50 | 100 |
| 20ENE05 | French | HSS | 2 | 0 | 2 | 3 | 50 | 50 | 100 |
| 20ENE06 | German | HSS | 2 | 0 | 2 | 3 | 50 | 50 | 100 |
| 20ENE07 | Japanese | HSS | 2 | 0 | 2 | 3 | 50 | 50 | 100 |

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| III SEMESTER | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Code No.** | **Course** | **Category** | **Periods / Week** | | | **C** | **Maximum Marks** | | |
| | | | **L** | **T** | **P** | | **CA** | **FE** | **Total** |
| **Theory Course(s)** | | | | | | | | | |
| 20MA302 | Partial Differential Equation and Linear Algebra | BS | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| 20BM301 | Signals and Systems for Bioengineers | PC | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| 20BM302 | Circuit Theory | ES | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BM303 | Electronic Device and Circuits | PC | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BM304 | Biosensors and Measurements | PC | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| **Theory with Practical Course(s)** | | | | | | | | | |
| 20BM305 | Human Anatomy and Physiology | PC | 3 | 0 | 2 | 4 | 50 | 50 | 100 |
| **Practical Course** | | | | | | | | | |
| 20BM306 | Electronic Devices and Circuits Laboratory | PC | 0 | 0 | 4 | 2 | 50 | 50 | 100 |
| **Mandatory Course** | | | | | | | | | |
| 20MC301 | Environmental Sciences | MC | 2 | 0 | 0 | 0 | 100 | - | 100 |
| **Total** | | | **20** | **2** | **06** | **23** | **400** | **400** | **800** |

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| IV SEMESTER | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Code No. | Course | Category | Periods / Week | | | C | Maximum Marks | | |
| | | | L | T | P | | CA | FE | Total |
| **Theory Course(s)** | | | | | | | | | |
| 20MA402 | Probability and Stochastic Process | BS | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| 20BM401 | Digital Electronics | PC | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| 20BM402 | Medical and Radiation Physics | PC | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BM403 | Healthcare Data Analytics | PC | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BM404 | Pathology and Microbiology | PC | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| **Theory with Practical Course(s)** | | | | | | | | | |
| 20CS407 | Data Structure using Object Oriented Programming | ES | 3 | 0 | 2 | 4 | 50 | 50 | 100 |
| **Practical Course** | | | | | | | | | |
| 20BM405 | Pathology and Microbiology Laboratory | PC | 0 | 0 | 3 | 2 | 50 | 50 | 100 |
| **Mandatory Course** | | | | | | | | | |
| 20MC401 | Soft Skills | MC | 2 | 0 | 0 | 0 | 100 | - | 100 |
| **Total** | | | **20** | **2** | **3** | **23** | **400** | **400** | **800** |

| V SEMESTER | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Code No. | Course | Category | Periods / Week | | | C | Maximum Marks | | |
| | | | L | T | P | | CA | FE | Total |
| **Theory Course(s)** | | | | | | | | | |
| 20BM501 | Biocontrol system | PC | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| 20BM502 | Biomedical Instrumentation | PC | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BM503 | Biosignal Processing | PC | 3 | 1 | 0 | 4 | 50 | 50 | 100 |
| 20BM504 | Radiological Equipment's | PC | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BMEXX | Professional Elective-I | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20YYOXX | Open Elective-I | OE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| **Practical Course(s)** | | | | | | | | | |
| 20BM507 | Biomedical Instrumentation Laboratory | PC | 0 | 0 | 2 | 1 | 50 | 50 | 100 |
| 20BM508 | Biosignal Processing Laboratory | PC | 0 | 0 | 2 | 1 | 50 | 50 | 100 |
| **Total** | | | **18** | **2** | **4** | **22** | **350** | **450** | **800** |

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| VI SEMESTER | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Code No.** | **Course** | **Category** | **Periods / Week** | | | **C** | **Maximum Marks** | | |
| | | | **L** | **T** | **P** | | **CA** | **FE** | **Total** |
| **Theory Course(s)** | | | | | | | | | |
| 20BM601 | Medical Regulatory Affairs and Ethics | PC | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BM602 | Biomaterials and Artificial Organs | PC | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BM603 | Biomechanics | PC | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BMEXX | Professional Elective-II | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20YYOXX | Open Elective-II | OE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| **Theory with Practical Course** | | | | | | | | | |
| 20BM604 | Diagnostic and Therapeutic Equipment's | PC | 3 | 0 | 2 | 4 | 50 | 50 | 100 |
| **Practical Course(s)** | | | | | | | | | |
| 20BM605 | Mini Project | EEC | 0 | 0 | 2 | 1 | 50 | 50 | 100 |
| 20BM606 | Internship | EEC | 2 weeks | | | 1 | 100 | 0 | 100 |
| **Total** | | | **18** | **0** | **6** | **21** | **450** | **450** | **900** |

| VII SEMESTER | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Code No.** | **Course** | **Category** | **Periods / Week** | | | **C** | **Maximum Marks** | | |
| | | | **L** | **T** | **P** | | **CA** | **FE** | **Total** |
| **Theory Courses** | | | | | | | | | |
| 20BM701 | Hospital Management | HSS | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BM702 | Medical Image Processing | PC | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BM703 | Neural Networks and Fuzzy logic | PC | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BMEXX | Professional Elective-III | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BMEXX | Professional Elective-IV | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20YYOXX | Open Elective-III | OE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| **Practical Course(s)** | | | | | | | | | |
| 20BM704 | Biomedical Image Analysis Laboratory | PC | 0 | 0 | 2 | 1 | 50 | 50 | 100 |
| 20BM705 | Hospital Training | EEC | 0 | 0 | 2 | 1 | 100 | 00 | 100 |
| 20BM706 | Design Project | EEC | 0 | 0 | 2 | 1 | 50 | 50 | 100 |
| **Total** | | | **18** | **0** | **8** | **21** | **440** | **460** | **900** |

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| VIII SEMESTER | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Code No. | Course | Category | Periods / Week | | | C | Maximum Marks | | |
| | | | L | T | P | | CA | FE | Total |
| 20BMEXX | Professional Elective-V | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BMEXX | Professional Elective-VI | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BM801 | Major Project | EEC | 0 | 0 | 20 | 10 | 50 | 50 | 100 |
| **Total** | | | **6** | **0** | **20** | **16** | **130** | **170** | **300** |

| PROFESSIONAL ELECTIVES (PE) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Code No. | Course | Category | Periods / Week | | | C | Maximum Marks | | |
| | | | L | T | P | | CA | FE | Total |
| **STREAM – 1 BIOMEDICAL SIGNAL AND IMAGE PROCESSING (BSIP)** | | | | | | | | | |
| 20BME01 | Physiological Signal Processing | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BME02 | Biometric Systems | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BME03 | Computer Vision and Pattern Recognition for Biological applications | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BME04 | Speech Processing | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BME05 | Biostatistics | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BME06 | Quality Assurance & Medical Device Regulations | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BME07 | Medical Image Analysis | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BME08 | Brain Computer Interface and its Applications | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BME09 | Soft computing and applications | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BME10 | Deep Learning for Healthcare | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BME11 | Machine Learning for Healthcare | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BME12 | Neuro-Science Engineering | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BME13 | Real Time Embedded Systems | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| **STREAM – 2 HEALTH CARE SYSTEMS (HCS)** | | | | | | | | | |
| 20BME21 | Human Assist Devices | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BME22 | Robotics in Medicine | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BME23 | Medical Device Design and Prototyping | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BME24 | Hospital Information System | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |

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| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 20BME25 | Tele Health Technology | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BME26 | Wearable Systems | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BME27 | Body Area Networks | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BME28 | Data communication and Networking | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BME29 | Internet of Things in Medicine | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BME30 | Biomedical Data Science | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BME31 | Medical Informatics | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BME32 | Medical Ethics and Standards | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BME33 | Bioinformatics and Drug Design | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| **STREAM – 3 BIOENGINEERING (BE)** | | | | | | | | | |
| 20BME41 | Rehabilitation Engineering | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BME42 | Principles of Tissue Engineering | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BME43 | Molecular Biology | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BME44 | Biophotonics | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BME45 | Genetic Engineering | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BME46 | Nano Technology and Applications | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BME47 | Tissue Engineering and Artificial Organs | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BME48 | Bio MEMS | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BME49 | Lab-on-Chip & Point-of-care Devices | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BME50 | Physiological Modelling | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BME51 | Virtual Instrumentation | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BME52 | Medical Optics | PE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |

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| OPEN ELECTIVE COURSES (For Other Branches) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Code No.** | **Course** | **Category** | **Periods / Week** | | | **C** | **Maximum Marks** | | |
| | | | **L** | **T** | **P** | | **CA** | **FE** | **Total** |
| 20BMO01 | Principles of Telemedicine | OE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BMO02 | Biosensor and wearable technology | OE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BMO03 | Bioinformatics with soft computing tools | OE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BMO04 | Healthcare Data Analytics | OE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BMO05 | Medical nanotechnology | OE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BMO06 | Rehabilitation Engineering | OE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BMO07 | Medical electronics | OE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BMO08 | Biomedical instrumentation | OE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BMO09 | Hospital management | OE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BMO10 | Introduction to Medical informatics | OE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BMO11 | Biochemistry and Lab-on-chip | OE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 20BMO12 | Biology for Engineers | OE | 3 | 0 | 0 | 3 | 40 | 60 | 100 |

| ONE CREDIT COURSES | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Code No.** | **Course** | **Category** | **Periods / Week** | | | **C** | **Maximum Marks** | | |
| | | | **L** | **T** | **P** | | **CA** | **FE** | **Total** |
| 20BMA01 | Scientific Computing for Biologists | EEC | 1 | 0 | 0 | 1 | 100 | 0 | 100 |
| 20BMA02 | Frontiers in Medical Informatics | EEC | 1 | 0 | 0 | 1 | 100 | 0 | 100 |
| 20BMA03 | Medical Imaging Equipment's | EEC | 1 | 0 | 0 | 1 | 100 | 0 | 100 |
| 20BMA04 | IoT for Healthcare Applications | EEC | 1 | 0 | 0 | 1 | 100 | 0 | 100 |
| 20BMA05 | Electronic Design Automation Tools for Medical Devices | EEC | 1 | 0 | 0 | 1 | 100 | 0 | 100 |
| 20BMA06 | Ventilator with monitoring equipment for Critical Care | EEC | 1 | 0 | 0 | 1 | 100 | 0 | 100 |
| 20BMA07 | Human Computer Interface | EEC | 1 | 0 | 0 | 1 | 100 | 0 | 100 |
| 20BMA08 | 3D Printing/Modeling for Health Care | EEC | 1 | 0 | 0 | 1 | 100 | 0 | 100 |

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## SUMMARY

| S.No | Category | CREDITS PER SEMESTER | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | I | II | III | IV | V | VI | VII | VIII | Total Credits (AICTE) | Credits in % |
| 1 | HSS | 3 | 3 | | | | | 3 | | 9 (10-14) | 5.48% |
| 2 | BS | 8 | 8 | 4 | 4 | | | 0 | | 24 (22-28) | 14.63% |
| 3 | ES | 8 | 8 | 3 | 3 | | | 0 | | 22 (24) | 13.41 % |
| 4 | PC | | | 16 | 16 | 16 | 14 | 8 | | 70 (48) | 42.68 % |
| 5 | PE | | | | | 3 | 3 | 6 | 6 | 18 (18) | 10.97% |
| 6 | OE | | | | | 3 | 3 | 2 | | 8 | 4.87% |
| 7 | EEC | | | | | | 1 | 2 | 10 | 13 (12-16) | 7.92% |
| 8 | MC | 0 | 0 | 0 | 0 | | | | | 0 | 0 |
| **Total** | | 19 | 19 | 23 | 23 | 22 | 21 | 21 | 16 | 164 | 100% |

HSS - Humanities and Social Sciences

BS - Basic Sciences

ES - Engineering Sciences

PC - Professional Core

PE - Professional Electives

OE - Open Electives

EEC - Employability Enhancement Courses

MC - Mandatory Courses (Non-Credit Courses) CA - Continuous Assessment

FE - Final Examination

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**I SEMESTER**

| 20MA101 | Mathematics - I for Electrical Sciences (Common to ECE and BME) | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 2 | 0 | 4 |
| **Nature of Course** | Basic Sciences | | | | |
| **Pre requisites** | Fundamentals of basic Mathematics | | | | |

**Course Objectives**

The course is intended to

1. Study the methodologies involved in solving problems related to fundamental principles of matrices and calculus.
2. Acquaint the student with mathematical tools needed in evaluating limits, derivatives and differentiation of one variable.
3. Learn the basic tools of calculus for the purpose of modeling the engineering problems mathematically and obtaining solutions.
4. Provide the concepts of evaluating multiple integrals and their usage.
5. Study the basics of vector calculus comprising of gradient, divergence, curl, line, surface, volume integrals and the classical theorems

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No. | Course Outcome | Bloom's Level |
|---|---|---|
| CO1 | Apply the concept of orthogonal reduction to diagonals the given matrix | Apply |
| CO2 | Understand the limit definition and rules of differentiation to differentiate functions. | Understand |
| CO3 | Determine the circle of curvature, evaluate and envelope of the curves | Apply |
| CO4 | Compute double and triple integrals | Understand |
| CO5 | Apply the concepts of differentiation and integration to vectors | Apply |

**Course Contents**

**Unit – I Matrices** **12**

Characteristic equation – Eigen values and Eigen vectors of a real matrix – Properties(statement only) – Cayley-Hamilton theorem and its applications – Orthogonal transformation of a symmetric matrix to diagonal form – Reduction of quadratic form to canonical form by orthogonal transformation.

**Unit – II Limits, Continuity and Differentiability** **12**

Representation of functions – Limit of a function – Continuity – Derivatives – Differentiation rules – Rolle 's Theorem – Mean value theorem - Maxima and Minima of one variable.

**Unit – III Differential Calculus** **12**

Curvature – radius of curvature (Cartesian and Polar co-ordinates) – Centre of curvature – Circle of curvature – Involute and evolute – envelope.

**Unit – IV Multiple Integrals** **12**

Double integration- Cartesian and Polar co-ordinates – Change of order of integration – Area between two curves – Area of double integral – Triple integration

**Unit – V Vector Calculus** **12**

Gradient, Divergence and Curl – Directional derivative – Irrotational and Solenoidal vector fields – Vector integration – Green's, Gauss divergence and Stokes ' theorem – Statement, Verification and Simple applications.

**Total: 60 Periods**

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**Text Books:**

1. Grewal B.S, "Higher Engineering Mathematics", Khanna Publishers, 44th Edition 2016.
2. Veerarajan T," Engineering Mathematics for Semester I and II", Tata McGraw Hill, 3rd Edition 2014.

**Reference Books:**

1. N.P.Bali, Manish Goyal, "A text book of Engineering Mathematics Semester II", Laxmi Publications, 6th Edition 2015.
2. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education, 3rd Edition 2012.

**Web References**

1. nptel.ac.in/courses/111/105/111105121
2. nptel.ac.in/courses/111/105/111105122

| **Mapping of Course Outcomes (COs) with Program Outcomes (POs) Program Specific Outcomes (PSOs)** | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs** | **POs** | | | | | | | | | | | | **PSOs** | | |
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| CO1 | 3 | 3 | 2 | | | | | | | | | | 2 | | |
| CO2 | 3 | 3 | 2 | | | | | | | | | | 3 | | |
| CO3 | 3 | 2 | 2 | | | | | | | | | | 3 | | |
| CO4 | 3 | 3 | 2 | | | | | | | | | | 2 | | |
| CO5 | 3 | 3 | 2 | | | | | | | | | | 3 | | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| **Formative assessment** | | | |
|---|---|---|---|
| **Bloom's Level** | **Assessment Component** | **Marks** | **Total marks** |
| Remember | Online Quiz | 5 | 15 |
| Understand | Tutorial Class / Assignment | 5 | |
| | Attendance | 5 | |

| **Summative Assessment** | | | | |
|---|---|---|---|---|
| **Bloom's Category** | **Internal Assessment Examinations** | | | **Final Examination (60)** |
| | **IAE 1 (7.5)** | **IAE 2 (7.5)** | **IAE 3 (10)** | |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 10 | 10 | 10 | 20 |
| Apply | 30 | 30 | 30 | 60 |
| Analyze | | | | |
| Evaluate | | | | |
| Create | | | | |

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| 20BM101 | BASICS OF ELECTRICAL AND BIOMEDICAL ENGINEERING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| **Nature of Course** | **Engineering Sciences** | | | | |
| **Pre requisites** | Nil | | | | |

**Course Objectives**

The course is intended to

1. Understand the basic concepts of electric circuits and wiring.
2. Learn the principles of three phase circuits and magnetic circuits
3. Understand the operation of AC and DC machines.
4. Explore the knowledge on evolution and modern health care system in biomedical engineering
5. Study the properties of neurons and equivalent circuit model

**Course Outcomes**

On successful completion of the course, students will be able to

| CO.No. | Course Outcome | Bloom's Level |
|---|---|---|
| CO1 | Explain the concepts related with electrical circuits and wiring | Understand |
| CO2 | Explain the different three phase connections and the concepts of magnetic circuits | Apply |
| CO3 | Interpret the operating principle of AC and DC machines | Understand |
| CO4 | Identify the major role that advances in medical technology | Understand |
| CO5 | Describe the process used for communication among neurons | Understand |

**Course Contents**

**UNIT – I BASIC CIRCUITS AND DOMESTIC WIRING 10**

Electrical circuit elements (R, L and C)-Dependent and independent sources – Ohm's Law-Kirchhoff's laws - mesh current and node voltage methods (Analysis with only independent source) - Phasors – RMS-Average values-sinusoidal steady state response of simple RLC circuits. Types of wiring- Domestic wiring - Specification of Wires-Earthing-Methods-Protective devices.

**UNIT – II THREE PHASE CIRCUITS AND MAGNETIC CIRCUITS 10**

Three phase supply – Star connection – Delta connection –Balanced and Unbalanced Loads-Power in three-phase systems – Comparison of star and delta connections – Advantages- Magnetic circuits-Definitions-MMF, Flux, Reluctance, Magnetic field intensity, Flux density, Fringing, self and mutual inductances-simple problems.

**UNIT – III ELECTRICAL MACHINES 10**

Working principle of DC generator, motor-EMF and Torque equation-Types –Shunt, Series and Compound-Applications. Working principle of transformer-EMF equation-Operating principles ofthree phase and single-phase induction motor-Applications. Working principles of alternator-EMF equation-Operating principles of Synchronous motor, stepper motor-Applications.

**UNIT – IV HISTORICAL PERSPECTIVE OF BIOMEDICAL ENGINEERING 9**

The evolution and modern of health care system-Introduction to Biomedical Engineering-Recent advances in Biomedical Engineering-Ethical issues, Definition-Ethical issues in emergency use and treatment use-The role of biomedical engineer in FDA process.

**UNIT – V BIOELECTRIC PHENOMENA 6**

Introduction-Neurons-Basic Biophysics Tools-Equivalent circuit model for cell membrane-The Hodgkin-Huxley Model of Action Potential-model of whole neuron.

**Total: 45 periods**

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**Text books**

1. Dr.Kothari D.P, Prof Nagrath I J,"Basic Electrical Engineering" , 3rd edition, Tata McGraw Hill, 2009.

2.John D. Enderle and Joseph D. Bronzino "Introduction to Biomedical Engineering", Elsevier International Projects Ltd., Boston, 3rd edition, 2012.

3. Muthusubramaniam R, Salivahanan S and Muraleedharan A.K, "Basic Electrical, Electronics and Computer Engineering", TMH 2007.

**Reference books**

1. Vijay kumar Garg,"Basic Electrical Engineering (A complete Solution)", Wiley, Reprint 2015.

2. Sen,P.C, "Principles of Electrical Machines and Power Electronics", Wiley, Reprint 2016

3. John D. Enderle and Susan M. Blanchard, "Introduction to Biomedical Engineering", Elsevier International Projects Ltd., Boston, 3rd edition, 2011

| **Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)** | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs** | **POs** | | | | | | | | | | | | **PSOs** | | |
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | |
| CO1 | 3 | 3 | 1 | | | | | | | | | | 2 | 1 | |
| CO2 | 3 | 3 | 1 | | | | | | | | | | 2 | 1 | |
| CO3 | 3 | 3 | 1 | | | | | | | | | | 2 | 1 | |
| CO4 | 3 | 3 | 1 | | | | | 2 | | | | 1 | 2 | 2 | |
| CO5 | 3 | 3 | 1 | | | | | 2 | | | | 1 | 2 | 2 | |
| | 3 | High | | | | 2 | Medium | | | | 1 | Low | | | |

| **Formative assessment** | | | |
|---|---|---|---|
| **Bloom's Level** | **Assessment Component** | **Marks** | **Total marks** |
| Understand | Direct Measures: Quiz/Presentation/Tutorial | 5 | 15 |
| Understand | Indirect measures: Assignment/ Video presentation | 5 | |
| | Attendance | 5 | |

| **Summative Assessment** | | | | |
|---|---|---|---|---|
| **Bloom's Category** | **Continuous Assessment** | | | **Final Examination (Theory) (60)** |
| | **IAE 1 (7.5)** | **IAE 2 (7.5)** | **IAE 3 (10)** | |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 10 | 10 | 10 | 20 |
| Apply | 30 | 30 | 30 | 60 |
| Analyse | 0 | 0 | 0 | 0 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

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*Passed in Board of studies Meeting* *Approved in Academic Council Meeting*

| 20ENE01 | COMMUNICATIVE ENGLISH<br>(Common to all B.E. / B.Tech. Programmes) | L | T | P | C |
|---|---|---|---|---|---|
| | | 2 | 0 | 2 | 3 |
| **Nature of Course** | Humanities and Social Science | | | | |
| **Pre requisites** | Nil | | | | |

**Course Objectives**

The course is intended to

1. Improve lexical, grammatical and semantic competence.
2. Enhance communicative skills in real life situations.
3. Augment thinking in all forms of communication.
4. Equip with oral and written communication skills.
5. Gain employability skills.

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No. | Course Outcome | Bloom's Level |
|---|---|---|
| CO1 | Use effectively the lexical, grammatical and semantic knowledge | Remember |
| CO2 | Communicate with clarity using intentional vocabulary in English | Apply |
| CO3 | Articulate perfectly and express their opinions confidently using communicative strategies | Remember |
| CO4 | Accomplish listening and reading skills for lifelong learning | Understand |
| CO5 | Comprehend, interpret and present data | Understand |

**Course Contents**

**Unit - I Basic structure and Usage** **6**

Parts of Speech –- Articles –Tenses - Subject-Verb Agreement – Different Grammatical forms of the same word - Listening to Speeches and Conversations from Communication software – Listening to Announcements – Listening and Gap Filling.

**Unit - II Vocabulary and Language Development** **6**

Intentional vocabulary used in and around Airport, Hospital, Hotel, Court – Abbreviations and acronyms - One Word Substitution - Compound words – Homophones and Homonyms – Types of sentences - Ordering Jumbled Sentences Letter writing – informal.

**Unit – III Oral Communication Skills** **6**

Improving fluency – Articulation with pronunciation – Voice modulation in Speaking – One minute talk -Self Introduction and introducing ones friend – Telephonic conversations – Group Discussion – Modal Auxiliaries – discourse markers.

**Unit – IV Comprehensive Listening and Reading** **6**

Effective listening Strategies –– Listening to Interviews from Communication software – Phrasal verbs – Reading Comprehension – “An Astrologer’s Day” by R.K.Narayan and “Building a New State” by Dr. A.P.J. Abdul Kalam.

**Unit – V Effective Writing** **6**

Interpretation and presentation of data – developing Hints – general essays and paragraph writing – Report Writing – survey report and accident report - Instructions and Recommendations.

**Total: 30 Periods**

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**Laboratory Components**

| S.No | List of Exercises | CO Mapping | RBT |
|---|---|---|---|
| 1 | Role-play – One minute talk | 3 | Understand |
| 2 | Role-play – Telephonic conversations | 3 | Understand |
| 3 | Listening to speeches and lectures and gap filling | 4 | Understand |
| 4 | Group Discussion. | 4 | Understand |
| 5 | Articulation with pronunciation practice | 3 | Apply |
| 6 | Listening to Announcements – Listening and Gap Filling | 4 | Understand |
| 7 | Listening to Interviews & Native speakers' Conversations | 4 | Understand |
| 8 | Reading practice with articles in magazine and news papers. | 4 | Understand |
| 9 | Model – Job Interviews | 4 | Understand |
| 10 | Introspective report – Personal analysis | 5 | Understand |
| 11 | Telephone etiquette | 3 | Remember |
| 12 | Reading – Shorter texts and News Articles | 4 | Understand |
| 13 | Role Play – Getting and Giving Permission | 3 | Remember |
| 14 | Self Introduction( Formal ) | 3 | Understand |
| 15 | Recommendations/Suggestions | 3 | Apply |

**Total: 30 Periods**

**Text Books**

1. Rizvi, Ashraf M., "Effective Technical Communication", Tata McGraw Hill Publishing Company Limited, New Delhi, 5th Edition, 2007.

2. Board of Editers, "Using English – A Coursebook for Undergraduate Engineers and Technologists", Orient BlackSwan Private Limited, Hyderabad, 2nd Edition, 2017.

**Reference Books:**

1. Meenakshi Raman and Sangeetha Sharma, "Technical Communication", Oxford University Press, USA, 10th Edition, 2007.

2. John Cunnison Catford, "A Practical Introduction to Phonetics", Clarendon Press, Jamaica, 2nd Edition, 2001.

3. Hewings. M, "Advanced English Grammar", Cambridge University Press, Chennai, 3rd Edition, 2000.

4. S P Dhanavel "English and Soft Skills", Orient BlackSwan Private Limited, Hyderabad, 1st Edition, 2010.

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**Web reference**:

https://www.googleadservices.com/pagead/aclk?sa=L&ai=DChcSEwij4dCTucfsAhXE1pYKHch4ABMYABABGgJ0bA&ohost=www.google.com&cid=CAASEuRo76H-Vx9BpazOOBfXeJSKVQ&sig=AOD64_3O-HNEnUO4A5sc31MsUfaTBGG-dQ&q&adurl&ved=2ahUKEwjC3ceTucfsAhXBeisKHatlBewQ0Qx6BAgfEAE

| **Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)** | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs** | **POs** | | | | | | | | | | | | **PSOs** | | |
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| CO1 | | | | | | | 1 | | | 3 | 2 | 2 | 2 | | |
| CO2 | | | | | | | 1 | | | 3 | 2 | 2 | 2 | | |
| CO3 | | | | | | | 1 | | | 3 | 2 | 2 | 2 | | |
| CO4 | | | | | | | 1 | | | 3 | 2 | 2 | 2 | | |
| CO5 | | | | | | | 1 | | | 3 | 2 | 2 | 2 | | |
| | **3** | **High** | | | | **2** | **Medium** | | | | **1** | **Low** | | | |

| **Summative assessment** | | | | | | |
|---|---|---|---|---|---|---|
| **Bloom's Level** | **Continuous Assessment** | | | | | **Final Examination (Theory) [50 marks]** |
| | **Theory Marks** | | | | **Practical** | |
| | **IAE-I [7.5]** | **IAE-II [7.5]** | **IAE -III [10]** | **Attendance [5]** | **Rubric based CIA [20 Marks]** | |
| Remember | 20 | 20 | 20 | | 40 | 40 |
| Understand | 20 | 20 | 20 | | 40 | 40 |
| Apply | 10 | 10 | 10 | | 20 | 20 |
| Analyze | | | | | | |
| Evaluate | | | | | | |
| Create | | | | | | |

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| 20PH102 | Physics for Electrical Sciences (Common to ECE and BME) | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 4 |
| **Nature of Course** | Basic Sciences | | | | |
| **Pre requisites** | Fundamentals of Basic Physics | | | | |

**Course Objectives**: The course is intended to

1. Impart knowledge of optics, especially laser and their applications in fiber optics.
2. Gain knowledge to learn thermal properties of materials and their applications.
3. Provide knowledge of properties of matter like elasticity and its applications.
4. Learn the electronic properties of materials like semiconductors and its applications.
5. Develop a clear Understand of optical devices like solar cell, LED etc.

**Course Outcomes**

On successful completion of the course, students will be able to

| CO.No. | Course Outcome | Bloom's Level |
|---|---|---|
| CO1 | Compare the working of lasers and propagation of light through optical fibers and its applications. | Understand |
| CO2 | Demonstrate the thermal conductivity of the good and bad conductors | Understand |
| CO3 | Explain the knowledge about elasticity | Understand |
| CO4 | Interpret the knowledge about semiconductor materials. | Understand |
| CO5 | Illustrate the working of optoelectronic devices. | Understand |

**Course Contents:**

**UNIT I Laser and Fiber Optics 9**

Lasers: population of energy levels, Einstein's A and B coefficients derivation – resonant cavity, optical amplification (qualitative) – Semiconductor lasers: homojunction and heterojunction – Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibers (material, refractive index, mode) – optical fiber communication system – fiber optic endoscope.

**UNIT II Thermal Physics 9**

Transfer of heat energy – thermal expansion of solids and liquids – expansion joints - bimetallic strips - thermal conductivity - Forbe's and Lee's disc method: theory and experiment - conduction through compound media (series and parallel) – thermal insulation – applications : heat exchangers in refrigerators, ovens and solar water heaters.

**UNIT III Properties of Matter 9**

Elasticity – Stress-strain diagram and its uses - factors affecting elastic modulus and tensile strength – torsional stress and deformations – twisting couple - torsion pendulum: theory and experiment - bending of beams - bending moment – cantilever – uniform and non-uniform bending - I-shaped girders - stress due to bending in beams.

**UNIT IV Semiconductor Physics 9**

Intrinsic Semiconductors – Energy band diagram – direct and indirect band gap semiconductors – Carrier concentration in intrinsic semiconductors – extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors – Variation of carrier concentration with temperature – variation of Fermi level with temperature and impurity concentration –Hall effect and its applications.

**UNIT V Optical Properties of Materials 9**

Classification of optical materials – carrier generation and recombination processes - photo current in a P- N diode: principle and working – solar cell and photo detectors: working principle – LED: principle and working – Organic LED: principle and working, advantages over LED – Laser diodes: principle, working and applications.

**Total : 45 Periods**

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**Laboratory Components**

| S.No | List of Experiments | CO Mapping | RBT |
|---|---|---|---|
| 1 | Determination of rigidity modulus – Torsion pendulum | CO3 | Apply |
| 2 | Determination of Young's modulus by non-uniform bending method. | CO3 | Apply |
| 3 | Determination of wavelength, and particle size using Laser | CO1 | Apply |
| 4 | Determination of acceptance angle in an optical fiber | CO1 | Apply |
| 5 | Determination of thermal conductivity of a bad conductor by Lee's Disc method | CO2 | Apply |
| 6 | Determination of velocity of sound and compressibility of liquid - Ultrasonic interferometer | CO3 | Apply |
| 7 | Determination of Coefficient of viscosity of liquid | CO3 | Apply |

**Total: 30 Periods**

**TEXT BOOKS:**

1. Bhattacharya, D.K and Poonam, T, "Engineering Physics", 2nd edition, Oxford University Press, 2015.
2. M.N. Avadhanulu, M.N. & Kshirsagar PG. "A Text book of Engineering Physics", 10th edition, S.Chand and company, Ltd., New Delhi, 2014.
3. William D.Callister,Jr and David. G.Bethwisch, "Materials Science and Engineering", 9th edition, John Wiley & Sons, Inc, 2019.

**REFERENCES:**

1. Halliday, D, Resnick, R and Walker, J, "Principles of Physics", 10th edition, Wiley, 2014.
2. Serway, R.A. & Jewett, J.W, "Physics for Scientists and Engineers", 9th edition, Cengage Learning, 2019.
3. Raghavan, V. "Materials Science and Engineering, A First course", 5th edition, PHI Learning, 2015.

**Web References:**

1. https://nptel.ac.in/courses/115/107/115107095/
2. https://www.coursera.org/lecture/fe-exam/stresses-in-beams-strains-in-pure-and-nonuniform-bending-6aMRx
3. https://nptel.ac.in/courses/115/105/115105099/#
4. https://www.youtube.com/watch?v=uv0LxMoalEQ

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| **Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)** | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs** | **POs** | | | | | | | | | | | | **PSOs** | | |
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| CO1 | 3 | 2 | 1 | | | | | | | | | | | | |
| CO2 | 3 | 1 | 1 | | | | | | | | | | | | |
| CO3 | 3 | 2 | 1 | | | | | | | | | | | | |
| CO4 | 3 | 1 | 1 | | | | | | | | | | | | |
| CO5 | 3 | | 1 | | | | | | | | | | | | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| **Summative assessment** | | | | | | |
|---|---|---|---|---|---|---|
| **Bloom's Level** | **Continuous Assessment** | | | | | **Final Examination (Theory) [50 marks]** |
| | **Theory Marks** | | | | **Practical** | |
| | **IAE-I [7.5 ]** | **IAE-II [7.5]** | **IAE-III [10]** | **Attendance [5]** | **Rubric based CIA [20 Marks]** | |
| Remember | 30 | 30 | 30 | | - | 30 |
| Understand | 62 | 62 | 62 | | 40 | 62 |
| Apply | 8 | 8 | 8 | | 60 | 8 |
| Analyse | - | - | - | | - | - |
| Evaluate | - | - | - | | - | - |
| Create | - | - | - | | - | - |

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*Passed in Board of studies Meeting* *Approved in Academic Council Meeting*

| 20CS102 | PROBLEM SOLVING USING PYTHON (Common to all Branches) | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 4 |
| **Nature of Course** | Engineering Sciences | | | | |
| **Pre requisites** | Mathematical and Logical Knowledge | | | | |

**Course Objectives**

The course is intended

1. To think logically and write algorithm and draw flow charts for problems.
2. To read and write simple Python programs.
3. To develop Python programs with conditionals and loops.
4. To define Python functions and call them.
5. To use Python data structures –- lists, tuples, dictionaries and files.

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No. | Course Outcome | Bloom's Level |
|---|---|---|
| CO1 | Develop algorithmic solutions to simple computational problems and read, write, execute by simple python programs. | Apply |
| CO2 | Structure simple python programs for solving problems. | Understand |
| CO3 | Administer the role of control statements and functions involving the idea of modularity. | Apply |
| CO4 | Represent compound data using python strings and lists. | Apply |
| CO5 | Read and write data from/to files in python Programs. | Understand |

**Course Contents:**

**Unit I Basics of Computers & Problem Solving 9**

Computer Basics – Components-Computer organization - Computer Software- Types of software - Software Development steps -Need for logical analysis and thinking- Algorithms – Flowchart - Number system.

**Unit II Introduction of Python Programming 9**

Introduction-Python Interpreter-Interactive and script mode -Values and types, variables, operators, expressions, statements, precedence of operators, Multiple assignments, comments, Input and Output Statements.

**Unit III Control statements and Functions 9**

Conditional (if), alternative (if-else), chained conditional (if-elif-else)-Iteration-while, for, break, continue, pass – Functions - Introduction, inbuilt functions, user defined functions, passing parameters, return values, recursion, Lambda functions.

**Unit IV Strings and Lists 9**

Strings-String slices, immutability, string methods and operations -Lists-creating lists, list operations, list methods, mutability, aliasing, cloning lists, list and strings, list and functions-list processing-list comprehension, searching and sorting.

**Unit V Tuples, Dictionaries and Files 9**

Tuples- Tuple assignment, lists and tuples, Tuple as return value- Dictionaries-operations and methods, Files and Exception-Text files, reading and writing files, format Operator, Exception handling.

**TOTAL : 45 Periods**

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**Laboratory Components**

| S.No | List of Experiments | CO Mapping | RBT |
|---|---|---|---|
| 1 | Write a algorithm & draw flowchart for simple computational problems | CO1 | Understand |
| 2 | Write a program to perform different arithmetic operations on numbers in python. | CO2 | Understand |
| 3 | Write a python program to implement the various control structures | CO3 | Apply |
| 4 | Write a python program for computational problems using recursive function. | CO3 | Apply |
| 5 | Demonstrate use of list for data validation. | CO4 | Apply |
| 6 | Develop a python program to explore string functions | CO4 | Analyze |
| 7 | Implement linear search and binary search. | CO4 | Apply |
| 8 | Develop a python program to implement sorting methods | CO4 | Analyze |
| 9 | Develop python programs to perform operations on dictionaries. | CO5 | Analyze |
| 10 | Write a python program to read and write into a file | CO5 | Apply |

**TOTAL: 30 Periods**

**Text Books:**

1. Reema Thareja, "Problem Solving and Programming with Python", Oxford University Press, 2018
2. Dr. R. Nageswara Rao, "Core Python Programming", Dreamtech Press, 2017 Edition

**Reference Books:**

1. Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012
2. Ashok Namdev Kamthane, Amit Ashok Kamthane, "Programming and Problem Solving with Python" , Mc-Graw Hill Education, 2018.
3. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem Solving Focus", Wiley India Edition, 2013
4. Timothy A. Budd," Exploring Python", Mc-Graw Hill Education (India) Private Ltd., 2015

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| Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO) | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs** | **POs** | | | | | | | | | | | | **PSOs** | | |
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| CO1 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 | |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 | |
| CO3 | 3 | 2 | 2 | | | | | | | | | | 3 | 1 | |
| CO4 | 3 | 2 | 2 | | | | | | | | | | 3 | 1 | |
| CO5 | 3 | 2 | 2 | | | | | | | | | | 3 | 1 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Summative assessment | | | | | | |
|---|---|---|---|---|---|---|
| **Bloom's Level** | **Continuous Assessment** | | | | | **Final Examination (Theory) [50 marks]** |
| | **Theory Marks** | | | | **Practical** | |
| | **IAE-I [7.5]** | **IAE-II [7.5]** | **IAE-III [10]** | **Attendance [5]** | **Rubric based CIA [20 Marks]** | |
| Remember | 10 | 10 | 10 | | | 20 |
| Understand | 20 | 20 | 20 | | 30 | 50 |
| Apply | 20 | 20 | 20 | | 50 | 30 |
| Analyse | - | - | - | | 20 | - |
| Evaluate | - | - | - | | - | - |
| Create | - | - | - | | - | - |

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*Passed in Board of studies Meeting* *Approved in Academic Council Meeting*

| 20BM102 | BIOMEDICAL ENGINEERING PRACTICES LAB<br>(Common to ECE & BME Branches) | L | P | T | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| **Nature of Course** | Engineering Science | | | | |
| **Pre requisites** | NA | | | | |

**Course Objectives**

The course is intended to

1. Provide hands on experience on various Hospital wiring and its Control Circuit
2. Understand patient and electrical safety including calibration
3. Provide a comprehensive Understand of basic electronic components and equipment's
4. Study the basic circuits using Active and Passive Components
5. Understand the fundamental principles of logic gates

**Course Outcomes**

On successful completion of the course, students will be able to

1. Construct basic Hospital electrical wirings for Intensive Care Units [ICU]
2. Test and Measure patient lead leakage including electrical quantities using Patient Safety Analyzers
3. Demonstrate sine, square and triangular waveforms with required frequency and amplitude using function generator
4. Identify the RLC Components and Logic gates
5. Design medical electronic circuits using Electronic Design tools

**CYCLE-1**

| S.No. | Course Content | CO | Bloom's Level |
|---|---|---|---|
| 1 | Hospital Wiring using switches, fuse, indicator, lamp and energy meter with Control Circuits | CO 1 | Understand |
| 2 | Fluorescent lamp wiring | CO 1 | Apply |
| 3 | Stair case wiring | CO 1 | Apply |
| 4 | Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit | CO 2 | Understand |
| 5 | Measurement of energy using single phase energy meter | CO 2 | Understand |
| 6 | Calibration and Testing of Biomedical Equipment's | CO 2 | Apply |

**CYCLE-2**

| S.No. | Course Content | CO | Bloom's Level |
|---|---|---|---|
| 1 | Study of Electronic components and equipments – Resistor - Color coding. Measurement of AC signal parameter (peak-peak Voltage, RMS Voltage, frequency) using CRO | CO 4 | Understand |
| 2 | Study of logic gates AND, OR, EX-OR and NOT | CO 4 | Understand |
| 3 | Generation of Clock Signal | CO 3 | Remembering |
| 4 | Soldering practice – Components Devices and Circuits – Using general purpose PCB | CO 5 | Apply |
| 5 | Measurement of ripple factor of HWR & FWR | CO 3 | Analyzing |
| 6 | Design Bio-amplifier for Noise elimination | CO 5 | Apply |

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| Mapping of Course Outcomes (COs) with Program Outcomes (POs) Program Specific Outcomes (PSO) | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs** | **POs** | | | | | | | | | | | | **PSOs** | | |
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| 1 | 3 | 1 | 1 | | 1 | 1 | | | | | | | 3 | 1 | 1 |
| 2 | 3 | 1 | 1 | | 1 | 1 | | | | | | | 3 | 1 | 1 |
| 3 | 3 | 1 | 1 | | 1 | 1 | | | | | | | 3 | 1 | 1 |
| 4 | 3 | 1 | 1 | | 1 | 1 | | | | | | | 3 | 1 | 1 |
| 5 | 3 | 1 | 1 | | 1 | 1 | | | | | | | 3 | 1 | 1 |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Summative assessment based on Continuous and Final Examination | | |
|---|---|---|
| | | |
| **Bloom's Level** | **Rubric based Continuous Assessment [50 marks]** | **Final Examination [50 marks]** |
| Remember | 10 | 10 |
| Understand | 50 | 50 |
| Apply | 30 | 30 |
| Analyze | 10 | 10 |
| Evaluate | - | - |
| Create | - | - |

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| 20MC101 | Induction Programme (Common to all Branches) | L | T | P | C |
|---|---|---|---|---|---|
| | | 2 | 0 | 0 | 0 |
| **Nature of Course** | Mandatory, Non Credit | | | | |
| **Pre requisites** | Completion of Schooling at Higher Secondary Level | | | | |

**Course Objectives**

The course is intended to

1. To nurture the character and behavior as a student.
2. To have broad Understand of society andrelationships.
3. To impart interpersonal and softskills.
4. To inspire the students in the field ofengineering.
5. To provide exposure toindustries.

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No. | Course Outcome | Bloom's Level |
|---|---|---|
| CO 1 | Perform curricular and co-curricular activities excellently. | Knowledge |
| CO 2 | Do the skill based training with excellence. | Understand |
| CO 3 | Work as team for the given task | Apply |
| CO 4 | Gain character and behaviour | Knowledge |
| CO 5 | Demonstrate the acquired skills effectively | Apply |

**Course Contents**

**PHYSICAL ACTIVITY**

Yoga, Sports

**CREATIVE ARTS (students can select any one of their choice)**

Painting, sculpture, pottery, music, craft making and so on

**UNIVERSAL HUMAN VALUES**

Enhancing soft skills

**LITERARY AND PROFICIENCY MODULES**

Reading, Writing, Speaking- Debate, Role play etc.,

Communication and computer skills

**LECTURES BY EMINENT PEOPLE**

Guest lecture by subject experts

**VISIT TO LOCAL CITIES**

Meditation centers / Industry

**FAMILARIZATION TO DEPARTMENT / BRANCH INNOVATION**

Lectures by Departments Head and senior faculty members

**Total Hours: 45**

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**Mapping of COs with POs and PSOs**

| **Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)** | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs** | **POs** | | | | | | | | | | | | **PSOs** | | |
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| CO1 | | | | | | 2 | 1 | 2 | | | | 3 | 2 | | |
| CO2 | | | | | | 2 | 1 | 2 | | | | 3 | 2 | | |
| CO3 | | | | | | 2 | 1 | 2 | | | | 3 | 2 | | |
| CO4 | | | | | | 2 | 1 | 2 | | | | 3 | 2 | | |
| CO5 | | | | | | 2 | 1 | 2 | | | | 3 | 2 | | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| **Bloom's Level** | **Continuous Assessment (Non-Credit, Mandatory)** | | | | |
|---|---|---|---|---|---|
| | **Test -I [20 ]** | **Test -II [20]** | **Test - III [20]** | **Assignment/ Activity [20]** | **Attendance [20]** |
| Remember | 10 | 10 | 10 | | |
| Understand | 20 | 20 | 20 | 10 | |
| Apply | 20 | 20 | 20 | 10 | |
| Analyse | | | | | |
| Evaluate | | | | | |
| Create | | | | | |

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| 20ENE02 | Advanced Communicative English<br>(Common to all B.E./ B.Tech Programmes) | L | T | P | C |
|---|---|---|---|---|---|
| | | 2 | 0 | 2 | 3 |
| **Nature of Course** | Humanities and Social Sciences | | | | |
| **Pre requisites** | Basics of Communicative English | | | | |

**Course Objectives**

The course is intended to

1. Demonstrate satisfactory control over complex structures and mechanics in English.
2. Develop fluency and accuracy in oral communication.
3. Communicate effectively and actively in social interactions.
4. Read English at inspectional level.
5. Face interviews with confidence.

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No. | Course Outcome | Bloom's Level |
|---|---|---|
| CO1 | Apply knowledge of English grammar for effective communication | Remember |
| CO2 | Make use of common English phrases and vocabulary strength. | Understand |
| CO3 | Build self-confidence and enhance professionalism | Apply |
| CO4 | Implement listening, reading and writing skills in real - life situations | Apply |
| CO5 | Speak fluently in English with proper pronunciation, intonation, tone and accent. | Understand |

**Course Contents**

**Unit – I Grammar and usage** **6**

Active voice and passive voice – Prefixes and suffixes – Connotation – Clauses - If conditionals – Idioms & Phrases - Right forms of verbs – Modal Auxiliaries - Spotting errors.

**Unit - II Lexical competence** **6**

Technical Vocabulary - Expressions – Frequency – Cause and effect - Words often Miss-spelled – Syntax and structure - Homophones and Homonyms- Verbal analogy - Idioms and Phrases.

**Unit - III Conversational etiquette** **6**

Processes description – Tone and accent in speech – Role-play (Job-Interview) – Presentation skills – Mechanics of presentation - Telephone etiquette – Group Discussion strategy - Formal & Informal subjective and objective introduction – Body Language – Mock Interview.

**Unit – IV Listening reading and writing** **6**

Listen to Scientific / Technical talks and gap filling – Listening to TED/INK Talks – Reading – "Water: The Elixir of Life" by Sir. C.V.Raman. "Progress" by St. John Ervine - Instructions and Recommendations – Letter writing formal – Job application- Report writing – Introspective report – Creative writing – Essays and Paragraphs.

**Unit – V Phonetics** **6**

Production and classification of speech sound – International Phonetic Alphabet and transcriptions – Phonological rules – way and Place of articulation – Vowels, consonants and diphthongs. Specific characteristics feature of vowel sounds.

**Total: 30 Periods**

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**Laboratory Components**

| S.No | List of Exercises | CO Mapping | RBT |
|---|---|---|---|
| 1 | Role-play – Processes Description | 2 | Remember |
| 2 | Listening to TED/INK Talks and gap filling | 4 | Understand |
| 3 | Group Discussion | 3 | Understand |
| 4 | Articulation with pronunciation practice | 3 | Apply |
| 5 | Reading – Longer texts and Technical Articles (Skimming & Scanning). | 4 | Apply |
| 6 | Presentation skills – Mechanics of presentation | 5 | Understand |
| 7 | Individual presentation on given topics | 5 | Remember |
| 8 | Telephone etiquette | 5 | Understand |
| 9 | Instructions and Recommendations | 5 | Remember |
| 10 | Writing – General Essays. | 4 | Apply |
| 11 | Report writing technique- write up | 4 | Remember |
| 12 | Introspective report – Personal analysis | 4 | Understand |
| 13 | Model Job Interviews | 3 | Understand |
| 14 | Job Interviews (Role play) | 3 | Apply |
| 15 | Body Language | 3 | Understand |

**Total: 30 Periods**

**Text Books**

1. Rizvi, Ashraf.M, “Effective Technical Communication”, Tata McGraw Hill Publishing Company Limited, New Delhi, 5th Edition, 2007.

2. Hewings. M, “Advanced English Grammar”, 3rd Edition, Cambridge University Press, Chennai, 5th Edition, 2000.

3. Board of Editers, “Using English – A Coursebook for Undergraduate Engineers and Technologists”, Orient BlackSwan Private Limited, Hyderabad, 2nd Edition, 2017.

**Reference Books:**

1. Raman M & Sangeetha Sharma, “Technical Communication”, Oxford University Press, USA, 10th Edition, 2007.
2. John Cunnison Catford, “A Practical Introduction to Phonetics”,Clarendon Press, Jamaica, 2nd Edition, 2001.
3. Norman Whitby, Business Benchmark – “Pre-Intermediate to Intermediate, Students Book”, Cambridge University Press, 1st Edition, 2006.
4. Dhanavel S. P., “English and Soft Skills”, 1st Edition,Orient BlackSwan Private Limited, Hyderabad, 1st Edition, 2010.

**Web reference:**

1. https://www.coursera.org/lecture/tesol-speaking/video-2-listening-strategies-for-learners-3AeBL?utm_source=mobile&utm_medium=page_share&utm_content=vlp&utm_campaign=top_button

**2.** blob:https://www.youtube.com/73f7256d-d302-4563-bed5-9e84c94a26ac

| Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO) | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs** | **Pos** | | | | | | | | | | | | **PSOs** | | |
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| CO1 | | | | | | | | | | 3 | 1 | 2 | 2 | | |
| CO2 | | | | | | | | | | 3 | 1 | 2 | 2 | | |
| CO3 | | | | | | | | | | 3 | 1 | 2 | 2 | | |
| CO4 | | | | | | | | | | 3 | 1 | 2 | 2 | | |
| CO5 | | | | | | | | | | 3 | 1 | 2 | 2 | | |
| | 3 | High | | | | 2 | Medium | | | | 1 | Low | | | |

| **Summative assessment** | | | | | | |
|---|---|---|---|---|---|---|
| **Bloom's Level** | **Continuous Assessment** | | | | | **Final Examination (Theory) [50 marks]** |
| | **Theory Marks** | | | | **Practical** | |
| | **IAE-I [7.5]** | **IAE-II [7.5]** | **IAE -III [10]** | **Attendance [5]** | **Rubric based CIA [20 Marks]** | |
| Remember | 20 | 20 | 20 | | 40 | 40 |
| Understand | 20 | 20 | 20 | | 40 | 40 |
| Apply | 10 | 10 | 10 | | 20 | 20 |
| Analyse | | | | | | |
| Evaluate | | | | | | |
| Create | | | | | | |

CHAIRMAN - BOARD OF STUDIES

II SEMESTER

| 20MA201 | Mathematics - II for Electrical Sciences (Common to ECE and BME) | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 2 | 0 | 4 |
| **Nature of Course** | Basic Sciences | | | | |
| **Pre requisites** | Fundamentals of Basic Mathematics | | | | |

**Course Objectives**

The course is intended to

1. Learn rigorous and analytic approach to analyze the conformal mapping.
2. Study the knowledge of evaluating contour integrals using residue theorem.
3. Explain the concept of Laplace transforms and its applications to various problems related to Engineering.
4. Acquaint the student with Fourier transform techniques used in wide variety of situations
5. Study the knowledge of specific mathematical tools and techniques such as Z-transforms and solutions of difference equations

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No. | Course Outcome | Bloom's Level |
|---|---|---|
| CO1 | Compute an analytic function ,when its real or imaginary part is known | Understand |
| CO2 | Identify the Singularities and its corresponding Residues for the given function | Apply |
| CO3 | Compare Laplace transform, Inverse Laplace transform and solve the linear differential equations by Laplace transform techniques. | Apply |
| CO4 | Solve Engineering problems using Fourier transform techniques | Apply |
| CO5 | Solve difference equations using Z-transforms that arise in discrete time systems | Apply |

**Course Content**

**Unit - I Complex Differentiation and Conformal Mapping 12**

Functions of a complex variable – Analytic functions – Statement of Cauchy – Riemann equation – Harmonic functions – Harmonic conjugate – Construction of analytic functions – Conformal mapping : w=z +c, cz, 1/z and Bilinear transformation.

**Unit - II Complex Integration and Calculus of Residues 12**

Cauchy's Integral theorem (statement only) – Cauchy's integral formula – Liouville's theorem - Maximum Modulus Principle - Taylor's series and Laurent's series – Classification of singularities – Cauchy's residue theorem – Contour integration.

**Unit - III Laplace Transforms 12**

Laplace transforms – Transform of elementary functions – Properties – Transform of periodic functions. Definition of Inverse Laplace transforms – Statement and applications of Convolution theorem – Initial and Final theorems – Solution of linear ODE of second order with constant coefficient by Laplace transforms.

**Unit - IV Fourier Transforms 12**

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity - Application to boundary value problems.

**Unit - V Z - Transforms 12**

Z-Transform, Elementary Properties, Inverse Z-Transform, Convolution Method- Partial fraction method, Solution of Difference Equations using Z-Transform.

**Total: 60 Periods**

**Text Books:**

1. Grewal B.S, "Higher Engineering Mathematics", Khanna Publishers, 44th Edition 2016.
2. Veerarajan T, "Engineering Mathematics for Semester I and II", Tata McGraw Hill, 3rd Edition, 2014.

**Reference Books:**

1. Bali N.P and Dr. Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications(P)Ltd, 8th Edition, 2015.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons(Asia) Limited, 10th Edition, 2018.

**Web References:**

1. nptel.ac.in/courses/111/105/111105134
2. nptel.ac.in/courses/111/102/111102129

| **Mapping of Course Outcomes (COs) with Program Outcomes (POs) Program Specific Outcomes (PSOs)** | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **POs** | | | | | | | | | | | | **PSOs** | | |
| **COs** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| CO1 | 3 | 2 | 1 | | | | | | | | | | 2 | | |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 2 | | |
| CO3 | 2 | 3 | 2 | | | | | | | | | | 3 | | |
| CO4 | 3 | 3 | 3 | | | | | | | | | | 2 | | |
| CO5 | 3 | 2 | 3 | | | | | | | | | | 2 | | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| **Formative assessment** | | | |
|---|---|---|---|
| **Bloom's Level** | **Assessment Component** | **Marks** | **Total marks** |
| Remember | Online Quiz | 5 | 15 |
| Understand | Tutorial Class / Assignment | 5 | |
| | Attendance | 5 | |

| **Summative Assessment** | | | | |
|---|---|---|---|---|
| **Bloom's Category** | **Continuous Assessment Tests** | | | **Final Examination** |
| | **IAE-1 (7.5)** | **IAE-2 (7.5)** | **IAE-3 (10)** | **(60)** |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 10 | 10 | 10 | 20 |
| Apply | 30 | 30 | 30 | 60 |
| Analyze | | | | |
| Evaluate | | | | |
| Create | | | | |

CHAIRMAN - BOARD OF STUDIES

*Passed in Board of studies Meeting* *Approved in Academic Council Meeting*

| 20BM201 | BIOCHEMISTRY | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| **Nature of Course** | Engineering Sciences | | | | |
| **Pre requisites** | NIL | | | | |

**Course Objectives:**

The course is intended to

1. To learn the fundamentals of bio chemical reactions and bio molecules.
2. To study structural and functional properties of carbohydrates.
3. To Understand of the core principles and structure of proteins, lipids and nucleic acids.
4. To emphasize the role of biomolecules by providing basic information on specific metabolic diseases and disorders of biomolecules.
5. Acquire knowledge and understand of metabolic functions and synthesis.

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No. | Course Outcome | Bloom's Level |
|---|---|---|
| CO1 | Explain the Chemical bonds and its application | Understand |
| CO2 | Classify the Metabolic activity of Carbohydrates | Understand |
| CO3 | Understand the basics of Protein Metabolism | Understand |
| CO4 | Compare fatty acid metabolism and nucleic acid metabolism | Understand |
| CO5 | Classify the bio energetic and high energy compounds | Understand |

**Course Contents:**

**UNIT I Introduction to Biochemistry** **9**

Introduction of organic chemistry-Chemical Bonds–role of carbon–type of functional group-chemical nature of water-pH-Buffers–Biological Buffer-Carbohydrates-Lipids–Proteins–transamination–deamination–decarboxylation.

**UNIT II Metabolism of Carbohydrates** **9**

Introduction to Metabolism-Glycolysis–Citricacid cycle–Gluconeogenesis-Glycogen metabolism–Glycogenesis–Glycogenolysis-Biochemical aspects of Diabetes Mellitus.

**UNIT III Protein Metabolism** **9**

Introduction-Metabolism of amino acids-Transamination-Deamination-Metabolism of ammonia-Ureacycle-Biosynthesis of amino acids-Disorders of tyrosine (phenylalanine) metabolism

**UNIT IV Fatty Acid Metabolism and Nucleic Acid Metabolism** **9**

Introduction-Fatty acid oxidation-Ketone bodies & Ketogenesis-Biosynthesis of Fatty acids-Eicosanoids–Cholesterol Biosynthesis–Lipoproteins–Disorders of Lipid metabolism-Nucleic acids Biosynthesis of Purine and Pyrimidines-Degradation of purine nucleotides and pyrimidine Nucleotides-Disorders of Purine and pyrimidine metabolism.

**UNIT V Oxidative Phosphorylation** **9**

Introduction-Bioenergetics, High energy compounds, Biological oxidation Electron transport chain, Oxidative phospholyration, Chemiosmotic theory–Shuttle pathway Glycerol phosphate Shuttle, Malate aspartate Shuttle – Shunt pathways.

**TOTAL PERIODS:45**

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**TEXT BOOK**

1. JL Jain,Nitin,Sunjay Jain.,"*Fundamentals of Biochemistry*",S.Chand Group, 7th edition, 2016.
2. U.Satyanarayana. and U.Chakrapani.,"*Biochemistry",* Books And Allied(p)Ltd.,5th edition, 2019

**REFERENCES**

1. DavidL.Nelson, Albert Lester Lehninger, Michae lM.Cox.,"Lehninger principles of Biochemistry", 5th Edition,llustrated,W.H.Freeman,2008.
2. Jeremy M.Berg, JohnL. Tymoczko, Lubert Stryer.,"*Biochemistry*",W.H.Freeman,7thEdition,2012.

**Web References:**

1.https://nptel.ac.in/content/storage2/courses/126104004/LectureNotes/Week-1_06 Carbohydrate.pdf
2.https://nptel.ac.in/content/storage2/courses/104103071/pdf/mod10.pdf

| **Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)** | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs** | **Pos** | | | | | | | | | | | | **PSOs** | | |
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | |
| CO1 | 3 | 1 | 1 | | | 2 | 2 | | 1 | 2 | | | 1 | 1 | |
| CO2 | 3 | 1 | 1 | | | 2 | 2 | | 1 | 2 | | | 1 | 1 | |
| CO3 | 3 | 1 | 1 | | | 2 | 2 | | 1 | 2 | | | 1 | 1 | |
| CO4 | 3 | 1 | 1 | | | 2 | 2 | | 1 | 2 | | | 1 | 1 | |
| CO5 | 3 | 1 | 1 | | | 2 | 2 | | 1 | 2 | | | 1 | 1 | |
| | 3 | High | | | | 2 | Medium | | | | 1 | Low | | | |

| **Formative assessment** | | | |
|---|---|---|---|
| **Bloom's Level** | **Assessment Component** | **Marks** | **Total marks** |
| Remember | Online Quiz | 5 | 15 |
| Understand | Tutorial Class / Assignment | 5 | |
| | Attendance | 5 | |

| **Summative Assessment** | | | | |
|---|---|---|---|---|
| **Bloom's Category** | **Continuous Assessment** | | | **Final Examination (Theory) (60)** |
| | **IAE-1 (7.5)** | **IAE-2 (7.5)** | **IAE-3 (10)** | |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 10 | 10 | 10 | 20 |
| Apply | 30 | 30 | 30 | 60 |
| Analyse | | | | |
| Evaluate | | | | |
| Create | | | | |

CHAIRMAN - BOARD OF STUDIES

*Passed in Board of studies Meeting* *Approved in Academic Council Meeting*

| 20CH202 | CHEMISTRY FOR ELECTRICAL SCIENCES (Common to ECE and BME) | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 4 |
| **Nature of Course** | Basic Sciences | | | | |
| **Prerequisites** | Nil | | | | |

**Course Objectives:**

The course is intended to

1. Impart knowledge and Understand about the constituents present in water and the need for purification of water.
2. Understand the fundamentals of batteries.
3. Provide knowledge about materials like metals, refractories and cement.
4. Develop the Understand and applications of basic concepts of electrochemistry.
5. Understand the causes and control measures of corrosion.

**Course Outcomes**

On successful completion of the course, students will be able to

| CO.No | Course Outcome | Bloom's Level |
|---|---|---|
| CO1 | Develop innovative and eco-friendly method for water purification to meet the growing industrial demand | Apply |
| CO2 | Understand the basic principles and mechanism of working of batteries and fuel cells | Understand |
| CO3 | Deliberate about various types of alloys and engineering materials | Understand |
| CO4 | Use the principles of electro chemical cells, EMF, electroplating and electrolysis | Apply |
| CO5 | Demonstrate the importance of protection of metals from corrosion | Apply |

**Course Contents**

**Unit-I Water Analysis and Water Treatment** **9**

Water analysis: Sources of water, Hard water and soft water, Hardness of water, acidity, alkalinity, pH value, amount of free CO2, fluoride content and chloride content. Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD). Water treatment: Definition, Zeolite process, Conditioning methods: internal conditioning (Phosphate, Calgon) and external conditioning (Demineralization), Desalination, Reverseosmosis (RO).

**Unit-II Energy Storage Devices** **9**

Batteries: Definition, characteristics and classification, Primary battery: Alkaline battery, Secondary battery: lead acid battery, nickel cadmium battery, lithium battery and lithium-ion battery, Fuel cells: construction and working of phosphoric acid fuel cell.

**Unit-III Alloys and Engineering Materials** **9**

Alloys: classification and types, Ferrous alloys (Nichrome and stainless steel only), non-ferrous alloys (brass and bronze), Heat treatment of steel, Refractories: characteristics, classification – manufacture, Cement: manufacture and setting.

**Unit-IV Electrochemistry** **9**

Electrode potential, Nernst equation and problems, Reference electrodes, Standard hydrogen electrode, Calomel electrode, Ion selective electrode (glass electrode), Determination of pH by glass electrode, Electro chemical series, Electrochemical cell, Galvanic cell: measurement of EMF, Electrolytic cell.

**Unit-V Corrosion and its Control** **9**

Corrosion: Classification, Types: Chemical corrosion and electrochemical corrosion, mechanism. Corrosion control: Corrosion inhibitors, cathodic protection (sacrificial anodic protection, impressed current cathodic protection), Protective coating and Paint. Electroplating (Au).

**TOTALPERIODS:45**

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**Laboratory Component**

| S.No | Name of the Experiment | CO Mapping | RBT |
|---|---|---|---|
| 1 | Determination of hardness of water | CO1 | Apply |
| 2 | Determination of chloride content in water sample | CO1 | Apply |
| 3 | Conductometric titration of strong acid versus strong base | CO2 | Understand |
| 4 | Determination of strength of HCl by pH metry | CO2 | Understand |
| 5 | Estimation of copper in brass by EDTA method | CO3 | Apply |
| 6 | Determination of CaO in cement | CO3 | Apply |
| 7 | Estimation of strength of iron by potentiometric titration | CO4 | Apply |
| 8 | Determination alkalinity of water sample and making a comparative study of corrosion rate | CO5 | Apply |

**Text Books**

1. O.G.Palanna, “Engineering Chemistry” Tata McGraw-Hill Pub.Co.Ltd,1st Edition, New Delhi,2017.
2. P.C.Jain and Monicka Jain, “Engineering Chemistry”,Dhanapat Rai Publishing Company Pvt. Ltd, 2nd Edition,2017.

**Reference Books**

1. B.Sivasankar“EngineeringChemistry”TataMcGraw-HillPub.Co.Ltd,2nd Edition, New Delhi 2009.
2. R.Sivakumar and N.Sivakumar,“Engineering Chemistry”Tata McGraw-Hill Pub.Co.Ltd, New Delhi, 1st Edition, 2009.
3. Dr.Sivanesan and Nandagopal, “Engineering Chemistry-I” V.K.Pub.Pvt.Ltd,2nd Edition, 2011.

**Additional Resources**

1. https://nptel.ac.in/downloads/122101001
2. https://nptel.ac.in/courses/103103033/module9/lecture1.pdf
3. https://nptel.ac.in/courses/102103044/3
4. https://www.sciencedirect.com/topics/chemistry/phosphoric-acid-fuel-cells

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| Mapping of Course Outcomes (CO) with Programme Outcomes (PO) and Programme Specific Outcomes (PSO) | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs** | **POs** | | | | | | | | | | | | **PSOs** | | |
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| CO1 | 3 | 2 | | | | | | | | | 1 | | | | |
| CO2 | 3 | 2 | | | | | | | | | 1 | | | | |
| CO3 | 3 | 2 | | | | | | | | | 1 | | | | |
| CO4 | 3 | 2 | | | | | | | | | 1 | | | | |
| CO5 | 3 | 1 | | | | | | | | | 1 | | | | |
| | 3 | High | | | | 2 | Medium | | | | 1 | Low | | | |

| Summative Assessment | | | | | | |
|---|---|---|---|---|---|---|
| | **Continuous Assessment** | | | | | **Final [60]** |
| | **Theory** | | | | | |
| | **IAE-I [7.5]** | **IAE-II [7.5]** | **IAE-III[10]** | **Attendance [5]** | **Rubric based CIA [40]** | |
| Remember | 30 | 20 | 10 | | 10 | 20 |
| Understand | 10 | 20 | 30 | | 20 | 20 |
| Apply | 10 | 10 | 10 | | 10 | 20 |
| Analyze | | | | | | |
| Evaluate | | | | | | |
| Create | | | | | | |

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*Passed in Board of studies Meeting*

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| 20ME203 | Engineering Graphics | L | T | P | C |
|---|---|---|---|---|---|
| | | 1 | 0 | 4 | 3 |
| **Nature of Course** | Engineering Sciences | | | | |
| **Pre requisites** | Nil | | | | |

**Course Objectives:**

The course is intended to

1. Understand technical drawings in various fields of engineering
2. Imagine and visualize the geometric details of engineering objects.
3. Translate the geometric information of engineering objects into engineering drawings.
4. Develop the graphical skills for communication of concepts, ideas and design of engineering products through technical drawings.
5. Visualize and draw isometric and perspective views

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No. | Course Outcome | Bloom's Level |
|---|---|---|
| CO 1 | Develop the conic sections, special curves, and draw orthographic views from pictorial views. | Apply |
| CO 2 | Affront the principles of orthographic projections of points in all quadrants, lines and planes in first quadrant. | Apply |
| CO 3 | Construct the projections of simple solids like prisms, pyramids, cylinder and cone. | Apply |
| CO 4 | Build the sectional views of solids like cube, prisms, pyramids, cylinders & cones and development of its lateral surfaces. | Apply |
| CO 5 | Organize and draw isometric and perspective sections of simple solids. | Apply |

**Course Contents**

**Concepts and Conventions (Not for Examination)** **1**

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

**UNIT -I Plane Curves and Free Hand Sketching (15)**

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves.

Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three-Dimensional objects – Layout of views- Free hand sketching of multiple views from pictorial views of objects

**UNIT –II Projection of Points, Lines and Plane Surfaces (15)**

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

**UNIT –III Projection of Solids (15)**

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one of the principal planes by rotating object method.

**UNIT- IV Projection of Sectioned Solids and Development of Surface (15)**

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

**UNIT -V Isometric and Perspective Projections (15)**

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

**TOTAL: (75) Periods**

**TEXT BOOKS**

1. Venugopal K. and Prabhu Raja V., “Engineering Graphics”, New Age International (P) Limited, 2011
2. Natarajan K.V., “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2012.

**REFERENCE BOOKS**

1. Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 50th Edition, 2010.
2. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
3. Parthasarathy N S and Vela Murali, “Engineering Graphics”, Oxford University, Press, New Delhi, 2015.

**Web References**

1. http://nptel.ac.in/courses/112103019/Engineering drawing
2. http://pioneer.netserv.chula.ac.th/~kjirapon/self-practice.html

**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 only to Final Examinations of Engineering Graphics:**

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

CHAIRMAN - BOARD OF STUDIES

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs** | **POs** | | | | | | | | | | | | **PSOs** | | |
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| CO1 | 3 | 2 | | | | | | | | | | 1 | 2 | | |
| CO2 | 3 | 2 | | | | | | | | | | 1 | 2 | | |
| CO3 | 3 | 2 | | | | | | | | | | 1 | 2 | | |
| CO4 | 3 | 3 | | | | | | | | | | 1 | 2 | | |
| CO5 | 3 | 2 | | | | | | | | | | 1 | 2 | | |
| | 3 | High | | | | 2 | Medium | | | | 1 | Low | | | |

| Summative assessment | | | | | | |
|---|---|---|---|---|---|---|
| **Bloom's Level** | **Continuous Assessment** | | | | | **Final Examination (Theory) [50 marks]** |
| | **Theory** | | | | **Practical** | |
| | **IAE-I [7.5 ]** | **IAE-II [7.5 ]** | **IAE-III [10]** | **Attendance [5]** | **Rubric based CIA [50 Marks]** | |
| Remember | 10 | 10 | 10 | | 20 | 20 |
| Understand | 20 | 20 | 20 | | 40 | 40 |
| Apply | 20 | 20 | 20 | | 40 | 40 |
| Analyse | | | | | | |
| Evaluate | | | | | | |
| Create | | | | | | |

CHAIRMAN - BOARD OF STUDIES

| 20BM202 | BIOCHEMISTRY LABORATORY | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 4 | 2 |
| **Nature of Course** | Engineering Sciences | | | | |
| **Pre requisites** | NIL | | | | |

**Course Objectives**

The course is intended to

1. Estimation and Quantification of bio molecules
2. Separation of macromolecules
3. Estimation and interpretation of biochemical parameter.

**Course Outcomes**

On successful completion of the course, students will be able to

| CO.No. | Course Outcome | Bloom's Level |
|---|---|---|
| CO 1 | Get knowledge on the PH and buffer solution preparation. | Understand |
| CO 2 | Have adequate knowledge on qualitative analysis of bio molecules. | Analysis |
| CO 3 | Gain knowledge on the estimation of biomolecules. | Analysis |
| CO 4 | Acquire knowledge on collections of blood . | Understand |
| CO 5 | Get sufficient knowledge on the concept of SDS electrophoresis. | Understand |

**CYCLE-1**

| S.No. | Course Content | Bloom's Level |
|---|---|---|
| 1 | Standardization of pH meter, preparation of buffers, emulsions | Understand |
| 2 | General tests for carbohydrates, proteins and lipids. | Understand |
| 3 | Identification of Blood Collection Tubes and Phlebotomy equipment's | Analysis |
| 4 | Preparation of serum and plasma from blood. | Analysis |
| 5 | Estimation of blood glucose-Benedict's method | Analysis |
| 6 | Estimation of Hemoglobin | Understand |

**CYCLE-2**

| S.No. | Course Content | Bloom's Level |
|---|---|---|
| 1 | Estimation of creatinine. | Understand |
| 2 | Estimation of urea | Analysis |
| 3 | Estimation of Uric acid | Analysis |
| 4 | Estimation of cholesterol | Analysis |
| 5 | Assay of SGOT/SGPT. | Analysis |
| 6 | Separation of proteins by SDS electrophoresis (Demo) | Analysis |

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| **Mapping of Course Outcomes (CO) with Program Outcomes (PO) Program Specific Outcomes (PSO)** | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs** | **POs** | | | | | | | | | | | | **PSOs** | | |
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| 1 | | | | 2 | 2 | 2 | 2 | 2 | 2 | | | 2 | 3 | 1 | |
| 2 | | | | 2 | 2 | 2 | 2 | 2 | 2 | | | 2 | 3 | 1 | |
| 3 | | | | 2 | 2 | 2 | 2 | 2 | 2 | | | 2 | 3 | 1 | |
| 4 | | | | 2 | 2 | 2 | 2 | 2 | 2 | | | 2 | 2 | 1 | |
| 5 | | | | 2 | 2 | 2 | 2 | 2 | 2 | | | 2 | 2 | 1 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| **Summative assessment based on Continuous and End Semester Examination** | | |
|---|---|---|
| | | |
| **Bloom's Level** | **Rubric based Continuous Assessment [50 marks]** | **Finalr Examination [50 marks]** |
| Remember | - | - |
| Understand | 20 | 20 |
| Apply | - | - |
| Analyze | 30 | 30 |
| Evaluate | - | - |
| Create | - | - |

CHAIRMAN - BOARD OF STUDIES

| 20MC202 | INTERPERSONAL SKILLS | L | T | P | C |
|---|---|---|---|---|---|
| | | 2 | 0 | 2 | 0 |
| **Nature of Course** | Mandatory, Non-Credit | | | | |
| **Pre requisites** | Nil | | | | |

**Course Objectives**

The course is intended to

1. Use interpersonal communication skills to influence and build good relationships.
2. Identify and pursue personal learning goals.
3. Obtain feedback skills in service of evolving learning goals.
4. Learn about group dynamics, behaviors and feelings
5. Enhance the communication process in both formal and informal contexts

**Course Outcomes**

On successful completion of the course, students will be able to

| CO.No | Course Outcome | Bloom's Level |
|---|---|---|
| CO1 | Practice interpersonal communication skills to influence and build good relationships | Understand |
| CO2 | Identify and pursue personal learning goals. | Understand |
| CO3 | Give evident feedback | Understand |
| CO4 | Reveal group dynamics and amiable behavior | Understand |
| CO5 | Emphasis the communication process | Understand |

**Course Contents:**

**Unit I: Fundamentals of Interpersonal Communication** **6**

Facts of communication and Interpersonal communication – culture and gender – Communication and Self disclosure – Presentation of Interpersonal perception - Learning goals – Feeling and feedback.

**Unit II: Interpersonal communication in action** **6**

Nature of language – language and culture – usage and abuse of language –Positive communication -Non verbal communication - Listening strategies – Barriers of listening.

**Unit III: Emotional Intelligence** **6**

Influence of emotional experience and expressions – Accepting the responsibilities and changes - Negotiation tactics - Dealing with criticism and appreciation - Collaborative Problem Solving - Resilience Building.

**Unit IV: Transactions** **6**

Different types of transactions - Building Positive Relationship - Managing Conflict – Connecting across Difference – Factors hampering Interpersonal interactions – Assertiveness in communication.

**Unit V: Essential Interpersonal Competencies** **6**

Behaviour – Understand limiting behaviour - Interpersonal and small group behavior – Critical and lateral thinking- Win – Win attitude – Positive thinking – Stress management – Assertive feedback - Personal Evaluation of Interpersonal Relationship Skills

**Total 30 Periods**

CHAIRMAN - BOARD OF STUDIES

**Activity Component**

| S.No | Name of the Exercises | CO Mapping | RBT |
|---|---|---|---|
| 1 | Self-Introduction | 1 | Remember |
| 2 | Presentation of Individual perception | 2 | Understand |
| 3 | Role play - Non-verbal communication - Body language | 4 | Apply |
| 4 | Role play - Interpersonal interactions & Assertive feedback | 3 | Remember |
| 5 | Group Discussion | 4 | Apply |
| 6 | Role play - Situational conversation ( On spot ) | 5 | Understand |

**Text Books**

1. Bozeman, Jeanine C and Argile Smith, “Interpersonal Relationship Skills for Ministers” Gretna, LA: Pelican Publishing Company, 1st Edition, 2004.
2. Floyd, Kory, “Interpersonal Communication”, 2d. Boston: McGraw-Hill, 2nd Edition, 2011.

**Reference Books:**

1. Augsburger, David, “Caring Enough to Confront How to Understand and Express Your Deepest Feelings Towards Others”, updated ed. Ventura, CA: Regal Books, 2nd Edition 2009.
2. Vohs, Kathleen D., and Eli J., Finkel, eds, “Self and Relationships: Connecting Intrapersonal and Interpersonal Processes”, New York: Guilford Press, 1st Edition, 2006.

| Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO) | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs** | **Pos** | | | | | | | | | | | | **PSOs** | | |
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| CO1 | | | | | | | | | | 3 | 2 | 1 | 2 | | |
| CO2 | | | | | | | | | | 3 | 2 | 1 | 2 | | |
| CO3 | | | | | | | | | | 3 | 2 | 1 | 2 | | |
| CO4 | | | | | | | | | | 3 | 2 | 1 | 2 | | |
| CO5 | | | | | | | | | | 3 | 2 | 1 | 2 | | |
| | 3 | High | | | | 2 | Medium | | | | 1 | Low | | | |

| Bloom’s Level | Summative Assessment (Internal Mode) | |
|---|---|---|
| | **Assessment 1 (50 Marks)** | **Assessment 2 (50 Marks)** |
| Remember | 20 | 20 |
| Understand | 10 | 10 |
| Apply | 20 | 20 |
| Analyze | | |
| Evaluate | | |
| Create | | |

CHAIRMAN - BOARD OF STUDIES

| 20ENE02 | Advanced Communicative English<br>(Common to all B.E./ B.Tech Programmes) | L | T | P | C |
|---|---|---|---|---|---|
| | | 2 | 0 | 2 | 3 |
| **Nature of Course** | Humanities and Social Sciences | | | | |
| **Pre requisites** | Basics of Communicative English | | | | |

**Course Objectives**

The course is intended to

1. Demonstrate satisfactory control over complex structures and mechanics in English.
2. Develop fluency and accuracy in oral communication.
3. Communicate effectively and actively in social interactions.
4. Read English at inspectional level.
5. Face interviews with confidence.

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No. | Course Outcome | Bloom's Level |
|---|---|---|
| CO1 | Apply knowledge of English grammar for effective communication | Remember |
| CO2 | Make use of common English phrases and vocabulary strength. | Understand |
| CO3 | Build self-confidence and enhance professionalism | Apply |
| CO4 | Implement listening, reading and writing skills in real - life situations | Apply |
| CO5 | Speak fluently in English with proper pronunciation, intonation, tone and accent. | Understand |

**Course Contents**

**Unit – I Grammar and usage** **6**

Active voice and passive voice – Prefixes and suffixes – Connotation – Clauses - If conditionals – Idioms & Phrases - Right forms of verbs – Modal Auxiliaries - Spotting errors.

**Unit - II Lexical competence** **6**

Technical Vocabulary - Expressions – Frequency – Cause and effect - Words often Miss-spelled – Syntax and structure - Homophones and Homonyms- Verbal analogy - Idioms and Phrases.

**Unit - III Conversational etiquette** **6**

Processes description – Tone and accent in speech – Role-play (Job-Interview) – Presentation skills – Mechanics of presentation - Telephone etiquette – Group Discussion strategy - Formal & Informal subjective and objective introduction – Body Language – Mock Interview.

**Unit – IV Listening reading and writing** **6**

Listen to Scientific / Technical talks and gap filling – Listening to TED/INK Talks – Reading – “Water: The Elixir of Life” by Sir. C.V.Raman. “Progress” by St. John Ervine - Instructions and Recommendations – Letter writing formal – Job application- Report writing – Introspective report – Creative writing – Essays and Paragraphs.

**Unit – V Phonetics** **6**

Production and classification of speech sound – International Phonetic Alphabet and transcriptions – Phonological rules – way and Place of articulation – Vowels, consonants and diphthongs. Specific characteristics feature of vowel sounds.

**Total: 30 Periods**

CHAIRMAN - BOARD OF STUDIES

**Laboratory Components**

| S.No | List of Exercises | CO Mapping | RBT |
|---|---|---|---|
| 1 | Role-play – Processes Description | 2 | Remember |
| 2 | Listening to TED/INK Talks and gap filling | 4 | Understand |
| 3 | Group Discussion | 3 | Understand |
| 4 | Articulation with pronunciation practice | 3 | Apply |
| 5 | Reading – Longer texts and Technical Articles (Skimming & Scanning). | 4 | Apply |
| 6 | Presentation skills – Mechanics of presentation | 5 | Understand |
| 7 | Individual presentation on given topics | 5 | Remember |
| 8 | Telephone etiquette | 5 | Understand |
| 9 | Instructions and Recommendations | 5 | Remember |
| 10 | Writing – General Essays. | 4 | Apply |
| 11 | Report writing technique- write up | 4 | Remember |
| 12 | Introspective report – Personal analysis | 4 | Understand |
| 13 | Model Job Interviews | 3 | Understand |
| 14 | Job Interviews(Role play) | 3 | Apply |
| 15 | Body Language | 3 | Understand |

**Total: 30 Periods**

**Text Books**

1. Rizvi, Ashraf.M, “Effective Technical Communication”, Tata McGraw Hill Publishing Company Limited, New Delhi, 5th Edition, 2007.

2. Hewings. M, “Advanced English Grammar”, 3rd Edition, Cambridge University Press, Chennai, 5th Edition, 2000.

3. Board of Editers, “Using English – A Coursebook for Undergraduate Engineers and Technologists”, Orient BlackSwan Private Limited, Hyderabad, 2nd Edition, 2017.

**Reference Books:**

1. Raman M & Sangeetha Sharma, “Technical Communication”, Oxford University Press, USA, 10th Edition, 2007.
2. John Cunnison Catford, “A Practical Introduction to Phonetics”,Clarendon Press, Jamaica, 2nd Edition, 2001.
3. Norman Whitby, Business Benchmark – “Pre-Intermediate to Intermediate, Students Book”, Cambridge University Press, 1st Edition, 2006.
4. Dhanavel S. P., “English and Soft Skills”, 1st Edition,Orient BlackSwan Private Limited, Hyderabad, 1st Edition, 2010.

**Web reference:**

1. https://www.coursera.org/lecture/tesol-speaking/video-2-listening-strategies-for-learners-3AeBL?utm_source=mobile&utm_medium=page_share&utm_content=vlp&utm_campaign=top_button

**2.** blob:https://www.youtube.com/73f7256d-d302-4563-bed5-9e84c94a26ac

| **Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)** | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs** | **Pos** | | | | | | | | | | | | **PSOs** | | |
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| CO1 | | | | | | | | | | 3 | 1 | 2 | 2 | | |
| CO2 | | | | | | | | | | 3 | 1 | 2 | 2 | | |
| CO3 | | | | | | | | | | 3 | 1 | 2 | 2 | | |
| CO4 | | | | | | | | | | 3 | 1 | 2 | 2 | | |
| CO5 | | | | | | | | | | 3 | 1 | 2 | 2 | | |
| | 3 | High | | | | 2 | Medium | | | | 1 | Low | | | |

| **Summative assessment** | | | | | | |
|---|---|---|---|---|---|---|
| **Bloom's Level** | **Continuous Assessment** | | | | | **Final Examination (Theory) [50 marks]** |
| | **Theory Marks** | | | | **Practical** | |
| | **IAE-I [7.5]** | **IAE-II [7.5]** | **IAE -III [10]** | **Attendance [5]** | **Rubric based CIA [50 Marks]** | |
| Remember | 20 | 20 | 20 | | 40 | 40 |
| Understand | 20 | 20 | 20 | | 40 | 40 |
| Apply | 10 | 10 | 10 | | 20 | 20 |
| Analyse | | | | | | |
| Evaluate | | | | | | |
| Create | | | | | | |

CHAIRMAN - BOARD OF STUDIES

*Passed in Board of studies Meeting* *Approved in Academic Council Meeting*

| 20ENE03 | HINDI | L | T | P | C |
|---|---|---|---|---|---|
| | | 2 | 0 | 2 | 3 |
| **Nature of Course** | Humanities and Social Sciences | | | | |
| **Pre requisites** | Basic Perceptive of Language | | | | |

**Course Objectives**

The course is intended for learners.

1. To help students acquire the basics of Hindi
2. To teach them how to converse in Hindi on simple day-to-day situations
3. To help students acquire the ability to understand a simple technical text in Hindi

**Course Outcomes**

On successful completion of the course, students will be able to

| CO.No. | Course Outcome | Bloom's Level |
|---|---|---|
| CO.1 | Construct simple sentences and use vocabulary required for day-to-day conversation | Remember |
| CO.2 | Distinguish and understand the basic sounds of Hindi language. | Remember |
| CO.3 | Appear for Hindi examinations conducted by Dakshin Bharat Hindi Prachar Sabha. | Remember |

**Course Contents**:

**UNIT I: Introduction** 6

Hindi Alphabet: Introduction - Vowels - Consonants - Plosives - Fricatives - Nasal sounds - Owel Signs- Chandra Bindu & Visarg -Table of Alphabet -Vocabulary.

**UNIT II: Reading** 6

Nouns: Genders (Masculine & Feminine Nouns long vowels and short vowels - -Masculine & Feminine - Reading Exercises

**UNIT III: Grammar** 6

Pronouns and Tenses: Categories of Pronouns - Personal Pronouns - Second person you & honorific) - Definite & Indefinite pronouns - Relative pronouns - Present tense - Past tense - Future tense - Assertive & Negative Sentences – Interrogative Sentences.

**UNITI V**: **Vocabulary** 6

Classified Vocabulary: Parts of body - Relatives - Spices - Eatables - Fruit & Vegetables - Clothes - Directions - Seasons - Professions

**UNIT V: Speaking** 6

Speaking: Model Sentences and Rhymes - Speaking practice for various occasions.

**Total: 30 Periods**

Reference:

1. Hindi Prachar Vahini-1 by Dakshin Bharat Hindi Prachar Sabha Chennai
2. B.R.Kishore, Self-Hindi Teacher for Non-Hindi Speaking People, VeeKumar Publications(P)Ltd., NewDelhi,2009
3. Videos, Stories, Rhymes and Songs.

CHAIRMAN - BOARD OF STUDIES

*Passed in Board of studies Meeting* *Approved in Academic Council Meeting*

| 20ENE04 | FRENCH | L | T | P | C |
|---|---|---|---|---|---|
| | | 2 | 0 | 2 | 0 |
| **Nature of Course** | Humanities and Social Sciences | | | | |
| **Pre requisites** | Basic Perceptive of Language | | | | |

**Course Objectives**

The course is intended for learners.

1. To prepare the students for DELFA1Examination
2. To teach them to converse fluently in French in day-to-day scenarios

**Course Outcomes**

On successful completion of the course, students will be able to

| CO.No. | Course Outcome | Bloom's Level |
|---|---|---|
| CO1 | To help students acquire familiarity in the French alphabet &basic vocabulary | Remember |
| CO2 | listen and identify individual sounds of French | Remember |
| CO3 | Use basic sounds and words whiles peaking | Remember |
| CO4 | Read and understand short passages on familiar topics | Understand |
| CO5 | Understand and use basic grammar and appropriate vocabulary in completing language tasks | Understand |

**Course Contents:**

**UNIT I : Entrer En Contact** **6**

La langue francaise, alphabets, les numeros, les jours, les mois. Grammaire Les verbes s''appeler,etre, avoir, les articles definis, indefinis Communication - Saluer, s''informer sur quelquun, demander de se presenter Lexique - Les alphabets, les nationalites, age, les pays, les couleurs, les jours de la semaine, les mois de l''annee, les professions

**UNIT II :Partager Son Lieu De Vie** **6**

Lesfrancaisetleur habitat, des habitation s in solitesGrammaire- Verbes - Conjugaison : Present (Avoir / etre / ER, IR, RE : RegulieretIrregulier) –AdjectifsIdelieuCommunication - Chercher un logement, d''ecrire son voisin, s''informersur un logementLexique - L''habitat, les pieces, l''equipement, la descriptionphysiqu

**UNIT III: Vivre Au Quotidien** **6**

Grammaire - Articles contractes, verbesvouloir, pouvoir, devoir, adjective interrogative, future proche Communication- Exprimersesgouts, parler de sesloisirs, justifier un choix, exprimeruneenvieLexique - le temps libreet les loisirs, les saisons, les activitesquotidiennes, le temps (lematin, le soir, lanuit)

**UNIT IV: Comprendre Son EnvironnementOuvrir La Culture** **6**

Grammaire - Verbes- Finir, Sortir, les adjectifsdemonstratifs, le passe compose, l''imparfait Communication - Propose aÃƒ?Ã‚quelqu''''un de faire quelque chose, raconteur une sortie au passeparlerunfilmLexique - Les sorties, la famille, art, les vetementsetlesaccessoires

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*Passed in Board of studies Meeting* *Approved in Academic Council Meeting*

**UNIT V: Gouter ALa Campagne** **6**

Grammaire La forme negative, les verbesacheter, manger, payer, articles partitifs, le pronomen de quantite Communication Accepter et refuse rune invitation, donner des instructions, commander au restaurant Lexique Les services et les commerces, les aliments, les ustensiles, argent.

**Total: 30 Periods**

**Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)**

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | | | | | | | | | | 2 | | | | | |
| CO2 | | | | | | | | | | 2 | | | | | |
| CO3 | | | | | | | | | | 3 | | | | | |
| CO4 | | | | | | | | | | 3 | | | | | |
| CO5 | | | | | | | | | | 2 | | | | | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

CHAIRMAN - BOARD OF STUDIES

**III SEMESTER**

| 20MA302 | PARTIAL DIFFERENTIAL EQUATIONS AND LINEAR ALGEBRA (Common to ECE and BME) | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 2 | 0 | 4 |
| **Nature of Course** | Basic Sciences | | | | |
| **Pre requisites** | Mathematics-I & II for Electrical Sciences | | | | |

**Course Objectives**

**The course is intended to**

1. Learn vector spaces, subspaces, bases and dimensions.
2. Study the concepts of linear maps and inner product spaces in orthogonalization.
3. Provide the procedure to solve partial differential equations.
4. Acquire the knowledge of odd and even function, half range Fourier series.
5. Acquaint with the Fourier series techniques in solving one dimensional wave and heat equations**.**

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No. | Course Outcome | Bloom's Level |
|---|---|---|
| CO1 | Apply linear independence and dependence of vectors and basis of vector spaces | Apply |
| CO2 | Construct an orthonormal basis by Apply the Gram-Schmidt process. | Apply |
| CO3 | Classify the linear and non-linear partial differential equations. | Understand |
| CO4 | Apply Fourier series to solve engineering problems | Apply |
| CO5 | Interpret the solution of Partial Differential Equations. | Understand |

**Course Contents:**

**UNIT I Vector Spaces** **12**

Vector Spaces – Subspaces – Linear Combinations and Linear System of Equations-Linear independence and Linear dependence – Bases and Dimensions.

**UNIT II Linear transformation and Inner Product Spaces** **12**

Linear transformation – Null and Range Spaces – Dimension theorem – Inner product: Norms – Gram Schmidt Orthogonalization Process.

**UNIT III Partial Differential Equations** **12**

Solutions of standard types of first order non-linear partial differential equations: (i) f(p,q)=0, (ii) Clairaut's type – Lagrange's linear equation –Homogeneous linear partial differential equations of second & higher order with constant coefficients (R.H.S = Constant, $e^{ax+by}$, $cos(ax+by)$,$sin(ax+by)$

**UNIT IV Fourier series and Harmonic Analysis** **12**

Dirichlet's conditions – General Fourier series – Even and Odd functions - Half range Expansions – Harmonic analysis: π, degree and T- forms.

**UNIT V Applications of Partial Differential Equations** **12**

Classifications of Partial differential equations – Method of separation of variables –Solutions of one dimensional wave equation – Solutions of one dimensional heat equation.

**Total: 60 Periods**

*Passed in Board of studies Meeting* *Approved in Academic Council Meeting*

CHAIRMAN - BOARD OF STUDIES

**Text Books:**

1. Grewal B.S, "Higher Engineering Mathematics", 39th Edition, Khanna Publishers, 2014.
2. Friedberg, A.H., Insel, A.J. and Spence, L., Linear Algebra, Prentice Hall of India, New Delhi, 2004.

**Reference Books:**

1. Bali N.P and Manish Goyal, "A Text book of Engineering Mathematics", Lakshmi Publications Pvt Ltd, 3rd Edition, 2014.
2. Lay, D.C., Linear Algebra and its Applications, Pearson Education, 5th Edition, 2015
3. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India Publications, 8th Edition, 2012.

**Additional References:**

1. https://nptel.ac.in/courses/111/106/111106051/
2. https://pvpsitrealm.blogspot.com/2016/09/higher-engineering-mathematics-by-bs.html

| **Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)** | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs** | **POs** | | | | | | | | | | | | **PSOs** | | |
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| CO1 | 3 | 3 | 2 | | | | | | | | | | 2 | | |
| CO2 | 3 | 2 | 2 | 2 | | | | | | 2 | | | 2 | | |
| CO3 | 3 | 3 | 1 | | | 1 | | | | | | | 2 | | |
| CO4 | 2 | 2 | 2 | 2 | | | | | | | | | 1 | | |
| CO5 | 3 | 3 | 2 | | | | | | | 2 | | | 2 | | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| **Formative assessment** | | | |
|---|---|---|---|
| **Bloom's Level** | **Assessment Component** | **Marks** | **Total marks** |
| Remember | Online Quiz | 5 | 15 |
| Understand | Tutorial Class / Assignment | 5 | |
| | Attendance | 5 | |

| **Summative Assessment** | | | | |
|---|---|---|---|---|
| **Bloom's Category** | **Continuous Assessment Tests** | | | **Final Examination (60)** |
| | **IAE-1 (7.5)** | **IAE-2 (7.5)** | **IAE-3 (10)** | |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 30 | 30 | 30 | 60 |
| Apply | 10 | 10 | 10 | 20 |
| Analyse | | | | |
| Evaluate | | | | |
| Create | | | | |

| 20BM301 | SIGNALS AND SYSTEMS FOR BIOENGINEERS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 2 | 0 | 4 |
| **Nature of Course** | Professional Core | | | | |
| **Pre requisites** | Engineering Mathematics | | | | |

**Course objectives:**

**The course is intended to**

1. Understand the classification of signals and systems with state space model.
2. Analyze CT signals using Fourier series & Transforms in Time domain.
3. Analyze DT signals and systems using Fourier transform and Z-Transform.
4. Analyze concurrent, Coupled and Correlated Physiological Processes.
5. Understand Joint Time Frequency [JTF] concepts to Biosignal applications.

**Course Outcomes: On successful completion of the course, students will be able to**

| CO. No | Course Outcome | Bloom's Level |
|---|---|---|
| CO1 | Explain the basic concepts of Biosignals and Physiological Systems with its Characteristics | Understand |
| CO2 | Analyze Analog CT signals and systems with Fourier series, CTFT including Laplace Transform for LTI Analog System Analysis | Analyze |
| CO3 | Analyze Discrete DT signals and systems using Fourier transform, DTFT and Z-Transform Transform for LTI Discrete System Analysis | Analyze |
| CO4 | Analyze Concurrent, Coupled and Correlated Physiological Process with examples for event detection in Biomedical applications | Analyze |
| CO5 | Explain Joint Time Frequency [JTFA] Concepts for Biosignal interpretation and Classification | Understand |

**Course Contents:**

**UNIT I CLASSIFICATIONS OF BIOSIGNALS AND PHYSIOLOGICAL SYSTEMS 12**

Basics of Biosignals and Physiological Systems – Characteristics and representation of Biosignals -Sampling and quantization concepts- Coders/Encoders- Elementary signals – Representations of signals–Classifications of signals – Signal Operations. Analog Vs Discrete Signals - Periodic, aperiodic, transient, stationary and non-stationary signals including 2-dimensional signals as Images. Classifications of Systems-Non-linear, Stability and Feedback Physiological Systems-Multi-input Multi-output [MIMO] Systems

**UNIT II ANALYSIS OF CONTINOUS TIME SIGNALS AND LTI SYSTEMS 12**

Fourier series for CT Periodic Signals – Time domain Analysis- Dirichlet's conditions – Fourier transform for CT Aperiodic signals. LTI- Linear Time Invariant Systems Analysis in the Time Domain – Differential Equation-Impulse response of LTI systems - Convolutional Integral – Signal Averaging for Noise elimination-SNR-Analog Filters – Basics of Laplace Transform-Transfer function concepts.

**UNIT III ANALYSIS OF DISCRETE TIME SIGNALS AND FREQUENCY DOMAIN ANALYSIS 12**

Discrete Time Fourier transform [DTFT] for DT periodic signals – LTI- Linear Time Invariant Systems Analysis in the Frequency Domain – Difference Equation-Linear Convolution – Circular convolution – Digital Filters – Basics of Z-Transforms – Digital Transfer function -linearized model of the Guyton-Coleman body fluid balance system

**UNIT IV ANALYSIS OF CONCURRENT, COUPLED, AND CORRELATEDPROCESSES 12**

Illustration of the Problem with Physiological Case Studies-The ECG and the PCG interpretation -The importance of HRV [Heart Rate Variability]- The knee joint and muscle vibration signals-The Pan–Tompkins algorithm for QRS detection Theory & Concepts

**UNIT V JOINT TIME-FREQUENCY ANALYSIS OF BIOMEDICAL SIGNALS 12**

Introduction to Joint Time Frequency Analysis (JFTA) Using Wavelets - Applications of JTFA to Physiological Signals – Heart Sound, Murmurs Analysis for congenital heart diseases

**Total :60 Periods**

*Passed in Board of studies Meeting* *Approved in Academic Council Meeting*

CHAIRMAN - BOARD OF STUDIES

**Text Books:**


1. John Semmlow," Signals and Systems for Bioengineers" Elsevier India Private Limited, 2012
2. Rangayyan M. Rangaraj, “Biomedical Signal Analysis” 2nd Edition-Wiley (2015)
3. Robert B. Northrop”Signals and Systems Analysis in Biomedical Engineering”2nd Edition,2010 CRC Press
4. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, “Signals and Systems”, Pearson, 2015 (UNIT 1 to 3)


**References:**


1. B. P. Lathi, “Principles of Linear Systems and Signals”, Second Edition, Oxford, 2009.
2. R.E.Zeimer, W.H.Tranter and R.D.Fannin, “Signals & Systems -Continuous and Discrete”, Pearson, 2007.
3. John Alan Stuller, “An Introduction to Signals and Systems” Thomson, 2007.


**Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)**

| COs | Pos | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO2 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO3 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO4 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO5 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Formative assessment | | | |
|---|---|---|---|
| **Bloom’s Level** | **Assessment Component** | **Marks** | **Total marks** |
| Analyze | Classroom or Online Quiz | 5 | 15 |
| Understand | Assignment | 10 | |

| Summative Assessment | | | | |
|---|---|---|---|---|
| **Bloom’s Category** | **Continuous Assessment Tests** | | | **Terminal Examination (60)** |
| | **IAE-1 (7.5)** | **IAE-2 (7.5)** | **IAE-3 (10)** | |
| Remember | 5 | 5 | 5 | 10 |
| Understand | 5 | 5 | 5 | 20 |
| Apply | 20 | 20 | 20 | 30 |
| Analyze | 20 | 20 | 20 | 40 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

| 20BM302 | CIRCUIT THEORY | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| **Nature of Course** | Engineering Sciences | | | | |
| **Pre requisites** | Engineering Physics | | | | |

**Course Objectives**

The course is intended to

1. Introduce the basic concepts of DC and AC circuits behavior
2. Introduce different methods of circuit analysis using Network theorems and Topology
3. Understand the basic concepts of resonance circuits
4. Study and compare the transient and steady state response of the circuits subjected to step and sinusoidal excitations.
5. Understand the basic concepts of coupled circuits

**Course Outcomes**

On successful completion of the course, students will be able to

| CO.No. | Course Outcome | Bloom's Level |
|---|---|---|
| CO1 | Interpret DC and AC circuits using basic laws | Understand |
| CO2 | Solve and verify network theorems | Apply |
| CO3 | Analyze transient response of RC, RL and RLC circuits | Analyze |
| CO4 | Analyze any circuits by using frequency domain method | Analyze |
| CO5 | Illustrate the magnetically coupled circuits | Understand |

**Course Contents**

**UNIT I DC CIRCUIT ANALYSIS 9**

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

**UNIT II NETWORK THEOREMS 9**

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

**UNIT III TRANSIENTS AND RESONANCE IN RLC CIRCUITS 9**

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

**UNIT IV SINUSOIDAL STEADY STATE ANALYSIS 9**

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

**UNIT V COUPLED CIRCUITS AND TOPOLOGY 9**

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

**TOTAL: 45 PERIODS**

**Text Book:**

1. Hayt Jack Kemmerly, Steven Durbin, "Engineering Circuit Analysis", Mc Graw Hill education, 9th Edition, 2018.

**Reference Books:**

1. Robert.L. Boylestead, "Introductory Circuit Analysis", Pearson Education India, 12th Edition, 2014.
2. Sudhakar. A and Shyammohan S Pall, “Circuits and Networks” Tata McGraw Hill, 4th edition, 2010.
3. Charles.K.Alexander, Mathew N.O.Sadiku,"Fundamentals of Electric Circuits", McGraw Hill, 5th Edition, 2012.
4. Thomas L. Floyd and David M.Buchla, Principles of ‘Electric Circuits: Conventional Current’, Pearson Education, 10th Edition, 2020.

| Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO) | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cos | POs | | | | | | | | | | | | PSOs | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | |
| CO1 | 3 | 2 | 2 | 1 | 2 | | | | | | | 1 | 3 | 2 | |
| CO2 | 3 | 3 | 2 | 2 | 2 | | | | | | | 1 | 3 | 2 | |
| CO3 | 3 | 3 | 3 | 2 | 3 | | | | | | | 1 | 3 | 2 | |
| CO4 | 3 | 3 | 3 | 2 | 3 | | | | | | | 1 | 3 | 2 | |
| CO5 | 2 | 3 | 3 | 2 | 2 | | | | | | | 1 | 3 | 2 | |
| | 3 | High | | | | 2 | Medium | | | | 1 | Low | | | |

| Formative assessment | | | |
|---|---|---|---|
| **Bloom’s Level** | **Assessment Component** | **Marks** | **Total marks** |
| Understand | Direct Measures: Quiz/Presentation/Tutorial | 5 | 15 |
| Understand | Indirect measures: Assignment/ Video presentation | 5 | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|---|---|---|---|---|
| **Bloom’s Category** | **Continuous Assessment** | | | **Final Examination (Theory) (60)** |
| | **IAE-1 (7.5)** | **IAE-2 (7.5)** | **IAE-3 (10)** | |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 10 | 10 | 10 | 20 |
| Apply | 20 | 20 | 20 | 30 |
| Analyse | 10 | 10 | 10 | 30 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

| 20BM303 | ELECTRONIC DEVICES AND CIRCUITS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| **Nature of Course** | Professional Core | | | | |
| **Pre requisites** | Circuit Theory | | | | |

**Course Objectives**

The course is intended to

1. Introduce the basic concepts of PN junction diode
2. Study the characteristics of Bipolar Junction Transistors and Field Effect Transistors
3. Understand the operation of feedback amplifier and oscillators
4. Introduce the operational amplifiers and characteristics
5. Understand the practical applications of linear integrated circuits.

**Course Outcomes**

On successful completion of the course, students will be able to

| CO.No. | Course Outcome | Bloom's Level |
|---|---|---|
| CO1 | Explain the characteristics of PN junction diode and Zener diode | Understand |
| CO2 | Interpret the construction, operation and characteristics of BJT, FET and other power electronics devices | Understand |
| CO3 | Identify and design a suitable amplifier and Oscillator for a given specification | Apply |
| CO4 | Summarize the performance of operational amplifier with its applications | Apply |
| CO5 | Analyze the applications of operational amplifier | Analyze |

**Course Contents**

**UNIT I PN JUNCTION DEVICES 9**

PN junction diode–structure, operation and V-I characteristics, Diode clampers and clippers, Rectifiers-Half Wave and Full Wave Rectifier, Zener diode-characteristics-Zener Reverse characteristics – Zener as regulator.

**UNIT II TRANSISTORS 9**

BJT-structure, operation, characteristics, biasing, amplifier and switch, JFET- structure, operation, characteristics, biasing, amplifier and switch, MOSFET- structure, operation, characteristics, and biasing

**UNIT III FEEDBACK AMPLIFIERS AND OSCILLATORS 9**

Basic concepts of feedback-Properties of negative feedback-voltage / current, series, Shunt Feedback-Positive Feedback-Condition for oscillations-phase shift-Wien bridge, Hartley, Colpitts and Crystal oscillators.

**UNIT IV OPERATIONAL AMPLIFIER AND ITS APPLICATIONS 9**

Operational amplifier-characteristics, Performance Parameters-Inverting / Non-inverting Amplifiers. Voltage Follower, Differentiator, Integrator, Voltage to Current converter, Instrumentation amplifier, Low pass, High pass filter and band pass filters, Comparator, Multivibrator and Schmitt trigger

**UNIT V SPECIAL ELECTRONIC DEVICES AND POWER SUPPLY 9**

IGBT-structure and characteristics, Thyristors - (SCR, DIAC, TRIAC, UJT)-structure and operation. Design of DC Power Supply-Voltage Regulators –DC-DC Converter- Linear and Switched types- SMPS

**TOTAL: 45 PERIODS**

**Text Book:**

1. David A. Bell, “Electronic Devices and Circuits”, 6th Edition, Oxford University Press, 2009.
2. D. Roy Choudhry, Shail Jain, “Linear Integrated Circuits”, New Age International Pvt. Ltd., 2000.

**Reference Books:**

1. Thomas L. Floyd, “Electronic devices” Prentice Hall”, 10th Edition, 2018
2. Robert L. Boylestad and Louis Nashelsky, “Electronic Devices and Circuit Theory”, 11th Edition, Pearson Education, 2015.
3. Sergio Franco, “Design with operational amplifiers and analog integrated circuits”, 3rd Edition, Tata McGraw-Hill, 2007.
4. G.K.Mithal, “Electronic devices and circuits”, Khanna Publishers, 2010.

| Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO) | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs** | **POs** | | | | | | | | | | | | **PSOs** | | |
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | |
| CO1 | 3 | 2 | 2 | 2 | 1 | | | | | | | | 3 | 2 | |
| CO2 | 2 | 3 | 2 | 2 | 2 | | | | | | | | 3 | 2 | |
| CO3 | 2 | 2 | 3 | 3 | 1 | | | | | | | | 3 | 2 | |
| CO4 | 3 | 2 | 2 | 3 | 2 | | | | | | | | 3 | 2 | |
| CO5 | 3 | 2 | 3 | 3 | 2 | | | | | | | | 3 | 2 | |
| | 3 | High | | | | 2 | Medium | | | | 1 | Low | | | |

| Formative assessment | | | |
|---|---|---|---|
| **Bloom’s Level** | **Assessment Component** | **Marks** | **Total marks** |
| Understand | Direct Measures: Quiz/Presentation/Tutorial | 5 | 15 |
| Understand | Indirect measures: Assignment/ Video presentation | 5 | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|---|---|---|---|---|
| **Bloom’s Category** | **Continuous Assessment** | | | **Final Examination (Theory) (60)** |
| | **IAE-1 (7.5)** | **IAE-2 (7.5)** | **IAE-3 (10)** | |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 10 | 10 | 10 | 30 |
| Apply | 20 | 20 | 20 | 40 |
| Analyse | 10 | 10 | 10 | 10 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

| 20BM304 | BIOSENSORS AND MEASUREMENTS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| **Nature of Course** | Professional Core | | | | |
| **Pre requisites** | Basics of Electrical Engineering and Biology | | | | |

**Course objectives:**

The course is intended to

1. Understand science of bio-measurement with desirable properties of biosensors, miniaturization and applications related to agriculture, bio-production and environment
2. Know in detail various electrochemical sensors and its sensing capabilities
3. Know the principles behind Seismic (mass) and Thermal sensors for human body status
4. Understand biochemical assaying formats and molecular level recognition
5. Explore benefits of optical sensors with its relevant source and detectors for non-invasive devices & quantification

**Course Outcomes: On successful completion of the course, students will be able to**

| CO. No | Course Outcome | Bloom's Level |
|---|---|---|
| CO1 | Understand common biochemical interactions used to quantify biological molecules and the electronic technologies used to detect and measure them | Understand |
| CO2 | Apply principles of electrochemical sensors and its sensing capabilities | Apply |
| CO3 | To know the principles behind Seismic (mass) and Thermal sensors for human body status | Understand |
| CO4 | Understand biochemical assaying formats and molecular level recognition | Understand |
| CO5 | To fully explore benefits of optical sensors with its relevant source and detectors for non-invasive devices & quantification | Understand |

**Course Contents:**

**UNIT I SCIENCE OF BIOMEASUREMENT 9**

Measurement System – Instrumentation – Classification and Characteristics of Transducers (Static and Dynamic) – Errors in Measurements – Calibration – Primary and secondary standards. Interfacing Biosensor to real world – resistive, capacitive, inductive types. Major components of Biosensor based systems - Biosensor applications and issues- Overview of biosensor applications: medicine, agriculture, bioproduction, and environment - Desired characteristics of biosensors: reliability, simplicity, cost, operating conditions, and safety.

**UNIT II ELECTROCHEMICAL SENSORS 9**

Biochemical recognition - Chemical reactions: history of gravimetric and colorimetric reactions. Problems of specificity - Redox potentials, membrane potential, basic electrochemistry; conductimetric sensors; potentiometric sensors (ISE's and ISFETs); Amperometric sensors; Charge sensing with FET

**UNIT III SEISMIC (MASS), GAS AND THERMAL SENSORS 9**

Electromechanical resonance -Piezoelectric, Quartz crystal Microbalance (QCM), Surface acoustic wave (SAW) devices; Hall effect Sensor, Proximity sensor and Gyroscopes - Henry's and ideal gas laws-Gas detection. Atomic force microscopy (AFM); Thermometric detection

**UNIT IV ASSAYING FORMATS 9**

Labels: Radioisotopes, fluorophores, dyes, enzymes/substrates, liposomes, electroactive compounds. ELISA's and nucleotide capture assays- Immobilization of biorecognition element; conjugation of labels-Aptamer (oligonucleotide) based recognition and molecularly imprinted polymers

**UNIT V OPTICAL SENSORS 9**

Fundamentals of optics- sources (LED's, lasers, lamps), detectors (photodiodes, photomultiplier tubes, charge coupled devices), and optical circuits (filters, gratings, fiber optics); detection of absorbance, reflectance, and fluorescence; Surface plasmon resonance (SPR) based devices

**Total: 45 Periods**

*Passed in Board of studies Meeting* *Approved in Academic Council Meeting*

CHAIRMAN - BOARD OF STUDIES

**Text Books:**

1. Eggins. B. R, “Chemical Sensors and Biosensors”, John Wiley & Sons, 2014.
2. Jon Cooper, Tony Cass “Biosensors-A practical approach” 2nd edition Oxford University Press, (2014)

**References:**

1. Florinel-Gabriel Banica “Chemical Sensors and Biosensors - Fundamentals and Applications” John Wiley & Sons, Ltd,2012
2. Gabor Harsanyi “Sensors in Biomedical Applications– Fundamentals, Technology & Applications” CRC Press,2014
3. Donald G. Buerk (Author) – Biosensors- Theory and Applications-CRC Press (2013)
4. Spichiger-Keller. U. E “Chemical Sensors and Biosensors for Medical and Biological Applications”, Wiley-VCH, 2008.
5. Robert S. Marks, Christopher R. Lowe, David C. Cullen, Howard H. Weetall, Isao Karube “Handbook of Biosensors and Biochips” Vol 2-John Wiley & Sons (2017)

| **Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)** | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs** | **POs** | | | | | | | | | | | | **PSOs** | | |
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | |
| CO1 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO2 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO3 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO4 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO5 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| | 3 | High | | | | 2 | Medium | | | | 1 | Low | | | |

| **Formative assessment** | | | |
|---|---|---|---|
| **Bloom’s Level** | **Assessment Component** | **Marks** | **Total marks** |
| Analyze | Classroom or Online Quiz | 5 | 15 |
| Understand | Assignment | 10 | |

| **Summative Assessment** | | | | |
|---|---|---|---|---|
| **Bloom’s Category** | **Internal Assessment Examinations** | | | **Final Examination (60)** |
| | **IAE-1 (7.5)** | **IAE-2 (7.5)** | **IAE-3 (10)** | |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 30 | 30 | 30 | 60 |
| Apply | 10 | 10 | 10 | 20 |
| Analyze | | | | |
| Evaluate | | | | |
| Create | | | | |

| 20BM305 | HUMAN ANATOMY AND PHYSIOLOGY | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 4 |
| **Nature of Course** | Professional core | | | | |
| **Pre requisites** | Basics of Biology | | | | |

**Course Objectives**

**The course is intended to**

1. Know basic structural and functional elements of human body
2. Learn organs and structures involving in system formation and functions
3. Understand structure and functions of the various types of systems of human body.
4. Demonstrate anatomical features and physiology of human systems

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No. | Course Outcome | Bloom's Level |
|---|---|---|
| CO1 | Explain basic structure and functions of cell | Understand |
| CO2 | Understand anatomy and physiology of various systems of human body | Understand |
| CO3 | Identify all systems in the human body. | Remember |
| CO4 | Explain organs and structures involving in system formation and functions. | Understand |
| CO5 | Understand human digestive and excretory system functional aspects | Understand |

**Course Contents:**

**UNIT I CELL AND TISSUE STRUCTURE 9**

Structure of Cell – structure and functions of sub organelles – Cell Membrane –Transport of Across Cell Membrane - Action Potential – Cell to Cell Signaling - origin of cell membrane potential. Types of Specialized tissues – Functions

**UNIT II SKELETAL, MUSCULAR AND RESPIRATORY SYSTEMS 9**

Skeletal - Types of Bone and function – Physiology of Bone formation – Division of Skeleton – Types of joints and function – Types of cartilage and function. Muscular: Parts of Muscle – Movements. Respiratory: Parts of Respiratory Systems – Types of respiration - Mechanisms of Breathing – Regulation of Respiration

**UNIT III CIRCULATORY SYSTEM 10**

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

**UNIT IV NERVOUS AND ENDOCRINE SYSTEMS AND SENSE ORGANS 9**

Nervous: Cells of Nervous systems – Types of Neuron and Synapses – Mechanisms of Nerve impulse – Brain: Parts of Brain – Spinal Cord – Tract and Pathways of Spines – Reflex Mechanism – Classification of Nerves - Autonomic Nervous systems and its functions. Endocrine - Pituitary and thyroid gland, Sense Organs: Eye and Ear

**UNIT V DIGESTIVE AND URINARY SYSTEMS 9**

Digestive: Organs of Digestive system – Digestion and Absorption. Urinary: Structure of Kidney and Nephron – Mechanisms of Urine formation – Regulation of Blood pressure by Urinary System – Urinary reflex

**Total: 45 Periods**

*Passed in Board of studies Meeting* *Approved in Academic Council Meeting*

CHAIRMAN - BOARD OF STUDIES

## LIST OF EXPERIMENTS

| S.No. | Course Content | CO | Bloom's Level |
|---|---|---|---|
| 1 | Collection of Blood Samples | CO 1 | Understand |
| 2 | Identification of Blood groups (Forward and Reverse) | CO 2 | Understand |
| 3 | Bleeding and Clotting time | CO 2 | Apply |
| 4 | Estimation of Hemoglobin | CO 3 | Apply |
| 5 | Calculate the amount of Total RBC Count present in the blood | CO 3 | Apply |
| 6 | Calculate the amount of Total WBC Count present in the blood | CO 3 | Apply |
| 7 | Differential count of Blood cells | CO 3 | Apply |
| 8 | Estimation of ESR | CO 3 | Apply |
| 9 | Calculate the amount of PCV, MCH, MCV, MCHC present in blood cells | CO 3 | Analyze |
| 10 | Hearing test – Tuning fork | CO 4 | Analyze |
| 11 | Visual Activity – Snellen's Chart and Jaeger's Chart | CO 5 | Analyze |

**TEXT BOOKS:**

1. Prabhjot Kaur,"Text Book of Anatomy and Physiology" Lotus Publishers. 2014
2. Elaine.N. Marieb, "Essential of Human Anatomy and Physiology", Eight Edition, Pearson Education, New Delhi, 2007

**REFERENCES:**

1. Frederic H. Martini, Judi L. Nath, Edwin F. Bartholomew, Fundamentals of Anatomy and Physiology. Pearson Publishers, 2014
2. Gillian Pocock, Christopher D. Richards, The human Body – An introduction for Biomedical and Health Sciences, Oxford University Press, USA, 2013
3. William F.Ganong, "Review of Medical Physiology", 22nd Edition, Mc Graw Hill, New Delhi, 2010
4. Eldra Pearl Solomon, "Introduction to Human Anatomy and Physiology", W.B. Saunders Company, 2015
5. Guyton & Hall, "Medical Physiology", 13th Edition, Elsevier Saunders, 2015

| Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO) | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs** | **POs** | | | | | | | | | | | | **PSOs** | | |
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | |
| CO1 | | | | | | | | 2 | | | 3 | | 3 | 2 | |
| CO2 | 2 | | | | | 2 | | 2 | 1 | | | 2 | 3 | 2 | |
| CO3 | | | | | | | | 2 | | | 2 | | 3 | 2 | |
| CO4 | 1 | | | | | 3 | | 3 | 3 | | | 3 | 3 | 2 | |
| CO5 | 1 | 1 | | | | 3 | | 3 | 2 | | | 3 | 3 | 2 | |
| | 3 | High | | | | 2 | Medium | | | | 1 | Low | | | |

| Formative assessment | | | |
|---|---|---|---|
| **Bloom's Level** | **Assessment Component** | **Marks** | **Total marks** |
| Remember | Online Quiz | 5 | 25 |
| Understand | Tutorial Class / Assignment | 15 | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|---|---|---|---|---|
| **Bloom's Category** | **Internal Assessment Examinations** | | | **Final Examination (50)** |
| | **IAE-1 (7.5)** | **IAE-2 (7.5)** | **IAE-3 (10)** | |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 10 | 10 | 10 | 20 |
| Apply | 20 | 20 | 20 | 40 |
| Analyze | 10 | 10 | 10 | 20 |
| Evaluate | | | | |
| Create | | | | |

| 20BM306 | ELECTRONIC DEVICES AND CIRCUITS LABORATORY | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 4 | 2 |
| Nature of Course | Professional core | | | | |
| Pre requisites | Engineering Physics | | | | |

**Course Outcomes**

On successful completion of the course, students will be able to

1. Find the V-I characteristics of PN junction and Zener diode
2. Demonstrate the construction, operation and characteristics of BJT and FET
3. Design and analyze the frequency response of amplifiers and oscillators
4. Analyze the application of operational amplifier
5. Analyze the operation of multivibrators using 555 timers

**CYCLE-1**

| S.No. | Course Content | CO | Bloom's Level |
|---|---|---|---|
| 1 | Practical Verification of superposition theorem and Maximum power transfer theorem | CO 1 | Apply |
| 2 | Construct and testing of half wave and full wave rectifiers circuit using PN Junction Diode | CO 1 | Apply |
| 3 | Conduct the experiment of Characteristics of Zener Diode application as voltage regulator | CO 1 | Understand |
| 4 | Determine the BJT and FET Characteristics | CO 2 | Understand |
| 5 | Perform the Frequency Response of CE Amplifier | CO 3 | Understand |
| 6 | Design of RC Oscillators and LC Oscillators using BJT | CO 3 | Apply |

**CYCLE-2**

| S.No. | Course Content | CO | Bloom's Level |
|---|---|---|---|
| 1 | Design of Inverting, non-inverting amplifier and comparator | CO 4 | Analyze |
| 2 | Design and verify the output of Integrator and Differentiator | CO 4 | Apply |
| 3 | Design and analysis of active filters using opamp | CO 4 | Analyze |
| 4 | Measure the threshold point of Schmitt trigger using operational amplifier | CO 4 | Understand |
| 5 | Design Instrumentation amplifier using operational amplifier | CO 4 | Analyze |
| 6 | Measure the frequency of oscillation of Multivibrators using IC 555 Timer | CO 5 | Understand |

| Mapping of Course Outcomes (COs) with Program Outcomes (POs) Program Specific Outcomes (PSO) | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs** | **POs** | | | | | | | | | | | | **PSOs** | | |
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | |
| 1 | 3 | 1 | 3 | | 2 | 1 | | | 3 | | | | 2 | 3 | |
| 2 | 3 | 1 | 3 | | 2 | 1 | | | 3 | | | | 2 | 3 | |
| 3 | 3 | 1 | 3 | | 2 | 1 | | | 3 | | | | 2 | 3 | |
| 4 | 3 | 1 | 3 | | 2 | 1 | | | 3 | | | | 2 | 3 | |
| 5 | 3 | 1 | 3 | | 2 | 1 | | | 3 | | | | 2 | 3 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Summative assessment based on Continuous and Final Examination | | |
|---|---|---|
| **Bloom's Level** | **Rubric based Continuous Assessment [50 marks]** | **Final Examination [50 marks]** |
| Remember | 5 | 10 |
| Understand | 10 | 20 |
| Apply | 15 | 30 |
| Analyze | 20 | 40 |
| Evaluate | - | - |
| Create | - | - |

| 20MC301 | ENVIRONMENTAL SCIENCE (Common to CSE, IT, AI&DS, ECE and BME) | L | T | P | C |
|---|---|---|---|---|---|
| | | 2 | 0 | 0 | 0 |
| **Nature of Course** | Mandatory | | | | |
| **Pre requisites** | Nil | | | | |

**Course Objectives**

The course is intended to

1. Understand the concept of eco system and environment.
2. Become conversant with ecological balance and values of bio diversity.
3. Know the role of human in prevention of pollution and making a clean environment.
4. Get knowledge about conservation of non-conventional energy resources.
5. Study about the nature and management of e-waste and solid waste.

**Course Outcomes**

On successful completion of the course, students will be able to

| CO.No. | Course Outcome | Bloom's Level |
|---|---|---|
| CO1 | Describe the ecosystem and environment | Understand |
| CO2 | Understand the ecological balance and preservation of bio diversity | Understand |
| CO3 | Demonstrate various types of pollution in order to control pollution | Apply |
| CO4 | Classify the energy sources for the conservation of non-conventional energy sources | Understand |
| CO5 | Identify the nature and management of e-waste and solid waste | Understand |

**Course Contents**

**UNIT I Ecosystem** **6**

Eco system **-** Food chains, Food webs and Ecological pyramids. Ecosystem - (a) Forest eco system, (b) Aquatic eco system (pond ecosystem and marine ecosystem).

**UNIT II Biodiversity** **6**

Introduction to Bio diversity, Values of Bio diversity**,** Threads to Bio diversity**,** Endangered and Endemic species of India, Hotspots of biodiversity. Conservation of Bio diversity: In-Situ and Ex-Situ conservation of bio diversity.

**UNIT III Environmental Pollution** **6**

Definition, Causes, Effects and Control of (a) Air pollution (b) Water pollution (c) Soil pollution. Electrostatic Precipitator for controlling air pollution.

**UNIT IV Non-Conventional Energy Resources** **6**

Introduction, Types: Solar Energy, Wind Energy and Geo Thermal Energy.

**UNIT V Environmental Management** **6**

Sustainable Development, Role of Information technology in Environment and Human. HIV and AIDS: causes and control measures. Green chemistry: Definition and Principles

**Activity Component**

| S.No | Name of the Experiment | CO Mapping | RBT |
|---|---|---|---|
| 1 | Field study of simple eco system: pond, river and hill slopes | CO1 | Understand |
| 2 | Case study regarding environmental management | CO5 | Apply |

**Total: 30 periods**

**Text Books**

1. Anubha Kaushik and C.P. Kaushik, "Environmental Science and Engineering, New Age International Publishers, New Delhi, 2nd Edition, 2015.
2. V. Kumar, "An Introduction to Green Chemistry" Vishal publishing Co. Reprint Edition, 2010.

**Reference Books**

1. Masters, Gilbert M, "Introduction to Environmental Engineering and Science", Pearson Education, New Delhi, 2nd Edition, 2012.
2. Santosh Kumar Garg and Rajeshwari Garg "Ecological and Environmental Studies", Khanna Publishers, Nai Sarak, Delhi, 2nd Edition, 2014.

**Additional Resources**

1. https://nptel.ac.in/courses/122103039/38
2. https://bch.cbd.int/cms/ui/collaboration/download/download.aspx?id=909
3. https://nptel.ac.in/courses/105102089/air%20pollution%20(Civil)/Module-3/3a.htm
4. www.vssut.ac.in/lecture_notes/lecture1428910296.pdf
5. nptel.ac.in/courses/120108004/module7/lecture8.pdf

**Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)**

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | | | | | | | 3 | | | | | 3 | | | |
| CO2 | | | | | | | 3 | | | | | 3 | | | |
| CO3 | | | | | | | 3 | | | | | 3 | | | |
| CO4 | | | | | | | 3 | | | | | 3 | | | |
| CO5 | | | | | | | 3 | | | | | 3 | | | |
| | 3 | High | | | | | 2 | Medium | | | | 1 | Low | | |

| Bloom's Level | Continuous Assessment | | | | |
|---|---|---|---|---|---|
| | IAE-I [20] | IAE-II [20] | IAE-III [20] | Attendance [10] | Activity [30] |
| Remember | 30 | 20 | 20 | | |
| Understand | 10 | 20 | 20 | | |
| Apply | 10 | 10 | 10 | | |
| Analyze | | | | | |
| Evaluate | | | | | |
| Create | | | | | |

*Passed in Board of studies Meeting*

CHAIRMAN - BOARD OF STUDIES

*Approved in Academic Council Meeting*

| 20BMA01 | Scientific Computing for Biologists | L | T | P | C |
|---|---|---|---|---|---|
| | | 1 | 0 | 0 | 1 |
| **Nature of course** | Employability Enhancement Course | | | | |
| **Pre requisites** | Nil | | | | |

**Course Objectives**

The course is intended to

1. Acquire live data from individuals, instruments, cards, sensors, or Internet of Things approaches
2. Automate biological analysis tasks such as cell counting
3. Develop bioinformatics analysis workflows needed to code and applications
4. Use extensive statistics capabilities to determine significance in studies
5. Create plots and reports for tabular data

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---|---|---|
| CO 1 | Understand the principles of acquiring biological data | Understand |
| CO 2 | Summarize the tools of biomedical signals | Understand |
| CO 3 | Classify the biological signals and patterns | Understand |
| CO 4 | Apply statistics capabilities to determine significance in Bio-studies | Apply |
| CO 5 | Create plots and reports for tabular biological data | Understand |

**Course Contents**

Application of Matrix Algebra to Biological Systems - MATLAB as a powerful and user-friendly package in scientific computing -standard plots, explore and analyze your data, conduct biological analysis and solve mathematical models of biological systems. **05**

Introduction to IoT and Analytics in the context of IoT- IoT Reference architecture, IoT Data overview- IoT Use cases, IoT Data Processing- Introduction to ML and Python for ML- IoT Analytics Data Science Life Cycle – Case study in health care **05**

KPIs in IoT Analytics and Data Acquisition for IoT-IoT Data Cleaning, Descriptive IoT Data Analytics- Inferential Data Analytics, Predictive Data Analytics- Prescriptive Analytics **05**

**Total: 15 Hours**

| **Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)** | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Cos** | **POs** | | | | | | | | | | | | **PSOs** | | |
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| CO 1 | 3 | 2 | 3 | | | | | | | | | | 1 | 2 | |
| CO 2 | 2 | 3 | 2 | | | | | | | | | | 1 | 2 | |
| CO 3 | 2 | 3 | 2 | | | | | | | | | | 1 | 2 | |
| CO 4 | 3 | 2 | 3 | | | | | | | | | | 1 | 2 | |
| CO 5 | 3 | 2 | 3 | | | | | | | | | | 1 | 2 | |
| | **3** | **High** | | | | **2** | **Medium** | | | | | **1** | **Low** | | |

| **Bloom's Level** | **Summative Assessment (Internal Mode)** | |
|---|---|---|
| | **Assessment 1 (50 Marks)** | **Assessment 2 (50 Marks)** |
| Remember | 10 | 10 |
| Understand | 10 | 10 |
| Apply | 30 | 30 |
| Analyze | | |
| Evaluate | | |
| Create | | |

**IV SEMESTER**

| 20MA402 | PROBABILITY AND STOCHASTIC PROCESS (Common to ECE & BME) | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 2 | 0 | 4 |
| **Nature of Course** | Basic Sciences | | | | |
| **Pre requisites** | Mathematics –I & II for Electrical Sciences | | | | |

**Course Objectives**
**The course is intended to**

1. Acquire the concepts of random variables essential for analog of digital communication.
2. Introduce the basic concepts of random variables.
3. Acquaint the basic concepts of random processes which are widely used in many fields.
4. Familiarize with the concept of correlation and spectral densities.
5. Study the significance of linear systems with random inputs.

**Course Outcomes**

On successful completion of the course, the students will be able to

| CO. No. | Course Outcome | Bloom's Level |
|---|---|---|
| CO1 | Explain the concepts of random variables and probability distributions. | Understand |
| CO2 | Compare the functions of multiple random variables. | Analyze |
| CO3 | Interpret the concepts of random processes in their fields. | Understand |
| CO4 | Determine correlation and spectral densities. | Apply |
| CO5 | Estimate the response of linear time invariant systems for random inputs with more than one variable. | Understand |

**Course Contents:**

**UNIT I Random Variables and Distributions 12**

Basics of Probability-Random Variables – Types of Random Variables: Discrete random variables – Continuous random variables– Probability functions, Moment Generating Functions –Discrete Distributions: Binomial and Poisson distributions–Continuous Distributions: Uniform and Exponential distributions.

**UNIT II Two Dimensional Random Variables 12**

Joint distributions – Marginal distributions – Covariance – Correlation and linear regression – Transformation of random variables – Central limit Theorem (for independent and identically distributed random variables).

**UNIT III Random Processes 12**

Classifications, First Order- Second Order - Strictly Stationary - Wide Sense Stationary and Ergodic Stationary Process – Markov process – Poisson process – Random telegraph process.

**UNIT IV Correlation and Spectral Densities 12**

Auto correlation - Cross correlation – Properties - Power spectral density - Cross spectral density – Properties - Wiener-Khintchine relation - Relationship between cross power spectrum and cross correlation function.

**UNIT V Linear Systems with Random Inputs 12**

Linear Time Invariant System – System Transfer Function – Linear Systems with Random Inputs – Auto Correlation and Cross Correlation Functions of Input and Output.

**Total: 60 Periods**

*Passed in Board of studies Meeting* *Approved in Academic Council Meeting*

CHAIRMAN - BOARD OF STUDIES

**Text Books:**

1. Oliver Ibe," Fundamentals of Applied Probability and Random Processes", Indian Reprint,Elsevier, 2nd Edition,2014.
2. Peebles, P.Z., "Probability, Random Variables and Random Signal Principles", Tata McGraw Hill, 4th Edition, 2017.

**Reference Books:**

1. Cooper. G.R., McGillem. C.D., "Probabilistic Methods of Signal and System Analysis", Oxford University Press, New Delhi, 3rd Edition,2012.
2. Yates.R.D. and Goodman.D.J.Probability and Stochastic Processes",Wiley India Pvt. Ltd., Bangalore, 4th Edition,2018.

**Additional References:**

1. https://nptel.ac.in/courses/117/103/117103067
2. https://nptel.ac.in/courses/117/105/117105085

| **Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)** | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs** | **POs** | | | | | | | | | | | | **PSOs** | | |
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| CO1 | 3 | 2 | 1 | | | | | | | | | 1 | 2 | | |
| CO2 | 3 | 2 | 1 | | | | | | | | | 1 | 3 | | |
| CO3 | 3 | 3 | 2 | | | | | | | | | 1 | 3 | | |
| CO4 | 3 | 3 | 2 | | | | | | | | | 1 | 3 | | |
| CO5 | 3 | 3 | 2 | | | | | | | | | 1 | 2 | | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| **Formative assessment** | | | |
|---|---|---|---|
| **Bloom's Level** | **Assessment Component** | **Marks** | **Total marks** |
| Remember | Quiz | 5 | 15 |
| Understand | Tutorial Class / Assignment | 5 | |
| | Attendance | 5 | |

| **Summative Assessment** | | | | |
|---|---|---|---|---|
| **Bloom's Category** | **Internal Assessment Examinations** | | | **Terminal Examination (60)** |
| | **IAE – I (7.5)** | **IAE – II (7.5)** | **IAE – III (10)** | |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 20 | 20 | 20 | 60 |
| Apply | 20 | 20 | 20 | 20 |
| Analyze | | | | |
| Evaluate | | | | |
| Create | | | | |

| 20BM401 | DIGITAL ELECTRONICS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 2 | 0 | 4 |
| **Nature of Course** | Professional Core | | | | |
| **Pre requisites** | Electronic devices | | | | |

**Course Objectives**

The course is intended to

1. Understand the digital fundamentals, Boolean algebra and its applications in digital systems
2. Design the various combinational digital circuits using logic gates
3. Introduce the analysis and design procedures for synchronous sequential circuits
4. Study the various semiconductor memories and integrated circuits
5. Understand the basic concepts of ADC and DAC

**Course Outcomes**

On successful completion of the course, students will be able to

| CO.No. | Course Outcome | Bloom's Level |
|---|---|---|
| CO1 | Apply Boolean theorems to minimize logic expressions in different forms and implement them using logic gates | Apply |
| CO2 | Design various combinational circuits using logic gates | Design |
| CO3 | Design synchronous-sequential circuits for a given specification | Design |
| CO4 | Analyze the characteristics and structure of different memory systems and programmable logic devices | Analyze |
| CO5 | Interpret the various ADC and DAC | Understand |

**Course Contents**

**UNIT I DIGITAL FUNDAMENTALS** **13**

Number Systems – Decimal, Binary, Octal, Hexadecimal, 1's and 2's complements, Codes – Binary, BCD, Excess 3, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Minterms and Maxterms, Karnaugh map Minimization and Quine-McCluskey method of minimization.

**UNIT II COMBINATIONAL CIRCUIT DESIGN** **13**

Design of Half and Full Adders, Half and Full Subtractors, Binary Parallel Adder – Carry look ahead Adder, BCD Adder, Multiplexer, Demultiplexer, Magnitude Comparator, Decoder, Encoder, Priority Encoder.

**UNIT III SYNCHRONOUS SEQUENTIAL CIRCUITS** **13**

Flip flops – SR, JK, T, D, Master/Slave FF – operation and excitation tables, Triggering of FF, Analysis and design of clocked sequential circuits – Design - Moore/Mealy models, state minimization, state assignment, circuit implementation – Design of Counters- Ripple Counters, Ring Counters, Shift registers, Universal Shift Register.

**UNIT IV MEMORY DEVICES AND DIGITAL INTEGRATED CIRCUITS** **13**

Basic memory structure – ROM -PROM – EPROM – EEPROM –EAPROM, RAM – Static and dynamic RAM - Programmable Logic Devices – Programmable Logic Array (PLA) - Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA) - Implementation of combinational logic circuits using PLA, PAL.

Digital integrated circuits: Logic levels, propagation delay, power dissipation, fan-out and fan-in, noise margin, logic families and their characteristics-RTL, TTL, ECL, CMOS.

**UNIT V ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS** **8**

Analog and Digital Data Conversions – specifications – D/A converter– weighted resistor type, R–2R Ladder type – Voltage Mode and Current Mode - R–2R Ladder types– high speed sample–and–hold circuits – A/D Converters– Flash type – Successive Approximation type.

**TOTAL: 60 PERIODS**

**Text Books:**

1. M.Morris Mano and Michael D.Ciletti, “Digital Design”, Pearson, 5th Edition, 2013.
2. Thomas L. Floyd, —Digital Fundamentals, 10th Edition, Pearson Education Inc, 2011

**Reference Books:**

1. Sergio Franco, “Design with operational amplifiers and analog integrated circuits”, Mc Graw Hill Education, 3rd Edition, 2017.
2. S.Salivahanan and S.Arivazhagan, “Digital Circuits and Design”, 5th Edition, Oxford UniversityPress, 2018.
3. A.Anand Kumar, Fundamentals of Digital Circuits, 4th Edition, PHI Learning Private Limited, 2016.

| Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO) | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cos | POs | | | | | | | | | | | | PSOs | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | |
| CO1 | 3 | 3 | 3 | 2 | 1 | | | | | | 2 | | 3 | 2 | |
| CO2 | 3 | 3 | 3 | 2 | 1 | | | | | | 2 | | 3 | 2 | |
| CO3 | 3 | 3 | 3 | 2 | 1 | | | | | | 2 | | 3 | 2 | |
| CO4 | 3 | 3 | 3 | 2 | 1 | | | | | | 2 | | 3 | 2 | |
| CO5 | 3 | 3 | 3 | 2 | 1 | | | | | | 2 | | 3 | 2 | |
| | 3 | High | | | | 2 | Medium | | | | 1 | Low | | | |

| Formative assessment | | | |
|---|---|---|---|
| Bloom’s Level | Assessment Component | Marks | Total marks |
| Understand | Direct Measures: Quiz/Presentation/Tutorial | 5 | 15 |
| Understand | Indirect measures: Assignment/ Video presentation | 5 | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|---|---|---|---|---|
| Bloom’s Category | Continuous Assessment | | | Final Examination (Theory) (60) |
| | IAE 1 (7.5) | IAE 2 (7.5) | IAE 3 (10) | |
| Remember | 5 | 5 | 5 | 10 |
| Understand | 5 | 5 | 5 | 10 |
| Apply | 20 | 20 | 20 | 40 |
| Analyse | 20 | 20 | 20 | 40 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

| 20BM402 | MEDICAL AND RADIATION PHYSICS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| **Nature of Course** | Professional core | | | | |
| **Pre requisites** | Physics for Electrical Sciences | | | | |

**Course Objectives**

**The course is intended to**

1. Study principles and effects of ionizing and non-ionizing radiation in human body
2. Discuss the physics of the senses
3. Explore the effects of radiation in matter and how isotopes are produced
4. Understand interaction of radiations with biological subjects.
5. Understand various detectors for detecting the presence of ionizing radiation

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No. | Course Outcome | Bloom's Level |
|---|---|---|
| CO1. | Interpret about non-ionizing radiation, interaction with tissue and its effects. | Understand |
| CO2. | Define and compare impact of doses and Target theory for tumour | Apply |
| CO3. | Summarize how radioactive nuclides are used in nuclear medicine | Understand |
| CO4. | Explain the fundamentals of biological effects of radiations | Understand |
| CO5. | Illustrate the methods of treatment of skin disorders by photomedicine | Understand |

**Course Contents**

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

Introduction and objectives - Tissue as a leaky dielectric - Relaxation processes, Debye model, Cole–Cole model, Overview of non-ionizing radiation effects-Specific Absorption Rate [SAR]-Low Frequency Effects- Higher frequency effects. Physics of light and its unit- limits of vision and color vision an overview. Thermography- Application

**UNIT II BASIC RADIATION QUANTITIES 9**

Introduction - Different radiation Unit, Roentgen, gray, Sievert -Exposure-Inverse square law-KERMA-Kerma and absorbed dose–stopping power -Tissue relationship between the dosimetric quantities - Bremsstrahlung radiation, Bragg's curve-concept of LD 30/50-Stochastic and Non-stochastic effects-Radiolysis of water – Basics of Target Theory – Single and Multiple Targets for melanoma curing

**UNIT III PRINCIPLES OF RADIOACTIVE NUCLIDES 9**

Radioactive Decay – Spontaneous Emission – Isometric Transition – Gamma ray emission, alpha, beta, Positron decay, electron capture, Sources of Radioisotopes Natural and Artificial radioactivity,. Production of radionuclides – Cyclotron produced Radionuclide- Reactor produced Radio- nuclide-Technetium generator - Radionuclide applications in Medicine and Therapy

**UNIT IV INTERACTION OF RADIATION WITH TISSUE AS MATTER 9**

Interaction of charged particles with Tissue as matter –Biological effects of radiation - Specific ionization, Linear energy transfer range, Radiation Biological Effectiveness [RBE], Annihilation, Interaction of X and Gamma radiation with Tissue- Photoelectric effect, Compton Scattering, Pair production, Attenuation of Gamma Radiation, Interaction of neutron with tissue and their clinical significance.

**UNIT V PHOTOMEDICINE 9**

Phototherapy - PUVA (Photochemotherapy), Narrowband UVB -skin disorders treatments – for Atopic dermatitis / Eczema- Psoriasis- Pruritus (itching)-Graft-versus-Host Disease (GVHD)-Vitiligo- and UVA1 phototherapy – Sclerodermas- Nephrogenic Systemic Fibrosis (NSF). Photopheresis - Cutaneous T-cell Lymphoma (CTCL)

**Total: 45 Periods**

*Passed in Board of studies Meeting*

CHAIRMAN - BOARD OF STUDIES

*Approved in Academic Council Meeting*

**TEXT BOOKS:**


1. Gopal B. Saha, “Physics and Radiobiology of Nuclear Medicine”, 4th Edition, Springer, 2013.
2. John R Cameran , James G Skofronick “Medical Physics” John-Wiley & Sons. 1978
3. 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.
4. W.J.Meredith and J.B. Massey “ Fundamental Physics of Radiology” Varghese Publishing house. 1992


**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
4. P.Uma Devi, A.Nagarathnam , B S SatishRao , “Intorduction to Radiation Biology” B.I Chur Chill Livingstone pvt Ltd, 2000
5. Lim, H.W - Clinical Photomedicine-Routledge (2018)


| Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO) | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cos | POs | | | | | | | | | | | | PSOs | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | |
| CO1 | 3 | | | | | 3 | | | | 3 | | | | | |
| CO2 | 3 | 2 | | | | | | | | | | | | | |
| CO3 | 3 | | | 3 | | 2 | | 3 | | | 3 | | | | |
| CO4 | | | 2 | | | | | | 2 | | 2 | 3 | | | |
| CO5 | | | 3 | 3 | | | | | 3 | | | 2 | | | |
| | 3 | High | | | | 2 | Medium | | | | 1 | Low | | | |

| Formative assessment | | | |
|---|---|---|---|
| **Bloom’s Level** | **Assessment Component** | **Marks** | **Total marks** |
| Understand | Direct Measures: Quiz/Presentation/Tutorial | 5 | 15 |
| Understand | Indirect measures: Assignment/ Video presentation | 5 | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|---|---|---|---|---|
| **Bloom’s Category** | **Continuous Assessment** | | | **Final Examination (Theory) (60)** |
| | **IAE 1(7.5)** | **IAE 2(7.5)** | **IAE 3 (10)** | |
| Remember | 10 | 10 | 10 | 10 |
| Understand | 10 | 10 | 10 | 20 |
| Apply | 20 | 10 | 20 | 40 |
| Analyse | 10 | 20 | 10 | 30 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

| 20BM403 | HEALTHCARE DATA ANALYTICS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

| | |
|---|---|
| **Nature of Course** | Professional core |
| **Pre requisites** | Fundamentals of Computers |

**Course Objectives**

**The course is intended to**

1. Study principles and basics of Bigdata platform
2. Understand biomedical text processing and discuss the retrieval of health data
3. Explore the role of social media in health analytics with data-ware housing.
4. Understand predictive models with biological subjects.
5. Understand various wireless health and quantified-self parameters on daily routine basis.

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No. | Course Outcome | Bloom's Level |
|---|---|---|
| CO1 | Understand the basics of big data and its contribution towards health analytics. | Understand |
| CO2 | Analyze the use of medical text data for processing/retrieval of health information | Analyze |
| CO3 | Determine the role of social media in health analytics and the need for data Warehousing | Apply |
| CO4 | Use R environment for analyzing healthcare data using Bayesian, Stochastic approach and Markov models. | Analyze |
| CO5 | Illustrate the need for wireless health and quantified self -movement in health analytics. | Understand |

**Course Contents**

**UNIT I AN INTRODUCTION TO HEALTHCARE DATA ANALYTICS 9**

Introduction - Healthcare Data Sources and Basic Analytics-Data Analytics for Healthcare-Applications and Practical Systems for Healthcare-Big Data Principles and their Application to Healthcare - social media as a Big Data Resource for Analytics, Health Surveys and Patient Reported Outcome (PRO) Analytics

**UNIT II GENOMIC DATA ANALYSIS FOR PERSONALIZED MEDICINE 9**

Genomic Data Generation-Methods and Standards for Genomic Data Analysis-Biomedical Text Processing, Health Information Retrieval, and Working with Healthcare Data Warehouses to inform Clinical Operations

**UNIT III DESCRIPTIVE ANALYSIS AND STATISTICS 9**

Measures of Central tendency - Arithmetic Mean, Median, Mode, Measures of Variability - Range, Variance, Standard Deviation, Co-efficient of Variation, Measures of Relative Standing. Testing of hypothesis-Large sample test - Test of significance for single proportion, difference of proportions, single mean and difference of means, F-test for variances, Chi square test for goodness of fit and independence of attributes - ANOVA one and Two way.

**UNIT IV PREDICTIVE ANALYTICS 9**

Probability distribution- axioms, conditional probability, law of total probability, Baye's theorem, independence-Stochastic approach, and Markov models. Applications in predictive analytics and Predictive Modelling

**UNIT V APPLICATIONS IN HEALTHCARE 9**

Health data expenditure, machine learning, data transformation, deriving rules, patterns, opportunities, Wireless Health and the Quantified Self Movement: Overview and Implications for Healthcare Analytics, Complete Human Condition Monitoring and Guidance, Electronic Health Records, Patient - Provider – Portals **Total Periods: 45**

*Passed in Board of studies Meeting* *Approved in Academic Council Meeting*

CHAIRMAN - BOARD OF STUDIES

**TEXT BOOK**

1. Reddy, Chandan K., Aggarwal, Charu C “Healthcare Data Analytics” Taylor & Francis ,2019
2. Nilanjan Dey(editor), " Big Data Analytics for Intelligent Healthcare Management” Academic press,2019.

**REFERENCES**

1. Wullianallur Raghupathi and Viju Raghupath, "Big data analytics in Healthcare: Promise and Potential", Health information Science and Systems-Biomed Central, 2014.
2. Chris Eaton, Dirk Deroos, Tom Deutsch et al., "Understand Big Data", McGrawHill, 2013.
3. Kim Seefeld, Ernst Linder, "Statistics using R with Biological Examples", University of North Hampshire 2017.
4. Alberto Cordoba, "Understand the Predictive Analytics Lifecycle", Wiley, 2014.
5. Baoying Wang, Ruowang Li, "Big Data Analytics in Bioinformatics and Healthcare", William Perrizo, CRC press,2015.

| Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO) | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Cos** | **POs** | | | | | | | | | | | | **PSOs** | | |
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | |
| CO1 | 3 | 2 | 2 | | | | | | | 2 | | | 3 | 2 | |
| CO2 | 3 | 2 | 2 | | | | | | | 2 | | | 3 | 2 | |
| CO3 | 3 | 2 | 2 | | | | | | | 2 | | | 3 | 2 | |
| CO4 | 3 | 2 | 2 | | | | | | | 2 | | | 3 | 2 | |
| CO5 | 3 | 2 | 2 | | | | | | | 2 | | | 3 | 2 | |
| | 3 | High | | | | 2 | Medium | | | | 1 | Low | | | |

| Formative assessment | | | |
|---|---|---|---|
| **Bloom’s Level** | **Assessment Component** | **Marks** | **Total marks** |
| Understand | Direct Measures: Quiz/Presentation/Tutorial | 5 | 15 |
| Understand | Indirect measures: Assignment/ Video presentation | 5 | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|---|---|---|---|---|
| **Bloom’s Category** | **Continuous Assessment** | | | **Final Examination (Theory) (60)** |
| | **IAE 1 (7.5)** | **IAE 2 (7.5)** | **IAE 3 (10)** | |
| Remember | 10 | 10 | 10 | 10 |
| Understand | 10 | 20 | 10 | 30 |
| Apply | 20 | 10 | 20 | 40 |
| Analyse | 10 | 10 | 10 | 20 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

| 20BM404 | PATHOLOGY AND MICROBIOLOGY | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| **Nature of Course** | Professional core | | | | |
| **Pre requisites** | Biochemistry | | | | |

**Course Objectives**

**The course is intended to**

1. Gain knowledge on the structural and functional aspects of living organisms.
2. Know the etiology and remedy in treating the pathological diseases.
3. Empower the importance of public health.
4. Learn the different staining methods and principles of different types of microscopy
5. Practice on chemical and structural examinations, histopathological examinations etc

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No. | Course Outcome | Bloom's Level |
|---|---|---|
| CO1 | Analyze structural and functional aspects of living organisms. | Analyze |
| CO2 | Summarize the function of microscope | Understand |
| CO3 | Interpret the importance of public health. | Understand |
| CO4 | Compare the methods involved in treating the pathological diseases. | Remember |
| CO5 | Infer the immunology related concepts | Understand |

**Course Content**

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

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

**UNIT II FLUID AND HEMODYNAMIC DERRANGEMENTS 9**

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

**UNIT III 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**

*Passed in Board of studies Meeting* *Approved in Academic Council Meeting*

CHAIRMAN - BOARD OF STUDIES

**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" Orient black swan, 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


| **Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)** | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Cos** | **Pos** | | | | | | | | | | | | **PSOs** | | |
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| CO1 | | 2 | | | 2 | | | 3 | | | | | | | |
| CO2 | 2 | | | | 1 | | | | 3 | | | 2 | | | |
| CO3 | | | | | 3 | 3 | | 2 | 1 | | | | | | |
| CO4 | | 3 | | | | 2 | | 3 | | 1 | 2 | 2 | | | |
| CO5 | | | | | | | | | | | | | | | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| **Formative assessment** | | | |
|---|---|---|---|
| **Bloom's Level** | **Assessment Component** | **Marks** | **Total marks** |
| Remember | Online Quiz | 5 | 15 |
| Understand | Tutorial Class / Assignment | 5 | |
| | Attendance | 5 | |

| **Summative Assessment** | | | | |
|---|---|---|---|---|
| **Bloom's Category** | **Internal Assessment Examinations** | | | **Final Examination (60)** |
| | **IAE 1 (7.5)** | **IAE 2 (7.5)** | **IAE 3 (10)** | |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 10 | 10 | 10 | 20 |
| Apply | 20 | 20 | 20 | 40 |
| Analyze | 10 | 10 | 10 | 20 |
| Evaluate | | | | |
| Create | | | | |

| 20CS407 | DATA STRUCTURES USING OBJECT ORIENTED PROGRAMMING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 4 |
| **Nature of Course** | Engineering Sciences | | | | |
| **Pre requisites** | Fundamentals of computers | | | | |

**Course Objectives**

The course is intended to

1. Learn the basics of C++
2. Comprehend the fundamentals of member functions and classes.
3. Learn the concepts of inheritance and polymorphism in C++.
4. Learn linear, non-linear data structures and their applications.
5. Use object-oriented programming to perform sorting and searching.

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No. | Course Outcome | Bloom's Level |
|---|---|---|
| CO1. | Understand the basics of C++. | Understand |
| CO2. | Illustrate the member function and classes, | Understand |
| CO3. | Summarize the inheritance and polymorphism. | Understand |
| CO4. | Identify the linear and non-linear data structures. | Analyze |
| CO5. | Solve the sorting and searching problems. | Apply |

**Course Contents**

**Unit - I BASICS OF C++ 9**

Basic components of a C++, Program and program structure, Compiling and Executing C++ Program. Selection of control statements in C++ – arrays - functions.

**Unit - II MEMBER FUNCTIONS AND CLASSES 9**

Member Functions and Classes - Scope and Accessing Class Members – Reference Variables – Initialization – Constructors – Destructors – Friend Function – Dynamic Memory Allocation Overloading: Function overloading and Operator Overloading.

**Unit - III INHERITANCE & POLYMORPHISM 9**

Inheritance - Base Classes and Derived Classes – Protected Members – Casting Class pointers – Constructors and Destructors in derived Classes - Virtual functions – This Pointer – Dynamic Binding.

**Unit – IV LINEAR AND NON-LINEAR DATA STRUCTURES 9**

Abstract Data Types (ADTs) – List ADT: array-based implementation – Singly linked list implementation- Stack ADT: array-based implementation – Trees – Binary Trees – Binary tree representation and traversals.

**Unit - V SEARCHING AND SORTING ALGORITHMS 9**

Sorting algorithms: Insertion sort – Quick sort – Merge sort – Searching: Linear search –Binary Search.

**Total: 45 Periods**

**List of Exercises**

| S.No | List of Exercises | CO Mapping | RBT |
|---|---|---|---|
| 1 | Develop simple programs in C++ using Control statements. | CO1 | Apply |
| 2 | Implement looping in C++. | CO1 | Apply |
| 3 | Implement friend function in C++. | CO2 | Apply |
| 4 | Develop the simple program with function and operator overloading. | CO2 | Apply |
| 5 | Build a C++ program with classes and objects. | CO3 | Apply |
| 6 | Make use of inheritance in C++ application. | CO3 | Apply |
| 7 | Build a C++ program to perform list operations using linked list. | CO4 | Apply |
| 8 | Construct a C++ program to perform stack operation using array | CO4 | Apply |
| 9 | Build a C++ application to perform merge sort. | CO5 | Apply |
| 10 | Construct a C++ program to perform Binary search | CO5 | Apply |

**Text Books:**


1. Deitel and Deitel, “C++, How To Program”, Fifth Edition, Pearson Education, 2005.
2. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C++”, Third Edition, AddisonWesley, 2007.


**Reference Books:**


1. Bhushan Trivedi, “Programming with ANSI C++, A Step-By-Step approach”, Oxford University Press, 2010.
2. Goodrich, Michael T., Roberto Tamassia, David Mount, “Data Structures and Algorithms in C++”, 7th Edition, Wiley. 2004.
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, “Introduction to Algorithms”, Second Edition, Mc Graw Hill, 2002.
4. Bjarne Stroustrup, “The C++ Programming Language”, 3rd Edition, Pearson Education, 2007.
5. Ellis Horowitz, Sartaj Sahni and Dinesh Mehta, “Fundamentals of Data Structures in C++”, Galgotia Publications, 2007


**Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)**

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 3 | 2 | | | | | | | | | 1 | 3 | 1 | |
| CO2 | 3 | 3 | 2 | | | | | | | | | 1 | 3 | 1 | |
| CO3 | 3 | 3 | 2 | | | | | | | | | 1 | 3 | 1 | |
| CO4 | 3 | 3 | 2 | | | | | | | | | 1 | 3 | 1 | |
| CO5 | 3 | 3 | 2 | | | | | | | | | 1 | 3 | 1 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Formative assessment | | | |
|---|---|---|---|
| **Bloom's Level** | **Assessment Component** | **Marks** | **Total marks** |
| Remember | Classroom or Online Quiz | 5 | 15 |
| Understand | Class Presentation/Power point presentation | 5 | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|---|---|---|---|---|
| **Bloom's Category** | **Continuous Assessment Tests** | | | **Terminal Examination** |
| | **IAE1 (7.5)** | **IAE2 (7.5)** | **IAE3 (10)** | **(60)** |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 20 | 20 | 20 | 50 |
| Apply | 20 | 20 | 20 | 30 |
| Analyse | 0 | 0 | 0 | 0 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

| 20BM405 | PATHOLOGY AND MICROBIOLOGY LABORATORY | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 4 | 2 |
| **Nature of Course** | Professional Core | | | | |
| **Pre requisites** | Nil | | | | |

**Course Objectives**

The course is intended to

1. Use Compound microscope.
2. Practice on chemical examinations, Cryoprocessing, Histopathological examinations etc
3. Understand the growth of microorganism.
4. Study Antigen-Antibody reaction.
5. Practice different staining processes.

**Course Outcomes**

On successful completion of the course, students will be able to

1. Explain the function of microscope
2. Perform different chemical examinations, Histopathological examinations,
3. Perform practical experiments on tissue processing, cryo-processing, staining etc
4. Discover the growth of microorganism.
5. Identify Antigen-Antibody reaction.

**CYCLE 1**

| S.No. | Course Content | CO | Bloom's Level |
|---|---|---|---|
| 1 | Study of parts of compound microscope | CO 1 | Understand |
| 2 | Urine physical and chemical examination (protein, reducing substances, ketones, bilirubin and blood) | CO 2 | Apply |
| 3 | Histopathological slides of benign and malignant tumours. | CO 2 | Understand |
| 4 | Manual paraffin tissue processing and section cutting (demonstration) | CO 3 | Apply |
| 5 | Cryo processing of tissue and cryosectioning (demonstration) | CO 3 | Apply |
| 6 | Hematology slides of anemia and leukemia. | CO 3 | Understand |
| 7 | Study of bone marrow charts. | CO 4 | Remembering |

**CYCLE 2**

| S.No. | Course Content | CO | Bloom's Level |
|---|---|---|---|
| 1 | Identify the type of bacteria by conducting Basic staining – Hematoxylin and eosin staining for the given Pathological tissue | CO 3 | Understand |
| 2 | Identify the type of bacteria by conducting Special stains – cresyl fast Blue (CFV)- Trichrome – oil red O – PAS for the given Pathological tissue | CO 3 | Understand |
| 3 | Perform capsule staining of given Pathological tissue | CO 3 | Apply |
| 5 | Perform Gram staining of given Pathological tissue | CO 3 | Apply |

| | | | |
|---|---|---|---|
| 6 | Identify the given bacterial sample by performing AFB staining technique | CO 3 | Understand |
| 7 | Perform Ag-Ab immune-electrophoresis and interpret results for determining the antibody specificity | CO 5 | Understand |
| 8 | Write a comment on Slides of malarial parasites, micro filaria and leishmania donovani. | CO 4 | Understand |

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) Program Specific Outcomes (PSO)**

| COs | Pos | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | |
| 1 | 3 | 1 | 2 | | 2 | 1 | | | 3 | | | | | | |
| 2 | 3 | 1 | 2 | | 2 | 1 | | | 3 | | | | | | |
| 3 | 3 | 1 | 2 | | 2 | 1 | | | 3 | | | | | | |
| 4 | 3 | 1 | 2 | | 2 | 1 | | | 3 | | | | | | |
| 5 | 3 | 1 | 2 | | 2 | 1 | | | 3 | | | | | | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

**Summative assessment based on Continuous and Final Examination**

| Bloom's Level | Rubric based Continuous Assessment [50 marks] | Final Examination [50 marks] |
|---|---|---|
| Remember | 10 | 10 |
| Understand | 40 | 40 |
| Apply | 30 | 30 |
| Analyze | 20 | 20 |
| Evaluate | - | - |
| Create | - | - |

| 20MC401 | SOFT SKILL | L | T | P | C |
|---|---|---|---|---|---|
| | | 2 | 0 | 0 | 0 |
| **Nature of Course** | Mandatory Course | | | | |
| **Pre requisites** | Nil | | | | |

**Course Objectives**

The course is intended to

1. Improve language skills in personal and professional life.
2. Equip students with the vital communication and soft skills to succeed in the highly competitive international arena.
3. Focus on the fundamental soft skills and of their practical social and work place usage.
4. Learn to identify and overcome the barriers in interpersonal relationships.
5. Enhance employability skills and ensure career success.

**Course Outcomes**

On successful completion of the course, students will be able to

| CO.No. | Course Outcome | Bloom's Level |
|---|---|---|
| CO1 | Relate the significance and fundamental nature of soft skills. | Remember |
| CO2 | Take part in a wide range of public speaking and professional group discussions. | Apply |
| CO3 | Plan one's time effectively and productively, especially at work. | Apply |
| CO4 | Make use of leadership skills to manage stress & conflict. | Apply |
| CO5 | Organize presentation effectively and participate in interview with confidence. | Apply |

**Course Contents**

**Unit - I Introduction to soft skills and Interpersonal Communication** **6**

An Introduction – Definition and Significance of Soft Skills; Interpersonal communication-types of interpersonal communication.

**Unit - II Public Speaking and Oral Communication skills** **6**

Public Speaking: Skills, Methods, Strategies Group Discussion: Importance, Planning, Elements.

**Unit – III Time Management and Personality Development** **6**

Time Management – concepts and essentials tips. Personality-development – meaning, SWOT analysis & goal setting- Stress and conflict management.

**Unit – IV Leadership skills and Emotional intelligence** **6**

Leadership skills: Concept of Leadership and honing Leadership Skills - Problem-Solving Skills - Group and Ethical Decision-Making. Emotional Intelligence: Strategies to enhance Emotional Intelligence.

**Unit-V Interview Skills** **6**

Interviewer - Interviewee perspectives - Self Introduction and Presentation: Types, Content and Essential Tips–before, during and after a presentation, Overcoming Nervousness - Mock Interview.

**Total:30 Periods**

**Text Books**

1. Managing Soft Skills for Personality Development–edited by B.N.Ghosh, McGraw Hill India, 2018.
2. English and Soft Skills–S.P. Dhanavel, Orient Black swan India, 2017

**Reference Books:**

1. Soft Skill Business and Professional Communication Book by Sutapa Banerjee, 2016
2. Communication Skills Book by Pushp Lata and Sanjay Kumar, 2015

**WEB REFERENCE:**

https://nptel.ac.in/courses/109/107/109107121/

| **Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)** | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs** | **POs** | | | | | | | | | | | | **PSOs** | | |
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| CO1 | | | | | | | | 1 | 2 | 3 | | 2 | | | |
| CO2 | | | | | | | | 1 | 2 | 3 | | 2 | | | |
| CO3 | | | | | | | | 1 | 2 | 3 | | 2 | | | |
| CO4 | | | | | | | | 1 | 2 | 3 | | 2 | | | |
| CO5 | | | | | | | | 1 | 2 | 3 | | 2 | | | |
| | **3** | **High** | | | | **2** | **Medium** | | | | **1** | **Low** | | | |

| **Bloom's Level** | **Summative Assessment (Internal Mode)** | |
|---|---|---|
| | **Assessment 1 (50 Marks)** | **Assessment 2 (50 Marks)** |
| Remember | 10 | 10 |
| Understand | 10 | 10 |
| Apply | 30 | 30 |
| Analyze | | |
| Evaluate | | |
| Create | | |

| 20BMA02 | FRONTIERS IN MEDICAL INFORMATICS | L | T | P | C |
|---|---|---|---|---|---|
| | | 1 | 0 | 0 | 1 |
| Nature of course | Employability Enhancement Course | | | | |
| Pre requisites | Nil | | | | |

**Course Objectives**

The course is intended to

1. Explore practical aspects of Digital Healthcare
2. Apply DICOM & HL7 towards Interoperability and Portability
3. Develop diagnostic display in computer aided diagnosis
4. Use extensive guidelines of National Digital Health Blueprint
5. Create plots and reports for clinical decision support system

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---|---|---|
| CO 1 | Understand the principles of Medical Informatics (MI) | Understand |
| CO 2 | Summarize the standards, applications, and uses in demanding clinical environment | Understand |
| CO 3 | Identify and solve MI problems | Apply |
| CO 4 | Apply MI concepts to build and run Clinical processes | Apply |
| CO 5 | Optimize complex healthcare processes | Apply |

**Course Contents**

Introduction to Medical Informatics MI - Digital Healthcare-Challenges in Digital Healthcare-Technology acceptance by healthcare professionals - Interoperability and Portability - Privacy - Cyber-Security - Largescale Data Handling & Analysis Medical standards (DICOM and HL7) HIS, RIS, PACS. IHE and workflow integration- Basic medical imaging: acquisition, diagnostic display, enhancement and analysis- Computer aided diagnosis (CAD) **8 Hours**

National Digital Health Blueprint-Networking and teleradiology- Fault-tolerance, scalability, and robustness - Security and confidentiality in medicine- Clinical modelling and performance optimization-Bringing MI to hospitals - Patient flow analysis. Scheduling problems-Clinical decision support- Clinical software development- Medical start-ups **7 Hours**

**Total: 15 Hours**

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Cos** | **POs** | | | | | | | | | | | | **PSOs** | | |
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| CO 1 | | | | | | | | | | | 3 | 3 | 1 | 2 | |
| CO 2 | | | | | | | | | | | 3 | 3 | 1 | 2 | |
| CO 3 | | | | | | | | | | | 3 | 3 | 1 | 2 | |
| CO 4 | | | | | | | | | | | 3 | 3 | 1 | 2 | |
| CO 5 | | | | | | | | | | | 3 | 3 | 1 | 2 | |
| | **3** | **High** | | | | **2** | **Medium** | | | | | **1** | **Low** | | |

| **Bloom's Level** | **Summative Assessment (Internal Mode)** | |
|---|---|---|
| | **Assessment 1 (50 Marks)** | **Assessment 2 (50 Marks)** |
| Remember | 10 | 10 |
| Understand | 10 | 10 |
| Apply | 30 | 30 |
| Analyze | | |
| Evaluate | | |
| Create | | |

**V Semester**

| 20BM501 | BIOCONTROL SYSTEM | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 2 | 0 | 4 |
| **Nature of course** | Professional Core | | | | |
| **Pre requisites** | Basics of Electrical Sciences | | | | |

**Course Objectives**

The course is intended to

1. Understand the concept behind feedback and continuum in Physiological systems and subsystems
2. Analyze the systems in time domain and its responses
3. Analyze the systems in frequency domain and to understand the concept of stability
4. Apply Sate Variables and its principles to biological systems
5. Analyze biological control system models with few case studies using MATLAB

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---|---|---|
| CO 1 | Understand the need for mathematical modeling of various systems, representation of systems in block diagrams and signal flow graphs and are introduced to biological control systems | Understanding |
| CO 2 | Analyze the time response of various systems and discuss the concept of system stability | Analyzing |
| CO 3 | Analyze the frequency response characteristics of various systems using different charts | Analyzing |
| CO 4 | Understand the concept of modeling basic physiological systems | Understanding |
| CO 5 | Comprehend the application aspects of time and frequency response analysis in physiological control systems. | Applying |

**Course Contents**

**Unit – I** **Introduction** **12**

Concepts of control systems- Open loop and closed loop control systems and their differences- Different examples of Biocontrol systems- classification of control systems. Mathematical models of physiological systems: Differential equations transfer function and block diagram representation of physiological systems- Electrical systems - Block diagram reduction using algebra- Representation by signal flow graph- reduction using Mason's gain formula

**Unit – II** **Time Response Analysis** **12**

Standard test signals- impulse, step and ramp response analysis of first order and second order systems- Characteristics Equation of Feedback control systems, Transient Response of second order systems- Time domain specifications Steady state response- Steady state errors and error constants- Effects of proportional derivative, proportional integral systems, performance indices . Definition of stability, Routh- Hurwitz criteria of stability, root locus technique, construction of root locus and study of stability

**Unit – III** **Frequency Response Analysis** **12**

Frequency response specifications- Bode diagrams- Determination of Frequency domain specifications and transfer function from the Bode diagram- Phase margin and Gain margin- Stability Analysis from Bode plots. Polar plots, Nyquist plots and applications of Nyquist criterion to find the stability- Effects of adding poles and zeros to G(s)H(s) on the shape of the Nyquist diagrams, Constant M and N circles- Nichols Chart- Frequency Domain specifications from Nichols Chart

**Unit – IV** **State-Variable Analysis** **12**

Introduction of state, state variables and state model, derivation of state models from block diagrams, Relationship between state equations and transfer functions- Characteristic equation, eigenvalues, eigenvectors, canonical forms Diagonalization- solving the time invariant state equations- State Transition Matrix. Controllability and observability

| **Unit – V** | **Biological Control System Analysis** | **12** |
|---|---|---|

Simple models of muscle stretch reflex action, Study of steady state analysis of muscle stretch reflex action, Study of transient response analysis of neuromuscular reflex model action, Study of frequency response of circulatory control model, Stability analysis of Pupillary light reflex.

**Total: 60 Periods**

**Text Books**

1. J. Nagarath and M. Gopal Control Systems Engineering", Fifth Edition, Anshan Publishers, 2008.
2. Michael C K Khoo, Physiological Control Systems, IEEE Press, Prentice Hall of India, 2005

**Reference Books**

1. Norman S. Nise, "Control Systems Engineering", John Wiley & Sons, 2014, 7th Edition
2. Benjamin C. Kuo, Automatic Control Systems, Prentice Hall of India, 2014.
3. John Enderle Susan Blanchard, Joseph Bronzino Introduction to Biomedical Engineering, second edition, Academic Press, 2005.
4. Richard C. Dorf, Robert H. Bishop, Modern control systems, Pearson, 2004.

**Additional / Web References**

**Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)**

| **COs** | **POs** | | | | | | | | | | | | **PSOs** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| CO1 | 3 | 3 | 2 | | | | | | | | | | 2 | | |
| CO2 | 3 | 2 | 2 | 2 | | | | | | 2 | | | 2 | | |
| CO3 | 3 | 3 | 1 | | | 1 | | | | | | | 2 | | |
| CO4 | 2 | 2 | 2 | 2 | | | | | | | | | 1 | | |
| CO5 | 3 | 3 | 2 | | | | | | | 2 | | | 2 | | |
| | 3 | High | | 2 | Medium | | | | | | | 1 | Low | | |

| **Formative assessment** | | | |
|---|---|---|---|
| **Bloom's Level** | **Assessment Component** | **Marks** | **Total marks** |
| Remember | Online Quiz | 5 | 15 |
| Understand | Tutorial Class / Assignment | 5 | |
| | Attendance | 5 | |

*Passed in Board of studies Meeting*

CHAIRMAN - BOARD OF STUDIES

*Approved in Academic Council Meeting*

| Summative Assessment | | | | |
|---|---|---|---|---|
| Bloom's Category | Continuous Assessment Tests | | | Final Examination (60) |
| | IAE-1 (7.5) | IAE-2 (7.5) | IAE-3 (10) | |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 30 | 30 | 30 | 60 |
| Apply | 10 | 10 | 10 | 20 |
| Analyze | | | | |
| Evaluate | | | | |
| Create | | | | |

| 20BM502 | BIOMEDICAL INSTRUMENTATION | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| **Nature of course** | Professional Core | | | | |
| **Pre requisites** | Basics of Biomedical Engineering | | | | |

**Course Objectives**

The course is intended to

1. Elaborate the development of biomedical instrumentation and its application in medical field, and the concepts behind measuring the blood pressure, cardiac output and heart sounds.
2. Revise the basics of EEG and to introduce the concepts of measuring the brain activity,
3. Familiarize with the basic principle, working and design of various automated diagnostic equipment related to ENT and ophthalmology.
4. Elaborate the need of scopy techniques in medical field and to develop the Understand towards the medical laboratory equipment.
5. Deliver the awareness towards shocks and hazards.

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---|---|---|
| CO 1 | Comprehend the development of biomedical instrumentation and its application in medical field. | Understand |
| CO 2 | Excel in measuring the blood pressure, cardiac output and heart sounds and to design small products related to this application. | Apply Analyze |
| CO 3 | Conceive the basics of EEG and the concepts of measuring the brain activity | Understand |
| CO 4 | Understand the basic principle, working and design of various automated diagnostic equipment related to ENT and ophthalmology. | Apply |
| CO 5 | Ability to plan, design and implement an instrument for medical applications. | |

**Course Contents**

**Unit – I** **Introduction** **9**

Introduction to Physiological System of Human Body, Development of Biomedical Instrumentation, Man instrument system, Problems encountered in the measurement, Body as a Control System, General constraints in design of medical instrumentation system.

**Unit – II** **Cardiovascular and Respiratory Instrumentation** **9**

Heart and cardiovascular system-model, Physiological Pressures, Blood pressure measurement, Measurement of heart sounds, Systemic and Pulmonary Circulation, Blood flow measurement, Cardiac output, Measurement of Pulmonary function, ECG, Standard Lead System, Respiratory system-model, Spirometer, Plethysmography.

**Unit – III** **Nervous System and Instrumentation** **9**

Neuronal communication system, The organization of the brain, measurements from the nervous system, EEG, Standard Lead System, Amplitude and Frequency Bands, Evoked Potential Recording, Sensory Measurement, Experimental Analysis of Behavior, Biofeedback Instrumentation

**Unit – IV** **ENT, Ophthalmic and Urological Instrumentation** **9**

Mechanism of hearing, Measurement of Sound, Basic Audiometer, Pure Tone and Speech Audiometer, Hearing Aids, Optometry, EOG, Glucometer, Endoscope, Cystoscope, Urological system: Nephroscope, Resectoscope, Ureteroscope

**Unit – V** **Medical Laboratory Instrumentation and Electrical Safety** **9**

Calorimeter, Flame photometer, Spectrophotometer, pH and Blood Gas Analyzer, Auto Analyzer, Electrical Safety and Hazards - Physiological Effects of Electrical Current, Shock Hazards, Methods of Accident Prevention-Electrical Safety Analyzer

**Total: 45 Periods**

**Text Books**

1. Joseph Carr, Brown, Introduction to Biomedical Equipment, Pearson, 2014

**Reference Books**

1. Leslie Cromwell, “Biomedical Instrumentation and measurement”, PHI, New Delhi, 2015
2. John G. Webster, “Medical Instrumentation Application and Design”, John Wiley and sons, New York, 2015.
3. Khandpur R.S Hand Book of Biomedical Instrumentation – Tata McGraw Hill publication , New Delhi, 2014

**Additional / Web References**

**Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)**

| COs | Pos | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO2 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO3 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO4 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO5 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Formative assessment | | | |
|---|---|---|---|
| **Bloom’s Level** | **Assessment Component** | **Marks** | **Total marks** |
| Remember | Online Quiz | 5 | 15 |
| Understand | Tutorial Class / Assignment | 5 | |
| | Attendance | 5 | |

**Summative Assessment**

| Bloom’s Category | Continuous Assessment Tests | | | Terminal Examination (60) |
|---|---|---|---|---|
| | IAE-1 (7.5) | IAE-2 (7.5) | IAE-3 (10) | |
| Remember | 5 | 5 | 5 | 10 |
| Understand | 5 | 5 | 5 | 20 |
| Apply | 20 | 20 | 20 | 30 |
| Analyze | 20 | 20 | 20 | 40 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

| 20BM503 | BIOSIGNAL PROCESSING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 2 | 0 | 4 |
| **Nature of course** | Professional Core | | | | |
| **Pre requisites** | Signals and Systems for Bioengineers | | | | |

**Course Objectives**

The course is intended to

1. Understand characteristics of some of the most commonly used biomedical signals, including ECG, EEG, EOG, and EMG.
2. Understand choice of filters to remove noise and artifacts from biomedical signals.
3. Apply established engineering methods to analyse ECG signal problems.
4. Apply established engineering methods to analyse neurological signals.
5. Analyse various biomedical signals through advanced techniques.

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---|---|---|
| CO 1 | Draw different types of biomedical signals and identify their spectral components. | Applying |
| CO 2 | Use different filters on biomedical signals and judge filter performance. | Analyzing |
| CO 3 | Identify physiological interferences and artifacts affecting ECG signal. | Analyzing |
| CO 4 | Compute power and correlation spectra of EEG signal. | Applying |
| CO 5 | Propose an algorithm to classify biomedical signals. | Applying |

**Course Contents**

| | | |
|---|---|---|
| **Unit – I** | **INTRODUCTION TO BIOMEDICAL SIGNALS** | **12** |

The Nature of Biomedical Signals - Examples of Biomedical Signals - The action potential of a cardiac myocyte - The action potential of a neuron - The electroneurogram (ENG) - The electromyogram (EMG) waves of a cardiac cycle as an ECG signal. electroencephalogram (EEG) – Event related potentials (ERPs) - Vibromyogram (VMG)- Vibroarthrogram (VAG) Objectives of Biomedical Signal Analysis

| | | |
|---|---|---|
| **Unit – II** | **Filtering for Removal of Artifacts** | **12** |

Time-domain Filters – synchronized averaging, Moving Average Filters, Derivative-based operators to remove low-frequency artifacts. Frequency-domain filters – Removal of High Frequency noise, Removal of low frequency noise, Removal of periodic artifacts, optimal filter- Wiener filter, Adaptive filters for removal of interference.

| | | |
|---|---|---|
| **Unit – III** | **Cardiovascular Applications** | **12** |

ECG Signal Processing: Baseline Wandering, Power line interference, Muscle noise filtering – QRS detection, Adaptive noise canceling in ECG, improved adaptive filtering in FECG, Wavelet detection in ECG – structural features, matched filtering, adaptive wavelet detection, detection of overlapping wavelets. Computation of diagnostic signal parameters of ECG like Heart rate and QRS detection using Multivariate analysis (PCA and ICA). Segmentation of PCG, intensity patterns, Spectral modeling and analysis of PCG signals.

| | | |
|---|---|---|
| **Unit – IV** | **Neurological signal processing** | **12** |

Correlation Analysis of EEG Rhythms- Detection of EEG rhythms- EEG analysis – Coherence analysis of EEG channels- Parametric modelling – Linear prediction theory; Autoregressive (AR) method; Recursive estimation of AR parameters.

| | | |
|---|---|---|
| **Unit – V** | **Analysis On Waveshape, Signal Classification and Recognition** | **12** |

Modeling intramuscular EMG-Intramuscular signal decomposition-Fractal analysis of EMG signals. Statistical analysis of VAG signals. Analysis on amplitude and latency of MEG signals. Analysis of ERP effect. Signal classification and recognition – Statistical signal classification, linear discriminant function, direct feature selection and ordering, Back propagation neural network-based classification. Analysis of EEG using Empirical mode decomposition (EMD).

**Total : 60 Periods**

**Text Books**

1. Rangayyan, Biomedical Signal Analysis, Wiley 2002.
2. Semmlow, Biosignal and Biomedical Image Processing, Marcel Dekker, 2004

**Reference Books**

1. Arnon Cohen, Bio-Medical Signal Processing Vol I and Vol II, CRC Press Inc., Boca Rato, Florida 1999.
2. D.C.Reddy, Biomedical Signal Processing: Principles and techniques , Tata McGraw Hill, New Delhi, 2005
3. Willis J Tompkins, Biomedical Digital Signal Processing, Prentice Hall, 1993
4. Bruce, Biomedical Signal Processing and Signal Modeling, Wiley, 2001
5. Sornmo, Bioelectrical Signal Processing in Cardiac and Neurological Applications, Elsevier 2005.

**Additional / Web References**

1. http://www.nptelvideos.in/2012/11/digital-signal-processing.html, "Digital Signal Processing",
   Prof.T.K.Basu, IIT Kharagpur
2. https://nptel.ac.in/courses/108/105/108105101/Biomedical Signal Processing, "Biomedical Signal Processing", Prof.Sudipta Mukhopadhyay, IIT Kharagpur

**Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)**

| COs | Pos | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 2 | 2 | 2 | 1 | | | | | | | | 3 | 2 | |
| CO2 | 3 | 2 | 2 | 2 | 1 | | | | | | | | 3 | 2 | |
| CO3 | 3 | 3 | 2 | 2 | 1 | | | | | | | | 3 | 3 | |
| CO4 | 3 | 3 | 2 | 2 | 1 | | | | | | | | 3 | 3 | |
| CO5 | 3 | 3 | 2 | 2 | 1 | | | | | | | | 3 | 3 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Formative assessment | | | |
|---|---|---|---|
| **Bloom's Level** | **Assessment Component** | **Marks** | **Total marks** |
| Remember | Online Quiz | 5 | 15 |
| Understand | Tutorial Class / Assignment | 5 | |
| | Attendance | 5 | |

*Passed in Board of studies Meeting*

CHAIRMAN - BOARD OF STUDIES

*Approved in Academic Council Meeting*

| Summative Assessment | | | | |
|---|---|---|---|---|
| **Bloom's Category** | **Internal Assessment Examinations** | | | **Final Examination (60)** |
| | **IAE – I (7.5)** | **IAE – II (7.5)** | **IAE – III (10)** | |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 10 | 10 | 10 | 20 |
| Apply | 10 | 10 | 10 | 20 |
| Analyze | 20 | 20 | 20 | 40 |
| Evaluate | | | | |
| Create | | | | |

| 20BM504 | RADIOLOGICAL EQUIPMENT'S | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| **Nature of course** | Professional Core | | | | |
| **Pre requisites** | Basics of Electrical Sciences | | | | |

**Course Objectives**

The course is intended to

1. Understand the generation of X-ray and its uses in imaging.
2. Describe the principle of Computed Tomography
3. Know the techniques used for visualizing various sections of the body using MRI
4. Learn the principles of different Nuclear medicine equipment in Imaging
5. Discuss the radiation therapy techniques and radiation safety

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---|---|---|
| CO 1 | Describe the working principle of X ray machine and its application | Understand |
| CO 2 | Illustrate the principle computed tomography | Apply |
| CO 3 | Interpret the technique used for visualizing various sections of the body using magnetic resonance imaging | Apply |
| CO 4 | Demonstrate the applications of radio nuclide imaging | Apply |
| CO 5 | Outline the methods of radiation safety | Understand |

**Course Contents**

**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, Cathode and filament currents, focusing cup, Thermionic emission, Electromagnetic induction, Line focus principle and the heel effect, causes of x-ray tube failure: Electron arcing/filament burn out, Failure to warm up tube, High temp due to over exposure, x-ray tube rating charts. X-ray Image Intensifier tubes – Fluoroscopy – Digital Fluoroscopy. Angiography, Cine Angiography, Digital subtraction Angiography. Mammography and Dental x-ray unit.

**Unit – II** **Computed Tomography** **9**

Principles of tomography, CT Generations - spiral CT scanning – Ultra fast CT scanners. Advantages of computed radiography over film screen radiography: Time, Image quality, Lower patient dose, Image characteristics, Image reconstruction techniques- back projection and iterative method - 3D Imaging and its application.

**Unit – III** **Magnetic Resonance Imaging** **9**

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

**Unit – IV** **Nuclear Medicine Techniques** **9**

Nuclear imaging – Whole Body Gamma Cameras – Pulse Height Analyzer – Single-Photon-Emission-Computed Tomography (SPECT), Positron Emission Tomography (PET) Scanner – Recent advances. Radionuclide imaging-Bone imaging, dynamic renal function, myocardial perfusion.

**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 Periods**

**Text Books**

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

**Reference Books**

1. Gopal B. Saha "Physics and Radiobiology of Nuclear Medicine"- 4th edition Springer, 2013.
2. Myer Kutz, "Standard handbook of Biomedical Engineering and design", McGraw Hill, 2003.
3. P.Ragunathan, "Magnetic Resonance Imaging and Spectroscopy in Medicine Concepts and Techniques",Paperback – Import, 2007
4. Paul Suetens, "Fundamentals of Medical Imaging", Cambridge University Press, 3rd ed 2017.
5. Russell K. Hobbie, Bradley J. Roth, "Intermediate Physics for Medicine and Biology", Springer International Publishing 1st edition 2015

**Additional / Web References**

**Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)**

| COs | Pos | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO2 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO3 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO4 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO5 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

**Formative assessment**

| Bloom's Level | Assessment Component | Marks | Total marks |
|---|---|---|---|
| Analyze | Classroom or Online Quiz | 5 | 15 |
| Understand | Assignment | 10 | |

**Summative Assessment**

| Bloom's Category | Continuous Assessment Tests | | | Terminal Examination (60) |
|---|---|---|---|---|
| | IAE-1 (7.5) | IAE-2 (7.5) | IAE-3 (10) | |
| Remember | 5 | 5 | 5 | 10 |
| Understand | 5 | 5 | 5 | 20 |
| Apply | 20 | 20 | 20 | 30 |
| Analyze | 20 | 20 | 20 | 40 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

| 20BM507 | BIOMEDICAL INSTRUMENTATION LABORATORY | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 2 | 1 |
| **Nature of Course** | Professional core | | | | |
| **Prerequisites** | Biomedical Instrumentation | | | | |

**COURSE OBJECTIVES:**

The student should be made to

- To study and design Bio amplifiers
- To provide hands on training on Measurement of physiological parameters

**Course Outcomes**

On successful completion of the course, students will be able to

- Design preamplifiers and amplifiers for various bio signal recordings.
- Design filter to remove artifact from various bio signal recordings.
- Measure various non-electrical parameters using suitable sensors/transducers
- Record Pulse Rate and respiration rate
- Design PCB layout for any bio amplifier.

**CYCLE-1**

| S.No. | Course Content | CO | Bloom's Level |
|---|---|---|---|
| 1 | Study of Biosignal Data Acquisition system and exploring Multiplexer and Demultiplexer for multichannel system | CO 1 | Understand |
| 2 | Design of pre-amplifiers to acquire bio signals along with impedance matching circuit using suitable IC's | CO 1 | Apply |
| 3 | Design of ECG Amplifiers with appropriate filter to remove power line and other artifacts. | CO 2 | Apply |
| 4 | Design of EMG amplifier | CO 2 | Apply |
| 5 | Design a suitable circuit to detect QRS complex and measure heart rate | CO 3 | Analyzing |
| 6 | Design of EOG amplifier to detect eye blink | CO 3 | Analyzing |
| 7 | Design and study the characteristics of optical Isolation amplifier | CO3 | Apply |

**CYCLE - 2**

| S.No. | Course Content | CO | Bloom's Level |
|---|---|---|---|
| 1 | Measurement of pulse-rate using Photo transducer. | CO 3 | Understanding |
| 2 | Measurement of pH and conductivity. | CO 4 | Understanding |
| 3 | Measurement of blood pressure using sphygmomanometer | CO 4 | Understanding |
| 4 | Measurement and recording of peripheral blood flow | CO 4 | Understanding |
| 5 | Design a PCB layout for any bio amplifier using suitable software tool | CO 5 | Analyzing |

| Mapping of Course Outcomes (COs) with Program Outcomes (POs) Program Specific Outcomes(PSO) | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs** | **Pos** | | | | | | | | | | | | **PSOs** | | |
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | |
| 1 | 3 | 3 | 3 | 2 | 1 | | | | | | 1 | | 3 | 1 | |
| 2 | 3 | 3 | 3 | 2 | 2 | | | | | | 1 | | 3 | 1 | |
| 3 | 3 | 3 | 3 | 2 | 2 | | | | | | 1 | | 3 | 1 | |
| 4 | 3 | 3 | 3 | 2 | 1 | | | | | | 1 | | 3 | 1 | |
| 5 | 3 | 3 | 3 | 2 | 1 | | | | | | 1 | | 3 | 1 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Assessment based on Continuous and Final Examination | | | |
|---|---|---|---|
| **Bloom's Level** | **Continuous Assessment (60 marks) (Attendance – 5 marks)** | | **Final Examination [40 marks]** |
| | **Rubric based Continuous Assessment [30 marks]** | **Model Examination [25 marks]** | |
| Remember | | | |
| Understand | 30 | 30 | 30 |
| Apply | 30 | 30 | 30 |
| Analyze | 40 | 40 | 40 |
| Evaluate | | | |
| Create | | | |

CHAIRMAN - BOARD OF STUDIES

| 20BM508 | BIOSIGNAL PROCESSING LABORATORY | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 2 | 1 |
| **Nature of course** | Professional Core | | | | |
| **Pre requisites** | Signals and Systems | | | | |

**Course Outcomes**

On successful completion of the course, students will be able to

1. Perform basic signal processing operations using Open-Source Software or MATLAB
2. Perform convolution, DFT and FFT operations using Open-Source Software MATLAB
3. Design FIR and IIR filter for the specification derived from the given problem and simulate the frequency response.
4. Perform event detection in EEG and ECG signals
5. Apply PCA and ICA algorithm in the given biomedical signal

**CYCLE-1**

| S.No. | Course Content | CO | Bloom's Level |
|---|---|---|---|
| 1 | Generation of impulse, sinusoidal, saw tooth, square and exponential signals | CO 1 | Understand |
| 2 | Perform the operations of Linear and Circular convolutions | CO 2 | Understand |
| 3 | Implement DFT and FFT algorithms for the given signal | CO 2 | Apply |
| 4 | Design of IIR Butterworth filter using bilinear transformation method | CO 3 | Analyzing |
| 5 | Design of Chebyshev IIR filter using one to one mapping method | CO 3 | Analyzing |

**CYCLE-2**

| S.No. | Course Content | CO | Bloom's Level |
|---|---|---|---|
| 1 | Design of FIR filter using Hamming window | CO 3 | Analyzing |
| 2 | Detection of the dicrotic notch in the carotid pulse signal | CO 4 | Apply |
| 3 | Design and Implement the Pan–Tompkins method for QRS detection | CO 4 | Analyzing |
| 4 | Design of cross-correlation for EEG spike and Wave detection using template matching | CO 4 | Analyzing |
| 5 | Separation of Mixtures of Signals using PCA and ICA | CO 5 | Analyzing |

| Mapping of Course Outcomes (COs) with Program Outcomes (POs) Program Specific Outcomes (PSO) | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs** | **POs** | | | | | | | | | | | | **PSOs** | | |
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| 1 | 3 | 3 | 3 | | 3 | | | | | | | | 3 | 3 | |
| 2 | 3 | 3 | 3 | | 3 | | | | | | | | 3 | 3 | |
| 3 | 3 | 3 | 3 | | 3 | | | | | | | | 3 | 3 | |
| 4 | 3 | 3 | 3 | | 3 | | | | | | | | 3 | 3 | |
| 5 | 3 | 3 | 3 | | 3 | | | | | | | | 3 | 3 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Assessment based on Continuous and Final Examination | | | |
|---|---|---|---|
| **Bloom's Level** | **Continuous Assessment (50 marks) (Attendance – 5 marks)** | | **Final Examination [50 marks]** |
| | **Rubric based Continuous Assessment [25 marks]** | **Model Examination [25 marks]** | |
| Remember | | | |
| Understand | 30 | 30 | 30 |
| Apply | 30 | 30 | 30 |
| Analyze | 40 | 40 | 40 |
| Evaluate | | | |
| Create | | | |

**VI Semester**

| 20BM601 | MEDICAL REGULATORY AFFAIRS AND ETHICS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| **Nature of course** | Professional Core | | | | |
| **Pre requisites** | Basics of Biomedical Engineering | | | | |

**Course Objectives**

1. To become Professionals in Regulatory affairs and in ensuring all Medical Devices to comply with regulations governing the industry.
2. As Regulatory professionals in industry and get involved with a wide range of medical devices made in various countries
3. Know Regulatory processes in complexity, scope and globalization within the healthcare domain, matching industry demand for Medical Devices regulatory affairs
4. Familiarity with Regulatory Affairs provides with the specialized knowledge required to help biotechnology, medical device, pharmaceutical and food companies manage regulatory processes.
5. Understand Legal Law within medical practice including ethics in patient care

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---|---|---|
| CO 1 | Understand Medical Devices Regulatory Affairs and MDRA Basics | Understand |
| CO 2 | Apply FDA / CDRH Functioning to Medical Device and invitro diagnostics | Apply |
| CO 3 | To perform biocompatibility Studies on Medical Devices and Clinical Investigation of Medical Devices | Analyze |
| CO 4 | Understand General controls and Special Controls including Pre-market approval | Understand |
| CO 5 | To know Law within medical practice and its issues in doctor– patient relationship | Understand |

**Course Contents**

**Unit – I Introduction to Regulatory Affairs for Medical Devices 9**

Medical Devices Regulatory Affairs - MDRA Basic concepts - Overview of Regulatory Requirements: Medical Devices - Taxonomy of medical devices and their risk classes - The regulatory process Regulatory Affairs Pre-Clinical Trial-Clinical Trial-Regulatory Bodies in India Central Drug Regulatory System-Drug & Cosmetics Act-Medical Device Registration in India Product Development Protocol-Environmental Protection Act

**Unit – II Medical Device and in Vitro Diagnostics 9**

IEC 60601-1 Classification of Medical Electrical Equipment- FDA / CDRH Functioning - Medical Device Classification -Types of devices including combination devices and Drug Vs device Vs IVD, Medical Device Rules, 2017: Implications on medical devices, Devices / Device Panels / Regulation Product Codes. 21 CFR Code for Federal Regulations- Parts 800-1299.

**Unit – III Standards of Medical Device, Quality Assurance, and Testing 9**

Biocompatibility Studies on Medical Devices, Clinical Investigation of Medical Devices - Quality Assurance and Quality Management System: ISO9000 and ISO13485 - Risk management: ISO14971- Distinct Product Code Identification Procedure- Total Product Life Cycle (TPCL) / TPCL Product Code Report - Labeling of medical devices-ISO 13485:2016 complaint handling procedure

**Unit – IV Manufacture of Medical Devices and IVDs 9**

General controls and Special Controls-Pre-market approval – PMA-Adulteration-Misbranding-Electronic Establishment Registration-Obtaining a license to manufacture a medical device- Risk Management System for medical devices (ISO 14971) - Inspection of medical device and IVD establishments, Import and export of medical devices and IVDs, Medical device regulation: in India and International practices

| Unit – V | Medical Ethics | 9 |
|---|---|---|
| Introduction to ethics - Law within medical practice- Issues in the doctor– patient relationship- Ethico- legal issues by medical specialism- Statutory provisions - Regulation of human tissue- The definition of mental disorder under the Mental Health Act | | |
| | | **Total: 45 Periods** |

**Text Books**

1. Jack Wong, Raymond Tong "Medical Regulatory Affairs: An International Handbook for Medical Devices and Healthcare Products"Jenny Stanford Publishing,2022
2. Anna Smajdor, Jonathan Herring, Robert Wheeler "Oxford Handbook of Medical Ethics and Law" OUP Oxford ,2022

**Reference Books**

1. Douglas J. Pisano, David Mantus "FDA Regulatory Affairs- A Guide for Prescription Drugs, Medical Devices, and Biologics" Informa Healthcare,2003
2. Stephen Amato,Bob Ezzell "Regulatory Affairs for Biomaterials and Medical Devices"Woodhead Publishing,2014
3. John Harris," The Value of Life- An Introduction to Medical Ethics" Routledge,1990

**Additional / Web References**

1. https://www.biomedicalviews.com/
2. https://www.biomedicalviews.com/search/label/ISO%2013485%3A2016

**Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)**

| COs | Pos | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO2 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO3 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO4 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO5 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Formative assessment | | | |
|---|---|---|---|
| **Bloom's Level** | **Assessment Component** | **Marks** | **Total marks** |
| Analyze | Classroom or Online Quiz | 5 | 15 |
| Understand | Assignment | 10 | |

| Summative Assessment | | | | |
|---|---|---|---|---|
| Bloom's Category | Continuous Assessment Tests | | | Terminal Examination (60) |
| | IAE-1 (7.5) | IAE-2 (7.5) | IAE-3 (10) | |
| Remember | 5 | 5 | 5 | 10 |
| Understand | 5 | 5 | 5 | 20 |
| Apply | 20 | 20 | 20 | 30 |
| Analyze | 20 | 20 | 20 | 40 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

| 20BM602 | BIOMATERIALS AND ARTIFICIAL ORGANS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| **Nature of course** | Professional Core | | | | |
| **Pre requisites** | Basics of Biomedical Engineering | | | | |

**Course Objectives**

1. Understand the properties of the Bio-compatible materials
2. Expose to different types of Biomaterials
3. Study polymeric materials and its role in tissue replacements
4.Estimate artificial organs and its constraints
5.Ability to design artificial organs and its practical considerations

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---|---|---|
| CO 1 | To understand and classify biomaterials based on their characteristic's property. | Understand |
| CO 2 | To justify different metals and ceramics usage based on different application. | Analyze |
| CO 3 | To decide polymeric materials and its distinctive combinations that could be used as a tissue replacement implants | Analyze |
| CO 4 | To apply the knowledge in artificial organ using these materials | Analyze |
| CO 5 | To comprehend the knowledge about the need for artificial organs with its desired design consideration, organ replacement and steps required to evaluate the device. | Understand |

**Course Contents**

| | | |
|---|---|---|
| **Unit – I** | **Structure of Biomaterials and Biocompatibility** | **9** |

Definition and classification of biomaterials, mechanical properties, surface and bulk properties of biomaterials, viscoelasticity, wound-healing process, body response to implants, blood compatibility.

| | | |
|---|---|---|
| **Unit – II** | **Metal and Ceramic Materials** | **9** |

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

| | | |
|---|---|---|
| **Unit – III** | **Polymeric Implant Materials** | **9** |

Polymerization, polyolefin, polyamicles, Acrylic, polymers, rubbers, high strength thermoplastics, natural and synthetic polymer, medical applications

| | | |
|---|---|---|
| **Unit – IV** | **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 – V** | **Design of Artificial Organs** | **9** |

Substitutive medicine, Biomaterial Concentration, Outlook for Organ Replacement, Design Consideration, Evaluation of Artificial Organs

**Total: 45 Periods**

**Text Books**

1. Park, Biomaterials: An Introduction, Springer Science & Business Media, 2012
2. Michael Lysaght, Thomas J Webster, Biomaterials for Artificial Organs, Elsevier Science, 2018

**Reference Books**

1. Sujata V. Bhatt, Biomaterials Second Edition, Narosa Publishing House, 2005
2. Standard Handbook of Biomedical Engineering & Design – Myer Kutz, McGraw-Hill, 2003
3. Introduction to Biomedical Engineering – John Enderle, Joseph D. Bronzino, Susan M. Blanchard, Elsevier, 200

**Additional / Web References**

**Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)**

| COs | Pos | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO2 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO3 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO4 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO5 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Formative assessment | | | |
|---|---|---|---|
| **Bloom's Level** | **Assessment Component** | **Marks** | **Total marks** |
| Analyze | Classroom or Online Quiz | 5 | 20 |
| Understand | Assignment | 15 | |

| Summative Assessment | | | | |
|---|---|---|---|---|
| **Bloom's Category** | **Continuous Assessment Tests** | | | **Terminal Examination (60)** |
| | **IAE-1 (7.5)** | **IAE-2 (7.5)** | **IAE-3 (10)** | |
| Remember | 5 | 5 | 5 | 10 |
| Understand | 5 | 5 | 5 | 20 |
| Apply | 20 | 20 | 20 | 30 |
| Analyze | 20 | 20 | 20 | 40 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

| 20BM603 | BIOMECHANICS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| **Nature of course** | Professional Core | | | | |
| **Pre requisites** | Biocontrol System, Human Body Skeletal and Physiological System | | | | |

**Course Objectives**

1. Understand interrelationships among kinematics and kinetics variables of human movement
2. Know the effects of the force–velocity, length–tension relationships on tissue function
3. Identify factors influencing the relative mobility and stability of Skeletal Joints articulations
4. Explain the ways in which composition and flow characteristics of a fluid affect forces.
5. Study human locomotion's with finite element analysis for Spine and hip prosthesis

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---|---|---|
| CO 1 | Illustrate the ways in which the kinetic and kinematics quantities can be applied to study human movement | Understand |
| CO 2 | Describe tissue injury in bone and cartilage using principle of mechanics | Apply |
| CO 3 | Derive the criteria for orthopedic implant design using complex mechanics of skeletal joints | Apply |
| CO 4 | Identify the viscoelastic properties of blood and analyze Newtonian and non-Newtonian fluids | Apply |
| CO 5 | Analyze the stresses and strains in spine and hip using different loading conditions involved in human locomotion for sports medicine | Analyze |

**Course Contents**

**Unit – I Fundamentals of Biomechanics** **9**

Introduction to statics and dynamics-Kinetics, Kinematics, kinesiology – rigid and non-rigid bodies – Forces and motion – Newtons laws – Moment of force – inertia, friction, work, and energy.

Static equilibrium – Centre of gravity – Stability of equilibrium - Steps in analyzing a biomechanical problem – Basics of Linear and Angular kinematics, Kinetics of human movement - Graphical methods – contact forces – resolution of forces.

**Unit – II Biomechanics from subcellular to tissue levels** **9**

Introduction to stress, strain, and constitutive laws of cells and tissues- skeletal muscles. Emphasis on biosolids as Soft-tissues- Introduction to elastic and viscoelastic behaviors - standard linear model of viscoelasticity. Characteristics of Hard tissue - bone, fracture mechanism and crack propagation in bones, fracture fixators. Pseudo elasticity, nonlinear stress-strain relationship, viscoelasticity, structure, function and mechanical properties of skin, ligaments and tendons.

**Unit – III Biomechanics of Skeletal Joints** **9**

Skeletal joints, basic considerations, basic assumption and limitations, forces and stresses in human joints, mechanics of the elbow, shoulder, spinal column, hip, knee and ankle. Human locomotion, gait analysis and goniometry, Ergonomics, Foot Pressure measurements – Pedobarographic, Force platform, mechanics of foot.

**Unit –IV Biomechanics for Biofluids** **9**

Mechanical properties of blood vessels – arteries, arterioles, capillaries, veins, physics of cardio vascular diseases, prosthetic heart valves and replacement. Fluids – density – pressure – blood pressure and gravity – buoyancy – moments of force and stability - Rheological properties of blood, laminar flow, Couette flow and Hagen-poiseuille equation, turbulent flow.

**Unit – V Advances in Biomechanics** **9**

Human locomotion, gait analysis and goniometry, Ergonomics, Foot Pressure measurements – Pedobarographic, Force platform, mechanics of foot. Sports Medicine -Finite element analysis of Spine - Total Hip Prosthesis: requirements, different types of components, Stress analysis & instrumentation, Knee Prosthesis

**Total: 45 Periods**

**Text Books**

1. Susan J Hall, “Basic Biomechanics”, 8th Edition, 2019, Mc Graw Hill, USA
2. Y C Fung, “Biomechanics – Mechanical Properties of Living Tissue” 2nd Edition, 1993, Reprinted in 2016, Springer, USA

**Reference Books**

1. Frank Bell, Principles of Mechanics and Biomechanics, Stanley Thorne (Publishers) Ltd., 1998
2. Donald R. Peterson and Joseph D. Bronzino, Biomechanics Principles and applications, CRC press, Taylor & Francis Group, LLC, 2008
3. Duane Knudson, Fundamentals of Biomechanics, Second Edition, Springer publication, 2007
4. Cynthia Norkins, “Joint Structure and Function: A Comprehensive Analysis”, 2019, 6th Edition, F. A. Davis Company, USA

**Additional / Web References**

**Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)**

| COs | Pos | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO2 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO3 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO4 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO5 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Formative assessment | | | |
|---|---|---|---|
| **Bloom’s Level** | **Assessment Component** | **Marks** | **Total marks** |
| Analyze | Classroom or Online Quiz | 5 | 20 |
| Understand | Assignment | 15 | |

| Summative Assessment | | | | |
|---|---|---|---|---|
| **Bloom’s Category** | **Continuous Assessment Tests** | | | **Terminal Examination (60)** |
| | **IAE-1 (7.5)** | **IAE-2 (7.5)** | **IAE-3 (10)** | |
| Remember | 5 | 5 | 5 | 10 |
| Understand | 5 | 5 | 5 | 20 |
| Apply | 20 | 20 | 20 | 30 |
| Analyze | 20 | 20 | 20 | 40 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

| 20BM604 | DIAGNOSTIC AND THERAPEUTIC EQUIPMENT'S | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 4 |
| **Nature of course** | Professional Core | | | | |
| **Pre requisites** | Biomedical Instrumentation | | | | |

**Course Objectives**

The course is intended to

1. Understand Patient Monitoring system for vital information in improving patient care
2. Explore ultrasound scanning machine for Cardiac, Abdomen and Gynecology applications
3. Develop cardiac pacemaker and defibrillator for synchronization of the heart action
4. Explain Surgical Diathermy, Physiotherapy and Electrotherapy Equipment
5. Identify the role of advanced hospital equipment's like Hemodialyzer, Heart-Lung Machine and Ventilators with anesthesia features

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---|---|---|
| CO 1 | Ability to correlate multiple parameters by displaying and centralizing clinical information from patients | Understanding |
| CO 2 | Apply Diagnostic ultrasound concepts in obtaining images of entire range of internal organs including cardiac and abdomen applications | Apply |
| CO 3 | Illustrate cardiac pacemaker and defibrillator device principles in recovering normal heart functions | Apply |
| CO 4 | Relate the concept of surgical diathermy, physiotherapy and electrical simulation procedure as therapeutic applications | Analyzing |
| CO 5 | Explain Hemodialyzer, Heart-Lung machine and Ventilators as assistive technology based modern hospital equipment | Understanding |

**Course Contents**

**Unit – I** **Patient Monitoring Systems** **9**

Single Channel to Multichannel System Concepts - Cardiac Monitor-Bedside Patient Monitoring Systems - Central Monitors for ICU - Foetal Monitoring Instruments-Measurement of Heart Rate, Temperature and Respiration Rate-Catheterization Laboratory Instrumentation - Exercise Stress Testing [TMT machine] -Ambulatory Monitoring Instruments –Biotelemetry Systems

**Unit – II** **Ultrasonic Imaging Systems** **9**

Diagnostic Ultrasound -Physics and Biological effects of Ultrasonic Waves in tissues-Basic Pulse-Echo techniques – U/s Scanners Imaging Modes - Real-Time Ultrasonic Imaging Systems -Different Probes - Mechanical Sector -Multi-Element Linear Array rectangular – Curvilinear-Duplex Scanner- Modern Ultrasound Imaging Systems-Beam Steering concepts and Digital scan converters- Portable Ultrasound Systems - 3D/4D Color Doppler Ultrasound Imaging Systems for Cardiac, Abdomen and Gynecology applications

**Unit – III** **Cardiac Pacemakers and Defibrillators** **9**

Cardiac Pacemakers - Need for Cardiac Pacemaker - External Pacemakers -Implantable Pacemakers - Recent Developments in Implantable Pacemakers - Pacing System Analyzer. Cardiac Defibrillators- Need for a Defibrillator - DC Defibrillator- Implantable Defibrillators - Pacer-Cardioverter Defibrillator - Defibrillator Analyzers- Left Ventricular Assist Device (LVAD)

**Unit –IV** **Surgical Diathermy, Physiotherapy and Electrotherapy Equipment** **9**

Instruments for Surgery- Principle of Surgical Diathermy- Surgical Diathermy Machine-Safety Aspects in Electrosurgical Units - Surgical Diathermy Analyzers. Physiotherapy Equipment-

| | | |
|---|---|---|
| High Frequency Heat Therapy - Short-Wave therapy -Microwave and Ultrasonic Therapy. Electrotherapy Equipment for Pain Relief – Functional Electric Stimulation [FES] and TENS | | |
| **Unit – V** | **Advanced Medical Equipment's** | **9** |
| Hemodialyzer as Artificial Kidney-Dialyzers-Membranes for Hemodialysis Machine-Electronic Controls and home (Portable) Kidney Machines. Heart Lung Machine-Uses and Need for heart surgery –Technical Controls and key design steps. Ventilators-Mechanics of Respiration-Artificial Ventilation by Ventilators-Types of Ventilators -Modern Ventilators with Humidifiers, Nebulizers and Aspirators - Need for Anesthesia - Anesthesia Machine-Capnography basics | | |
| | | **Total: 45 Periods** |

**Text Books**

1. R S Khandpur,"Handbook of Biomedical Instrumentation" McGraw-Hill Education ,India ,3rd edition (2014)

**Reference Books**

1. Myer Kutz, "Standard Handbook of Biomedical Engineering and Design" McGraw Hill, 2003.
2. L.A Geddes and L.E.Baker, "Principles of Applied Biomedical Instrumentation", 3rd Edition, 2008
3. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Pearson Education, New Delhi, 2007.
4. Antony Y.K.Chan, "Biomedical Device Technology, Principles and design", Charles Thomas Publisher Ltd, Illinois, USA, 2008

**Additional / Web References**

**Laboratory Tasks and components**

| S.No | List of Experiments | CO Mapping | Revised Blooms Taxonomy |
|---|---|---|---|
| **CYCLE 1** | | | |
| 1. | Measurement of various physiological signals using Biotelemetry | CO 1 | Understanding |
| 2. | Recording of ECG EMG and EEG signal | CO 1 | Understanding |
| 3. | Perform Electrical safety measurements for medical devices | CO 2 | Applying |
| 4. | Measurement of visually evoked potential and Galvanic skin resistance (GSR) measurement | CO 2 | Applying |
| 5. | Demonstrate, working of Pacemaker simulator and Defibrillator | CO 3 | Understanding |
| **CYCLE 2** | | | |
| 6. | Measurement of Respiratory parameters using Pulmonary Function Tester | CO 3 | Applying |
| 7. | Demonstrate of Ultrasonic diathermy for therapy | CO 4 | Applying |
| 8. | Study of Shortwave diathermy for pain relief | CO 4 | Understanding |
| 9. | Study of Heart lung machine model | CO 5 | Understanding |
| 10. | Study of Ventilators as Assistive Device | CO 5 | Understanding |
| | | | **Total: 30 Periods** |

| Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs) | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs** | **POs** | | | | | | | | | | | | **PSOs** | | |
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| CO 1 | 3 | 2 | 2 | 2 | | | | | | | | | | 3 | |
| CO 2 | 3 | 2 | 2 | 2 | | | | | | | | | | 3 | |
| CO 3 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO 4 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO 5 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Formative assessment | | | |
|---|---|---|---|
| **Bloom's Level** | **Assessment Component** | **Marks** | **Total marks** |
| Remember | Online Quiz | 5 | 25 |
| Understand | Practical Class / Assignment | 15 | |
| | Attendance | 5 | |

| Summative Assessment | | | | | | |
|---|---|---|---|---|---|---|
| **Bloom's Level** | **Continuous Assessment** | | | | | **Final Examination (Theory) (50)** |
| | **Theory** | | | | **Practical's** | |
| | **IAE – 1 (7.5)** | **IAE – 2 (7.5)** | **IAE – 3 (10)** | **Attendance (5)** | **Rubric based CIA (50)** | |
| Remember | 10 | 10 | 10 | | 10 | 10 |
| Understand | 30 | 30 | 30 | | 20 | 40 |
| Apply | 20 | 20 | 20 | | 20 | 40 |
| Analyze | 0 | 0 | 0 | | 0 | 10 |
| Evaluate | | | | | | |
| Create | | | | | | |

**VII SEMESTER**

| 20BM701 | HOSPITAL MANAGEMENT | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

| | |
|---|---|
| **Nature of Course** | Humanities and Social Sciences |
| **Pre requisites** | Code of conduct for Engineers |

**Course Objectives**

**The course is intended to**

1. Explain the principles of Hospital administration and Identify Information management systems and its uses.
2. Learn service design and service thinking in healthcare
3. Understand safety procedures followed in hospitals

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No. | Course Outcome | Bloom's Level |
|---|---|---|
| CO1 | Explain the basic planning and organization of hospitals using guiding principles | Understand |
| CO2 | Explore the roles and responsibilities in Hospital Administration, Human Resource management and finance Management with organizational hierarchy | Apply |
| CO3 | Identify and explain the role of medical and support services used for proper functioning of the hospitals | Apply |
| CO4 | Classify administrative services functional organization and engineering services of a hospital | Understand |
| CO5 | Identify and explain the key elements of security and safety management in Hospitals | Apply |

**Course Contents:**

**UNIT I HOSPITAL PLANNING AND DESIGN** **9**

The role of hospitals in Healthcare – Hospital Planning and Design – Guiding principles in planning -Regionalization of hospital services – Hospital Planning Team – Zonal Distribution and interrelationship of Departments – Gross space requirements – Climatic consideration in design –Preparation of Functional brief – Equipping a Hospital – Construction and commissioning

**UNIT II MANAGEMENT AND FINANCIAL MANAGEMENT** **9**

Principles of Management – Roles and functions of Hospital Administration – Skills of effective Managers – Characteristics of Effective Managers - Planning – Criteria for Effective Planning - Decision Making – Strategic Planning - The organizational chart – Financial planning – Cause of rise in hospital expenditure - revenue centres and cost centres - Hospital budgets

**UNIT III MEDICAL AND SUPPORTIVE SERVICES** **9**

Outpatient services – Definition, Planning of outpatient services – Planning considerations, ancillary services – Policies and Procedures - Clinical Laboratory services – Functional divisions and Functional planning – Policies and Procedures – Quality controls – Operational theatre suite – Facilities in the OT – Zoning – Functional interrelationships of rooms - Policies and Procedures – Intensive care units – Types of ICU – Planning and Organization - Pharmacy – Central Sterile Supply Department (CSSD) – Functions of CSSD – Policies and procedures – Autoclaving

**UNIT IV HOSPITAL FACILITY AND FUNCTIONAL SERVICES** **9**

Medical Records – Hospital Infections – Materials management – Process- Purchasing –Inventory – Issue and Distribution – Disposal and Contamination – Hospital Linen and Laundry Services – Linen classification and requirement of equipment - Disposal of Hospital Waste – Type and Classifications of Waste – Color coding of containers – Treatment technology – Engineering departments – Electrical system- Air conditioning system- Water supply and Sanitary system- Centralized medical gas system

**Unit V HOSPITAL SAFETY AND SECURITY** **9**

Safety in hospital – Security and loss prevention programme – Fire safety - Alarm System-Disaster management

**Total: 45 Periods**

**Text Books:**

1. B.M. Sakharkar, “Principles of hospital administration and planning”, Jaypee Brothers Medical Publishers Pvt Limited, 2nd edition, 2009.
2. G.D.Kunders, “Hospitals – Facilities Planning and Management – TMH, New Delhi – Fifth Reprint 2007

**Reference Books**

1. Dinesh Bhatia, Prabhat Kumar Chaudhari, Bhupinder Chaudhary, Sushman Sharma, Kunaal Dhingra “A Guide to Hospital Administration and Planning”-Springer (2023).
2. R.C.Goyal, “Hospital Administration and Human Resource Management”, PHI – Fourth Edition, 2006

**Additional / Web References**

1. https://www.youtube.com/watch?v=ZZS8-ySBNFM, “Organisation and Management of Hospital”, Prof. S.B.Aroara, Professor, School of Health Sciences, Indira Gandhi National Open University (IGNOU), Maidan Garhi, New Delhi
2. http://www.nptelvideos.in/2012/11/human-resource-management-i.html, “Lecture Series on Human Resource Management-I”, Prof. KalyanChakravarti, Vinod Gupta School of Management, IIT Kharagpur

**Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)**

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | | | | | 2 | 1 | 2 | 1 | | | | 2 | | |
| CO2 | 3 | | | | | 2 | 1 | 2 | 1 | 2 | | | 2 | | |
| CO3 | 3 | | | | | 2 | 1 | 2 | 1 | | | | 2 | | |
| CO4 | 2 | | | | | 2 | 1 | 2 | 1 | | | | 1 | | |
| CO5 | 3 | | | | | 2 | 1 | 2 | 1 | 2 | | | 2 | | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Formative assessment | | | |
|---|---|---|---|
| **Bloom’s Level** | **Assessment Component** | **Marks** | **Total marks** |
| Remember | Online Quiz | 5 | 15 |
| Understand | Tutorial Class / Assignment | 5 | |
| | Attendance | 5 | |

| Summative Assessment | | | | |
|---|---|---|---|---|
| **Bloom’s Category** | **Continuous Assessment Tests** | | | **Final Examination (60)** |
| | **IAE-1 (7.5)** | **IAE-2 (7.5)** | **IAE-3 (10)** | |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 10 | 10 | 10 | 20 |
| Apply | 30 | 30 | 30 | 60 |
| Analyze | | | | |
| Evaluate | | | | |
| Create | | | | |

| 20BM702 | MEDICAL IMAGE PROCESSING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

| | |
|---|---|
| **Nature of Course** | Professional Core |
| **Pre requisites** | Biosignal Processing |

**Course Objectives**

**The course is intended to**

1. Students will understand the fundamentals of image analysis and different Image formats
2. Explore morphology techniques for binary images
3. Explain Binary Large Object extraction and classification for cytometer images
4. Illustrate color images and its classification for a head CT image
5. Investigate Geometric Transformation, Image Registration and path tracing for medical images

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No. | Course Outcome | Bloom's Level |
|---|---|---|
| CO1 | Understand the fundamentals of image analysis and different Image formats | Understand |
| CO2 | Apply morphology techniques for binary images | Apply |
| CO3 | Explore Binary Large Object extraction and classification for cytometer images | Apply |
| CO4 | Demonstrate color images and its classification for a head CT image | Analyze |
| CO5 | Illustrate Geometric Transformation, Image Registration and path tracing for medical images | Analyze |

**Course Contents:**

**UNIT I FUNDAMENTALS OF IMAGE PROCESSING** **9**

Introduction of Image Processing-General Frame work-Digital Images-Image Coordinate Systems-The Region-of-Interest (ROI)- Binary Images-Label Images-Multi-spectral Images-16-Bit Images- and Image Formats-DICOM- Lossless Compression -Binary Image Compression. Basics of Point Processing and Neighborhood Processing

**UNIT II MORPHOLOGY TECHNIQUES** **9**

Convolution Vs Correlation kernels- Template Matching- Edge Detection- Gradients-Image Edges- Morphology on binary images- box-shaped and disc shaped structuring element- Hit and Fit, Dilation and Erosion, Compound Operations- Boundary Detection

**UNIT III BLOB [Binary Large Object] ANALYSIS** **9**

BLOB Extraction- The Grass-Fire Algorithm, BLOB Features- BLOB Area, Bounding Box, Bounding Circle, Convex Hull, compactness of a BLOB, Center of Mass, Perimeter, Circularity and BLOB Classification- Cell Classification Using BLOB Analysis for image cytometer- Feature Selection, Feature Ranges and Evaluation of Classification

**UNIT IV FUNDAMENTALS OF COLOR IMAGES** **9**

Basics of Psycho-visual experiments- subtractive colors- additive colors. Representation of an RGB Color Image-Bayer pattern of color image sensor/Color camera- The RGB Color Space - HSI Color Representation- Color Thresholding- Chroma-Keying- Postscript on Colors. Pixel Classification – case study on Classification of a head CT image – Histogram and annotation concepts - minimum distance classifier Vs parametric classifier - Bayesian Classification

**UNIT V GEOMETRIC TRANSFORMATIONS** **9**

Basics of rotation and scaling- Affine Transformations- homogeneous coordinates- Backward Mapping- Bilinear interpolation- Profile Analysis- projective transformation or homography. Image Registration- Feature-Based Image Registration Vs Intensity-Based Image Registration. Line and Path Detection- The Hough Transform-Path Tracing Using Dynamic Programming- Preprocessing for Path Tracing- Locating Circular Structures. Case study for an ophthalmology to track the veins in Fundus image.

**Total: 45 Periods**

**Text Books:**

1. Rasmus R. Paulsen, Thomas B. Moeslund “Introduction to Medical Image Analysis” Springer International Publishing (2020)

**Reference Books:**

1. Klaus D. Toennies “Guide to Medical Image Analysis- Methods and Algorithms” Springer-Verlag London (2017).
2. Nilanjan Dey, Amira S. Ashour, Harihar Kalia, Himansu Das, R. T. Goswami – “Histopathological Image Analysis in Medical Decision Making” -IGI Global book series Advances in Medical Technology (2019)
3. Rodrigo Rojas Moraleda, Nektarios A. Valous, Wei Xiong, Niels Halama – “Computational Topology for Biomedical Image and Data Analysis- Theory and Applications” CRC Press (2020)

| **Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)** | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs** | **POs** | | | | | | | | | | | | **PSOs** | | |
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| CO1 | 3 | 3 | 2 | | | | | | | | | | 2 | | |
| CO2 | 3 | 2 | 2 | 2 | | | | | | 2 | | | 2 | | |
| CO3 | 3 | 3 | 1 | | | 1 | | | | | | | 2 | | |
| CO4 | 2 | 2 | 2 | 2 | | | | | | | | | 1 | | |
| CO5 | 3 | 3 | 2 | | | | | | | 2 | | | 2 | | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| **Formative assessment** | | | |
|---|---|---|---|
| **Bloom’s Level** | **Assessment Component** | **Marks** | **Total marks** |
| Remember | Online Quiz | 5 | 15 |
| Understand | Tutorial Class / Assignment | 5 | |
| | Attendance | 5 | |

| **Summative Assessment** | | | | |
|---|---|---|---|---|
| **Bloom’s Category** | **Continuous Assessment Tests** | | | **Final Examination (60)** |
| | **IAE-1(7.5)** | **IAE-2(7.5)** | **IAE-3(10)** | |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 10 | 10 | 10 | 20 |
| Apply | 30 | 30 | 30 | 60 |
| Analyze | | | | |
| Evaluate | | | | |
| Create | | | | |

| 20BM703 | NEURAL NETWORKS AND FUZZY LOGIC | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| **Nature of Course** | Professional Core | | | | |
| **Pre requisites** | Linear Algebra and Set Theory | | | | |

**Course Objectives**

**The course is intended to**

1. Expose the students to the concepts of feed forward neural networks.
2. Provide adequate knowledge about feedback (recurrent) neural networks.
3. Teach about the concept of fuzziness involved in various systems.
4. To provide adequate knowledge about fuzzy set theory and fuzzy control.
5. Application of neural network and fuzzy logic control to real time systems

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No. | Course Outcome | Bloom's Level |
|---|---|---|
| CO1 | Demonstrate an Understand of the basic concepts and principles of neural computation as an approach to intelligent problem solving | Apply |
| CO2 | Illustrate the commonly used neural network architectures and learning algorithms | Apply |
| CO3 | Distinguish classes of problems solving including Vagueness problem | Understand |
| CO4 | Explore Fuzzy Logic and its solutions to complex control methods | Apply |
| CO5 | Design a neural network and Fuzzy Logic to solve a particular problem | Analyze |

**Course Contents:**

**UNIT I FUNDAMENTALS OF NEURAL NETWORKS 9**

Introduction to Artificial Neutral Network – Biological neurons and their artificial models – Neural processing; learning and adaptation; Neural Network Learning Rules – Hebbian, perception, – Activation functions- Learning factors – Linear separability.

**UNIT II NEURAL NETWORK ARCHITECTURES 9**

Single layer perceptron – Adaline – Madaline - Multilayer Feedforward Networks – Back propagation network – Hopfield network – Discrete Hopfield network – Recurrent Auto and Hetero associative memory – Hamming network –Adaptive Resonance Theory (ART-1).

**UNIT III FUNDAMENTALS OF FUZZY LOGIC 9**

Crisp set – Vagueness – Uncertainty and Imprecision – Fuzziness – Basic definitions - fuzzy set theory – classical set Vs fuzzy set - properties of fuzzy sets – Fuzzy operation – Fuzzy arithmetic – Fuzzy relation – Fuzzy relational equations – Fuzzy Cartesian product and composition –Tolerance equations relations

**UNIT IV FUZZY MODELS AND CONVERSION 9**

Introduction to Fuzzy model- fuzzy logic control – structure of FLC – Fuzzification models - knowledge Base – Rule base - Inference Engine – Fuzzy to Crisp Conversion - Lambda cuts for fuzzy sets and relations – Defuzzification Methods

**UNIT V APPLICATIONS OF NEURAL NETWORKS AND FUZZY LOGIC 9**

Application of Neural networks – XOR problem - Handwritten character recognition –Neuro controller for Biofeedback control system –Fuzzy image processing - Fuzzy logic controllers- Introduction to Neuro Fuzzy control.

**Total: 45 Periods**

**Text Books:**

1. Lawrence Fausset," Fundamentals of Neural Networks", Prentice Hall of India, New Delhi, 1994.
2. Timothy J Ross, "Fuzzy Logic with Engineering Applications", Mc GrawHill International Edition, USA, 1997.

*Passed in Board of studies Meeting* *Approved in Academic Council Meeting*

CHAIRMAN - BOARD OF STUDIES

**Reference Books:**


1. James M. Keller, Derong Liu, David B. Fogel - Fundamentals of Computational Intelligence_ Neural Networks, Fuzzy Systems, and Evolutionary Computation IEEE Press Wiley,2016
2. Ardahir Mohammadazadeh, Mohammad Hosein Sabzalian, Oscar Castillo, Rathinasamy Sakthivel, Fayez F. M. El-Sousy, Saleh Mobayen "Neural Networks and Learning Algorithms in MATLAB" Springer,2022
3. Bart Kosho "Neural Networks & Fuzzy systems", Prentice Hall of India, New Delhi, 1994.
4. J.A. Freeman & David.M. Skapura, Neural networks, Algorithms applications and programming techniques, Addison Wesley,1991
5. David M. Skapura, "Building Neural Networks", Addison Wesley, 1996


**Additional References:**

| **Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)** | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs** | **POs** | | | | | | | | | | | | **PSOs** | | |
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| O1 | 3 | 3 | | | 3 | | 1 | 3 | 3 | 3 | 3 | 1 | 2 | | |
| CO2 | 3 | 2 | | | 2 | | 2 | 2 | 2 | 2 | 2 | 1 | 2 | | |
| CO3 | 3 | 3 | | | 3 | | 1 | 3 | 3 | 3 | 3 | 1 | 2 | | |
| CO4 | 2 | 2 | | | 2 | | 2 | 2 | 2 | 2 | 2 | 1 | 1 | | |
| CO5 | 3 | 3 | | | 3 | | 1 | 3 | 3 | 3 | 3 | 1 | 2 | | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| **Formative assessment** | | | |
|---|---|---|---|
| **Bloom's Level** | **Assessment Component** | **Marks** | **Total marks** |
| Remember | Online Quiz | 5 | 15 |
| Understand | Tutorial Class / Assignment | 5 | |
| | Attendance | 5 | |

| **Summative Assessment** | | | | |
|---|---|---|---|---|
| **Bloom's Category** | **Continuous Assessment Tests** | | | **Final Examination (60)** |
| | **IAE-1 (5)** | **IAE-2 (10)** | **IAE-3 (10)** | |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 10 | 10 | 10 | 20 |
| Apply | 30 | 30 | 30 | 60 |
| Analyze | | | | |
| Evaluate | | | | |
| Create | | | | |

| 20BM704 | BIOMEDICAL IMAGE ANALYSIS LABORATORY | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 2 | 1 |
| **Nature of Course** | Professional core | | | | |
| **Pre requisites** | Biosignal Processing Laboratory | | | | |

**Course Objectives**

Medical image analysis is the process of extracting meaningful information from medical images, often using computational methods

**Course Outcomes**

On successful completion of the course, students will be able to,
Use the tools for practical image analysis which is rapidly evolving by using MATLAB for practical exercises and using Python, OpenCV or scikit-image. For time critical applications C++, OpenCV is preferred. For explorative analysis of images, we may use ImageJ.

CO1 - Understand **DICOM** and **NIfTI-1** data formats
CO2- Learn to display a medical image stored in a file
CO3 - Experiment Basic medical image segmentation and its Image Analysis
CO4 – Explore Medical Image Classification, Registration and Fusion concepts
CO5 – Case Study on some recent advances in analysis of medical images

**CYCLE-1**

| S.No. | Course Content | CO | Bloom's Level |
|---|---|---|---|
| 1 | Medical Imaging Exploration - DICOM and NIfTI-1 Data Format | CO 1 | Understand |
| 2 | Loading and Visualization - Render the image using Matplotlib | CO 2 | Apply |
| 3 | Digital X-Ray Medical Image Convolution and Correlation Kernel Practical Exercises | CO 3 | Apply |
| 4 | Vascular Medical Image Line and Edge detection Practical Exercises | CO 3 | Apply |
| 5 | Ultrasound Medical Image Segmentation Practical Exercises | CO 3 | Apply |
| 6 | Histopathological Image Analysis | CO 3 | Apply |

**CYCLE-2**

| S.No. | Course Content | CO | Bloom's Level |
|---|---|---|---|
| 1 | Medical Image Classification Practical Exercises | CO 4 | Analyze |
| 2 | Medical Image Registration Practical Exercises | CO 4 | Apply |
| 3 | Medical Image Fusion Techniques | CO 4 | Analyze |
| 4 | 3D reconstruction of image data | CO 5 | Understand |
| 5 | Case studies on some recent advances in analysis of Retinal/Fundus camera images | CO 5 | Analyze |
| 6 | Case studies on some recent advances in analysis of CT images | CO 5 | Analyze |
| 7 | Case studies on some recent advances in analysis of MRI images | CO 5 | Analyze |

| Mapping of Course Outcomes (COs) with Program Outcomes (POs) Program Specific Outcomes (PSO) | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs** | **POs** | | | | | | | | | | | | **PSOs** | | |
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | |
| 1 | 3 | 1 | 3 | | 2 | 1 | | | 3 | | | | 2 | 3 | |
| 2 | 3 | 1 | 3 | | 2 | 1 | | | 3 | | | | 2 | 3 | |
| 3 | 3 | 1 | 3 | | 2 | 1 | | | 3 | | | | 2 | 3 | |
| 4 | 3 | 1 | 3 | | 2 | 1 | | | 3 | | | | 2 | 3 | |
| 5 | 3 | 1 | 3 | | 2 | 1 | | | 3 | | | | 2 | 3 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Summative assessment based on Continuous and Final Examination | | |
|---|---|---|
| **Bloom's Level** | **Rubric based Continuous Assessment [50 marks]** | **Final Examination [50 marks]** |
| Remember | 5 | 10 |
| Understand | 10 | 20 |
| Apply | 15 | 30 |
| Analyze | 20 | 40 |
| Evaluate | - | - |
| Create | - | - |

| 20BM705 | HOSPITAL TRAINING | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 2 | 1 |
| **Nature of Course** | Professional core | | | | |
| **Pre requisites** | Nil | | | | |

**Course Objectives**

The course is intended to

1. Observe medical professionals at work in the wards and the roles of Allied Health Professionals
2. Provide access to healthcare Professionals to get a better Understand of their work
3. Demonstrate patient-care in a hospital environment

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---|---|---|
| CO 1 | Advocate a patient-centered approach in healthcare | Understand |
| CO 2 | Communicate with other health professionals in a respectful and responsible manner | Apply |
| CO 3 | Recognize the importance of inter-professional collaboration in healthcare | Understand |
| CO 4 | Propose a patient-centered inter-professional health improvement plan based upon the patient's perceived needs | Understand |
| CO 5 | Use the knowledge of one's own role and those of other professions to address the healthcare needs of populations and patients served | Understand |

**ASSESSMENT:**

- Students need to complete training in any leading multi-specialty hospital for a period of 15 days.
- They need to prepare an extensive report and submit to their respective course in-charges during the session.
- Out of the following departments, it is mandatory to complete training in any 10. The students can give a presentation of the remaining departments during laboratory hours.

| S.No. | Departments for visit |
|---|---|
| 1 | Cardiology |
| 2 | ENT |
| 3 | Ophthalmology |
| 4 | Orthopaedic and Physiotherapy |
| 5 | ICU/CCU |
| 6 | Operation Theatre |
| 7 | Neurology |
| 8 | Nephrology |
| 9 | Radiology |
| 10 | Nuclear Medicine |
| 11 | Pulmonology |
| 12 | Urology |
| 13 | Obstetrics and Gynaecology |
| 14 | Emergency Medicine |
| 15 | Biomedical Engineering Department |
| 16 | Histo Pathology |
| 17 | Biochemistry |
| 18 | Paediatric/Neonatal |
| 19 | Dental |

| | |
|---|---|
| 20 | Oncology |
| 21 | PAC's |
| 22 | Medical Records / Telemetry |

**Assessment (Internal Assessment only)**

| Assessment | Guide | Supervisor (Industry) | Total marks |
|---|---|---|---|
| Review 1 | 20 | 20 | 100 |
| Review 2 | 20 | 20 | |
| Report | | 20 | |

| 20BM706 | DESIGN PROJECT | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 2 | 1 |
| **Nature of Course** | Professional core | | | | |
| **Pre requisites** | Any Simulation Tool | | | | |

**Course Objectives**

- To study about innovation techniques in biomedical engineering field
- To learn about the design aspects of equipments and products in biomedical engineering field
- To Study about the design challenges in biomedical engineering field
- To enable development of skill set for designing and realizing prototype biomedical devices/ simulation model

**Course Methodology**

- The design project is a team activity having 3-4 students in a team.
- The project work should focus on design and development of biomedical devices using virtual simulation tools like MatLab[GUI] or LabVIEW
- The design project may be a complete hardware or a combination of hardware and software. The software part in mini project may be 80% of the total work.
- On completion of the design project, the student shall submit a detailed project report. The design project should be reviewed and the report shall be evaluated and the students shall appear for a viva-voce oral examination on the project approved by the Co-ordinator and the project guide

| Assessment | Committee | Guide | Marks | | |
|---|---|---|---|---|---|
| | | | CA | FE | Total |
| Review 1 | 10 | 10 | 50 | 50 | 100 |
| Review 2 | 10 | 10 | | | |
| Review 3 | 10 | 10 | | | |
| Report & Viva | 20 | 20 | | | |

**VIII SEMESTER**

| 20BM801 | MAJOR PROJECT | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 20 | 10 |
| **Nature of course** | Professional Core | | | | |
| **Pre requisites** | Mini & Design Project | | | | |

**Course objectives:**

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To train the students in preparing project reports and to face reviews and viva voce examination.
- The student in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor.
- The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department.
- A project report is required at the end of the semester.
- The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

**Course outcomes:**

- On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.

## PROFESSIONAL ELECTIVES (PE) STREAM 1

## BIOMEDICAL SIGNAL AND IMAGE PROCESSING (BSIP)

| 20BME01 | PHYSIOLOGICAL SIGNAL PROCESSING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| **Nature of course** | Professional Elective | | | | |
| **Pre requisites** | Signals and Systems | | | | |

**Course Objectives**

The course is intended to

1. Study the characteristics of different biomedical signals
2. Impart knowledge about spectral analysis
3. Learn the cardiological signal processing methods
4. Understand the classification of biosignals using wavelets
5. Study the feature reduction methods for biosignals

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---|---|---|
| CO 1 | Examine the basic signal processing for bio-signals | Remembering |
| CO 2 | Analyze biosignals in time domain & to estimate the spectrum. | Analyzing |
| CO 3 | Apply wavelet detection techniques for biosignal processing | Apply |
| CO 4 | Classify biosignals using neural networks and statistical classifiers | Understand |
| CO 5 | Demonstrate the feature reduction methods for different biosignals | Analyzing |

**Course Contents**

**Unit – I Physiological Signal Characteristics** **9**

Characteristics of dynamic biomedical signals: Electroneurogram (ENG), Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Event-related potentials (ERPs), Electroretinogram (ERG), Electrooculogram (EOG), Electrogastrogram (EGG), Phonocardlogram (PCG), speech signal, Vibroarthrogram (VAG) - Objectives of Biomedical Signal Analysis

**Unit – II Time Series Analysis and Spectral Estimation** **9**

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

**Unit – III Adaptive Filtering and Wavelet Detection** **9**

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

**Unit – IV Biosignal Classification and Recognition** **9**

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

| Unit – V | Time Frequency and Multivariate Analysis | 9 |
|---|---|---|

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

**Total: 45 Periods**

**Text Books**


1. Arnon Cohen, "Bio-Medical Signal Processing Vol I and Vol II", CRC Press Inc., Boca Rato, Florida, 1999.
2. Rangaraj M Rangayyan," Biomedical Signal Analysis A Case Study Approach" John Wiley, 2002


**Reference Books**


1. Reddy D C, "Biomedical Signal Processing -Principles and Techniques", The McGraw Hill Publishing Company Limited, New Delhi, 2005.
2. Willis J. Tompkins,"Biomedical Digital Signal Processing", Prentice Hall of India Publications, 1995.
3. Leif Sornmo, Pablo Laguna, "Bioelectrical Signal Processing in Cardiac & Neurological Applications", Elsevier, 2005.


**Additional / Web References**

1. https://physionet.org/about/tutorial/
2. https://nptel.ac.in/courses/108/105/108105101/Biomedical Signal Processing, "Biomedical Signal Processing", Prof.Sudipta Mukhopadhyay, IIT Kharagpur

**Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)**

| COs | Pos | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO2 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO3 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO4 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO5 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

**Formative assessment**

| Bloom's Level | Assessment Component | Marks | Total marks |
|---|---|---|---|
| Analyze | Classroom or Online Quiz | 5 | 15 |
| Understand | Assignment | 10 | |

**Summative Assessment**

| Bloom's Category | Continuous Assessment Tests | | | Terminal Examination (60) |
|---|---|---|---|---|
| | IAE-1 (7.5) | IAE-2 (7.5) | IAE-3 (10) | |
| Remember | 5 | 5 | 5 | 10 |
| Understand | 5 | 5 | 5 | 20 |
| Apply | 20 | 20 | 20 | 30 |
| Analyze | 20 | 20 | 20 | 40 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

| 20BME02 | BIOMETRIC SYSTEMS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| **Nature of course** | Professional Elective | | | | |
| **Pre requisites** | Basics of Biomedical Engineering | | | | |

**Course Objectives**

The course is intended to

1. Understand the principles in design of biometric systems and the underlying concepts
2. Apply technologies of fingerprint, iris, face and speech recognition
3. Learn evaluation of biometrics systems based on hand gesture technology
4. Explore iris-based recognition as vital feature
5. Relate Voice Scan and Multimodal Biometrics methodology

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---|---|---|
| CO 1 | Infer knowledge on biometric authentication system and its applications in biometric systems | Understand |
| CO 2 | Explain the functional description of fingerprint enhancement, feature extraction, classification and matching technique | Understand |
| CO 3 | Discuss about various classifiers, algorithm, feature extraction of face and hand geometry recognition | Understand |
| CO 4 | Describe about iris recognition | Understand |
| CO 5 | Identify issues in the voice scan and multimodal biometrics | Apply |

**Course Contents**

**Unit – I** **Introduction to Biometrics** **9**

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

**Unit – II** **Fingerprint Technology** **9**

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

**Unit –III** **Face Recognition and Hand Geometry** **9**

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

**Unit –IV** **Iris Recognition** **9**

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

**Unit – V** **Voice Scan and Multimodal Biometrics** **9**

Mel frequency cepstral coefficients, speaker matching, Gaussian mixture model, NIST speaker Recognition Evaluation Program, Introduction to multimodal biometric system–Integration strategies–Architecture–level of fusion–combination strategy, examples of multimodal biometric systems

**Total : 45 Periods**

**Text Books**

1. James Wayman, Anil Jain, Davide Maltoni, Dario Maio, "Biometric Systems, Technology Design and Performance Evaluation", Springer, 2005.
2. Paul Reid, "Biometrics for Network Security", Pearson Education, 2004

**Reference Books**

1. G.R.Sinha, Sandeep B.Patel, "Biometrics: Concepts and Applications", Wiley Publications, 1st edition, 2013.
2. Arun A Ross, Karthik Nandakumar and Anil K.Jain, "Handbook of Multibiometics", Springer,2006.

**Additional / Web References**

http:// nptel/biometrics- iit-kanpur, "Biometric Systems", Prof. PhalguniGupt , IIT, khanpur

**Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)**

| COs | Pos | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO2 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO3 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO4 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO5 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Formative assessment | | | |
|---|---|---|---|
| **Bloom's Level** | **Assessment Component** | **Marks** | **Total marks** |
| Analyze | Classroom or Online Quiz | 5 | 15 |
| Understand | Assignment | 10 | |

| Summative Assessment | | | | |
|---|---|---|---|---|
| **Bloom's Category** | **Continuous Assessment Tests** | | | **Terminal Examination (60)** |
| | **IAE-1 (7.5)** | **IAE-2 (7.5)** | **IAE-3 (10)** | |
| Remember | 5 | 5 | 5 | 10 |
| Understand | 5 | 5 | 5 | 20 |
| Apply | 20 | 20 | 20 | 30 |
| Analyze | 20 | 20 | 20 | 40 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

| 20BME03 | COMPUTER VISION AND PATTERN RECOGNITION FOR BIOLOGICAL APPLICATIONS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| **Nature of course** | Professional elective | | | | |
| **Pre requisites** | Nil | | | | |

**Course Objectives**

1. Learn and develop new computer vision algorithms
2. Ability to extract features from different data points, Line, image, object in different planes
3. Can develop skills to apply Image segmentation ideas
4. Study shape representation using various contour models
5. Perform and demonstrate object and motion analysis features

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---|---|---|
| CO 1 | To introduce student about computer vision algorithms. | Understand |
| CO 2 | To introduce mechanisms used in biological visual systems that inspire design of artificial unit. | Apply |
| CO 3 | Introduction to techniques in image segmentation. | Apply |
| CO 4 | Various techniques for image representation. | Apply |
| CO 5 | To introduce principles of motion analysis and object recognition | Analyze |

**Course Contents**

| | | |
|---|---|---|
| **Unit – I** | **Digital Image Formation, Depth Estimation and Multi-Camera Views** | **9** |

Fundamentals of image formation, transformation: orthogonal, Euclidean, affine, projective, etc; Fourier transform, convolution and filtering, image enhancement, restoration, histogram processing. Perspective, binocular stereopsis: camera and epipolar geometry; homography, rectification, direct linear transform, random sample consensus (RANSAC), 3-D reconstruction framework; auto-calibration.

| | | |
|---|---|---|
| **Unit – II** | **Feature Extraction** | **9** |

Edges - Canny, Laplacian of Gaussian, difference of Gaussian; line detectors (Hough Transform), corners - Harris and Hessian Affine, orientation histogram, scale invariant feature transform, SURF, histogram of oriented gradients scale-space analysis- image pyramids and Gaussian derivative filters, Gabor Filters and DWT.

| | | |
|---|---|---|
| **Unit – III** | **Image Segmentation** | **9** |

Region growing, edge-based approaches to segmentation, graph-cut, mean-shift, MRFs, texture segmentation; object detection.

| | | |
|---|---|---|
| **Unit –IV** | **Shape Representation** | **9** |

Deformable curves and surfaces, snakes and active contours, level set representations, Fourier and wavelet descriptors, medial representations, multiresolution analysis.

| | | |
|---|---|---|
| **Unit – V** | **Object Recognition and Motion Analysis** | **9** |

Shape correspondence and shape matching, principal component analysis, shape priors for recognition background subtraction and modeling, optical flow, KLT, spatio-temporal analysis, dynamic stereo; motion parameter estimation.

**TOTAL:45 Periods**

**Text Books**

1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag, 2011.
2. D. A. Forsyth, J. Ponce, Computer Vision: A Modern Approach, Pearson Education, 2003.

**Reference Books**

1. H Richard, Z Andrew, Multiple View Geometry in Computer Vision, Cambridge Press, 2003.
2. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Addison- Wesley, 1992

**Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)**

| COs | Pos | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO2 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO3 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO4 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO5 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Formative assessment | | | |
|---|---|---|---|
| **Bloom's Level** | **Assessment Component** | **Marks** | **Total marks** |
| Analyze | Classroom or Online Quiz | 5 | 15 |
| Understand | Assignment | 10 | |

| Summative Assessment | | | | |
|---|---|---|---|---|
| **Bloom's Category** | **Continuous Assessment Tests** | | | **Terminal Examination (60)** |
| | **IAE-1 (7.5)** | **IAE-2 (7.5)** | **IAE-3 (10)** | |
| Remember | 5 | 5 | 5 | 10 |
| Understand | 5 | 5 | 5 | 20 |
| Apply | 20 | 20 | 20 | 30 |
| Analyze | 20 | 20 | 20 | 40 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

| 20BME04 | SPEECH PROCESSING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| **Nature of course** | Professional Elective | | | | |
| **Pre requisites** | Bio Signal Processing | | | | |

**Course Objectives**

The course is intended to

1. Introduce speech production and related parameters of speech
2. Show the computation and use of techniques such as short time Fourier transform, linear predictive coefficients
3. Understand different speech modeling procedures such as Markov and their implementation issues
4. Introduce speech recognition algorithm
5. Introduce artificial speech of human speech

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---|---|---|
| CO 1 | Describe the production and classification of speech signal processing using articulatory and acoustic phonetics. | Remembering |
| CO 2 | Analyze the speech signal using feature extracting and pattern comparison techniques. | Analyzing |
| CO 3 | Evaluate the speech processing systems using deterministic and stochastic process models | Evaluating |
| CO 4 | Analyze the continuous speech recognition system using its architecture, acoustic and language models | Analyzing |
| CO 5 | Analyze the speech synthesis using Diaphone Waveform synthesis techniques and evaluation | Analyzing |

**Course Contents**

**Unit – I** **Basic Concepts** **9**

Speech Fundamentals: Articulatory Phonetics – Production and Classification of Speech Sounds; Acoustic Phonetics – Acoustics of speech production; Review of Digital Signal Processing concepts; Short-Time Fourier Transform, Filter-Bank and LPC Methods.

**Unit – II** **Speech Analysis** **9**

Features, Feature Extraction and Pattern Comparison Techniques: Speech distortion measures– mathematical and perceptual – Log–Spectral Distance, Cepstral Distances, Weighted Cepstral Distances and Filtering, Likelihood Distortions, Spectral Distortion using a Warped Frequency Scale, LPC, PLP and MFCC Coefficients, Time Alignment and Normalization – Dynamic Time Warping, Multiple Time – Alignment Paths.

**Unit – III** **Speech Modelling** **9**

Hidden Markov Models: Markov Processes, HMMs – Evaluation, Optimal State Sequence – Viterbi Search, Baum-Welch Parameter Re-estimation, Implementation issues.

**Unit –IV** **Speech Recognition** **9**

Large Vocabulary Continuous Speech Recognition: Architecture of large vocabulary continuous speech recognition system – acoustics and language models – n-grams, context dependent sub-word units; Applications and present status.

**Unit – V** **Speech Synthesis** **9**

Text Normalization – Phonetic Analysis – Prosodic Analysis – Diaphone Waveform synthesis – Unit selection synthesis and Evaluation

**Total : 45 Periods**

**Text Books**

1. Lawrence Rabiner, Biing-Hwang Juang and Yegnararayana, “Fundamentals of Speech Recognition”, Pearson Education,First edition, 2008..
2. Daniel Jurafsky and James H Martin, “Speech and Language Processing – An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition”, Pearson Education, second edition 2013

**Reference Books**

1. Thomas F Quatieri, “Discrete-Time Speech Signal Processing – Principles and Practice”, Pearson Education, 2004.
2. Ben Gold and Nelson Morgan, “Speech and audio signal processing, Processing and Perception of Speech and Music”, Wiley- India Edition, 2006
3. Lawrence R. Rabiner,, Ronald W. Schafer, “Digital Processing of Speech Signals”, Prentice-Hall, 1978.

**Additional / Web References**

1. http://freevideolectures.com/Course/2504/ELEC9344-Speech-and-Audio-Processing, “Introduction to speech processing”, Prof. E. Ambikairajah, The University of New South Wales

**Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)**

| COs | Pos | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO2 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO3 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO4 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO5 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Formative assessment | | | |
|---|---|---|---|
| **Bloom’s Level** | **Assessment Component** | **Marks** | **Total marks** |
| Analyze | Classroom or Online Quiz | 5 | 15 |
| Understand | Assignment | 10 | |

| Summative Assessment | | | | |
|---|---|---|---|---|
| Bloom's Category | Continuous Assessment Tests | | | Terminal Examination (60) |
| | IAE-1 (7.5) | IAE-2 (7.5) | IAE-3 (10) | |
| Remember | 5 | 5 | 5 | 10 |
| Understand | 5 | 5 | 5 | 20 |
| Apply | 20 | 20 | 20 | 30 |
| Analyze | 20 | 20 | 20 | 40 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

| 20BME05 | BIOSTATISTICS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| **Nature of course** | Professional elective | | | | |
| **Pre requisites** | Nil | | | | |

**Course Objectives**

1. Comprehend differences in data allocation through visual representation.
2. Realize and offer references of types of data occurring in clinical studies and public health
3. Understand and infer results from Analysis of Variance; this technique compares means between two autonomous populations.
4. Understand the importance of survival data and why it requires its type of analysis technique.

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---|---|---|
| CO 1 | Introduction to measurement & descriptive statistics in medical practices. | Understand |
| CO 2 | Get familiar with statistics software. | Apply |
| CO 3 | Understand basics of sampling. | Apply |
| CO 4 | Study of Hypothesis testing. | Apply |
| CO 5 | Knowledge of regression & correlation | Analyze |

**Course Contents**

| | | |
|---|---|---|
| **Unit – I** | **Measurements and Descriptive Statistics in Medical Research and Practice** | **9** |

Data types and scales of measurement: continuous vs. enumeration data, sampling distributions - normal distribution (continuous data), binomial distribution (proportions, based on enumeration data), measures of central tendency-mean, median, mode, measures of variability-standard deviation and standard error.

| | | |
|---|---|---|
| **Unit – II** | **Introduction to R - Software for Statistical Computing** | **9** |

Basics of R programming, data entry and exporting data, grouping, loops and conditional execution, functions. Summary statistics, graphics in R, probability and distribution

| | | |
|---|---|---|
| **Unit – III** | **Sampling** | **9** |

Concept of a source population, random sampling, estimation of population statistics, standard error of a sample mean and of a proportion, and their differences, confidence intervals

| | | |
|---|---|---|
| **Unit –IV** | **Inference and Hypothesis Testing** | **9** |

Hypothesis generation, null hypothesis, Type I and II errors, statistical power, interpretation of P-values and confidence intervals, statistical and clinical significance. Comparing 2 or more groups: Comparing means of two populations with the t-test (continuous data), comparing proportions of responders in two populations (enumeration data), Chi square with corrections (goodness of fit, test of independence). One - Way ANOVA: F distribution test.

| | | |
|---|---|---|
| **Unit – V** | **Regression and Correlation** | **9** |

Simple, partial and multiple correlation, simple linear /nonlinear regression, introduction to data mining for patterns, analytics.

**TOTAL: 45 Periods**

**Text Books**

1. Rao S, *Introduction to Biostatistics and Research Methods*, PHI, 2012.
2. Chad L., C. Wayne, W. Daniel, *Biostatistics: Basic Concepts and Methodology for the Health Sciences*, Wiley, 2014.

**Reference Books**

1. B.K Mahajan, *Methods in Biostatistics*, Jaypee Brothers, 2010.

**Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)**

| COs | Pos | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO2 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO3 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO4 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO5 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Formative assessment | | | |
|---|---|---|---|
| **Bloom's Level** | **Assessment Component** | **Marks** | **Total marks** |
| Analyze | Classroom or Online Quiz | 5 | 20 |
| Understand | Assignment | 15 | |

| Summative Assessment | | | | |
|---|---|---|---|---|
| **Bloom's Category** | **Continuous Assessment Tests** | | | **Terminal Examination (60)** |
| | **IAE-1 (7.5)** | **IAE-2 (7.5)** | **IAE-3 (10)** | |
| Remember | 5 | 5 | 5 | 10 |
| Understand | 5 | 5 | 5 | 20 |
| Apply | 20 | 20 | 20 | 30 |
| Analyze | 20 | 20 | 20 | 40 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

| 20BME07 | MEDICAL IMAGE ANALYSIS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| **Nature of course** | Professional Elective | | | | |
| **Pre requisites** | Digital Image Processing | | | | |

**Course Objectives**

The course is intended to

1. Learn debug and test functionality in image processing tools
2. Learn about sources of noise in medical images (i.e. Acquisition noise, low contrast)
3. Understand the design and implement automated medical analysis algorithms on clinical imaging data using Matlab
4. Introduce deep neural network for image analysis
5. Perform research on an image analysis algorithm

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---|---|---|
| CO 1 | Describe the medical image fundamentals | Remembering |
| CO 2 | Apply image enhancement techniques for processing images | Apply |
| CO 3 | Select the methodologies for image segmentation & recognition | Understand |
| CO 4 | Outline the deep learning techniques in practical applications | Remembering |
| CO 5 | Attribute image restoration and reconstruction techniques in real time applications | Analyzing |

**Course Contents**

**Unit – I** **Introduction to Medical Imaging** **9**

Introduction to Medical Imaging and Analysis Software, X-ray and Computed Tomography (CT) imaging, Magnetic Resonance Imaging (MRI), Ultrasonic Imaging, Molecular Imaging, SPECT and PET

**Unit – II** **Steps in Image Processing** **9**

Texture in Medical Images, Region Growing and Clustering, Random Walks for Segmentation, Active Contours for Segmentation, Systematic Evaluation and Validation

**Unit – III** **Image Segmentation & Analysis** **9**

Image Segmentation: Decision Trees for Segmentation and Classification and Random Forests for Segmentation and Classification. Image Analysis: Neural Networks for Segmentation and Classification and Deep Learning for Medical Image Analysis

.

**Unit –IV** **Deep Learning for Image Analysis** **9**

Advanced Computer Vision - Neural Networks for Image Processing – Overview of Deep Neural Networks - Convolutional Neural Networks and Deep Learning for Medical Image Analysis.

**Unit – V** **Applications** **9**

Retinal Vessel Segmentation, Vessel Segmentation in Lung CT Image, Lesion Segmentation in Brain MR

**Total : 45 Periods**

**Text Books**

1. Wolfgang Birkfellner, “Applied medical Image Processing- A basic course”, Second Edition, CRC Press, 2014
2. Rafael C. Gonzales, Richard E. Woods, “Digital Image Processing”, Fourth Edition, Pearson Education, 2018

**Reference Books**

1. A. P. Dhawan, H.K. Huang, and D. SH. Kim,” Principles and Advanced Methods in Medical Imaging and Image Analysis”, 2008
2. Anil Jain K. “Fundamentals of Digital Image Processing”, PHI Learning Pvt. Ltd., 2011
3. William K. Pratt, “Introduction to Digital Image Processing”, CRC Press, 2013.
4. Reiner Salzer, “Biomedical Imaging: Principles and Applications”, 2012, 1st Edition, Wiley, New Jersey

**Additional / Web References**

https://nptel.ac.in/courses/108/105/108105091/

**Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)**

| COs | Pos | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO2 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO3 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO4 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO5 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Formative assessment | | | |
|---|---|---|---|
| **Bloom’s Level** | **Assessment Component** | **Marks** | **Total marks** |
| Analyze | Classroom or Online Quiz | 5 | 20 |
| Understand | Assignment | 15 | |

| Summative Assessment | | | | |
|---|---|---|---|---|
| **Bloom’s Category** | **Continuous Assessment Tests** | | | **Terminal Examination (60)** |
| | **IAE-1 (7.5)** | **IAE-2 (7.5)** | **IAE-3 (10)** | |
| Remember | 5 | 5 | 5 | 10 |
| Understand | 5 | 5 | 5 | 20 |
| Apply | 20 | 20 | 20 | 30 |
| Analyze | 20 | 20 | 20 | 40 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

| 20BME012 | MACHINE LEARNING FOR HEALTHCARE | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| **Nature of course** | Professional Elective | | | | |
| **Pre requisites** | Linear algebra and Probability theory | | | | |

**Course Objectives**

The course is intended to

1. Learn the various types of machine learning and fundamental mathematical concepts
2. Understand the supervised Learning techniques like regression, classification tree
3. Understand the neural network-based Classification and Clustering techniques
4. Familiar with various classifications and clustering algorithms
5. Understand the various concepts of learning techniques and its medical application

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---|---|---|
| CO 1 | Apply the basic mathematical foundation for various Machine learning techniques | Applying |
| CO 2 | Implement supervised learning techniques for various data sets. | Analyzing |
| CO 3 | Implement and analyse data sets for clustering | Analyzing |
| CO 4 | Apply various reinforcement learning algorithms on data sets | Applying |
| CO 5 | Explain the learning techniques and its medical application | Understanding |

**Course Contents**

**Unit – I** **Introduction** **9**

Definition and Need for Machine Learning–Type–Supervised–Unsupervised Learning–Reinforcement–Basics Maths and Background–Probability–Linear Algebra–Statistical Decision Support Theory–Bayesian–Data set–Training–Testing–Validation–Models–Evaluation

**Unit – II** **Supervised Learning** **9**

Regression–Linear–Ridge–Lasso–Logistic regression–Regularizations; Classification algorithms: K–Nearest Neighbour–Decision Trees–Support Vector Machine–Kernel trick–Artificial Neural Networks–Feedforward–Back propagation–Case study on various classification applications

**Unit – III** **Unsupervised Learning** **9**

Clustering algorithms– K-Means–K-Medoids–DBSCAN –Hierarchical clustering – Spectral Clustering– Cluster Analysis – Objective Functions – Case study on various clustering applications

**Unit –IV** **Reinforcement Learning** **9**

Markov Decision process model–Policy–value–optimal–evaluation– Planning algorithms – value iteration–policy iteration–linear programming– Learning algorithms – Stochastic approximation – Q-Learning – SARSA – Case study on various reinforcement applications

**Unit – V** **APPLICATIONS OF MACHINE LEARNING IN MEDICAL FIELD** **9**

Study of Neuro marketing With EEG Signals and Machine Learning Techniques, Deep Learning on Symptoms in Disease Prediction, Deep Learning in Mining Biological Data, Prediction of protein structure using ML, Medical Image data classification and segmentation

**Total : 45 Periods**

**Text Books**

1. Mohri Mehryar, Afshin Rostamizadeh, and Ameet Talwalkar. “Foundations of machine learning”, MIT press, 2018
2. Sachi Nandan Mohanty, G. Nalinipriya, Om Prakash Jena, Achyuth Sarkar, "Machine Learning for Healthcare Applications" ISBN: 978-1-119-79181-2, Wiley Scrivener Publishing, 2021
3. Müller Andreas C. and Sarah Guido. “Introduction to Machine Learning with Python: A Guide for Data Scientists”, O’Reilly, 2016

**Reference Books**

1. Christopher M. Bishop. “Pattern Recognition and Machine Learning”, Springer, 2013
2. Ethem A Ipaydin. “Introduction to Machine Learning” Second Edition, PHI Learning,2012

**Additional / Web References**

https://nptel.ac.in/courses/106/106/106106236/

**Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)**

| COs | Pos | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO2 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO3 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO4 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO5 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Formative assessment | | | |
|---|---|---|---|
| **Bloom’s Level** | **Assessment Component** | **Marks** | **Total marks** |
| Analyze | Classroom or Online Quiz | 5 | 15 |
| Understand | Assignment | 10 | |

| Summative Assessment | | | | |
|---|---|---|---|---|
| **Bloom’s Category** | **Continuous Assessment Tests** | | | **Terminal Examination (60)** |
| | **IAE-1 (7.5)** | **IAE-2 (7.5)** | **IAE-3 (10)** | |
| Remember | 5 | 5 | 5 | 10 |
| Understand | 5 | 5 | 5 | 20 |
| Apply | 20 | 20 | 20 | 30 |
| Analyze | 20 | 20 | 20 | 40 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

| 20BME14 | REAL TIME EMBEDDED SYSTEMS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| **Nature of course** | Professional Elective | | | | |
| **Pre requisites** | Microcontrollers | | | | |

**Course Objectives**

The course is intended to

1. Study the architecture and programming of ARM processors
2. Understand the computing platform in memory
3. Understand the program validation and testing
4. Introduce the basic concepts of hard real time multiprocessing
5. Introduce the analytical concepts for effective programming

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---|---|---|
| CO 1 | Design and develop ARM processor-based systems | Apply |
| CO 2 | Comprehend and appreciate the significance and role of microcontrollers in embedded systems. | Understand |
| CO 3 | Analyze and demonstrate program design and optimization and proper scheduling of the process | Analyzing |
| CO 4 | Apply the concept of process, multiprocessing and operating systems in embedded system | Analyzing |
| CO 5 | Implement various communication protocols in distributed embedded computing platform | Analyzing |

**Course Contents**

**Unit – I** **Introduction to Embedded Computing and ARM Processors** **9**

Complex systems and microprocessors–Embedded system design process–Formalism for system design– Design example: Model train controller- ARM Processor Fundamentals-Instruction Set and Programming using ARM Processor

**Unit – II** **Computing Platform** **9**

CPU: Programming input and output–Supervisor mode, exception and traps–Coprocessor–Memory system mechanism–CPU performance–CPU power consumption- CPU buses–Memory devices–I/O devices–Component interfacing-System Level Performance Analysis-Parallelism. Design Example: Data Compressor

**Unit – III** **Program Design and Analysis** **9**

Program design–Model of programs–Assembly and Linking–Basic compilation techniques– Program Optimization-Analysis and optimization of execution time, power, energy, program size–Program validation and testing- Example: Software Modem

**Unit –IV** **Process and Operating Systems** **9**

Multiple tasks and Multi processes–Processes–Context Switching–Operating Systems–Priority based Scheduling- RMS and EDF- Inter Process Communication mechanisms–Evaluating operating system performance–Power optimization strategies for processes

**Unit – V** **Hardware Accelerators and Networks** **9**

Multiprocessors-CPUs and Accelerators–Performance Analysis- Distributed Embedded Architecture–Networks for Embedded Systems: I2C, CAN Bus, Ethernet, Myrinet–Network based design–Internet enabled systems. Design Example: Elevator Controller.

**Total : 45 Periods**

**Text Books**

1. Wayne Wolf, "Computers as Components - Principles of Embedded Computing System Design", Morgan Kaufmann Publisher (An imprint of Elsevier), 3rd Edition, 2008.
2. Andrew N Sloss, Dominic Symes, Chris Wright, "ARM System Developer's Guide-Designing and Optimizing System Software", Elsevier/Morgan Kaufmann Publisher, 2008

**Reference Books**

1. David E-Simon, "An Embedded Software Prime", Pearson Education, 2010.
2. K.V.K.K.Prasad, "Embedded Real-Time Systems: Concepts, Design & Programming", Dreamtech press, 2005.
3. Jane. W. S. Liu, "Real-Time Systems", Pearson Education Asia, 2011.

**Additional / Web References**

https://nptel.ac.in/courses/106/105/106105193/

**Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)**

| COs | Pos | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO2 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO3 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO4 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO5 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Formative assessment | | | |
|---|---|---|---|
| **Bloom's Level** | **Assessment Component** | **Marks** | **Total marks** |
| Analyze | Classroom or Online Quiz | 5 | 15 |
| Understand | Assignment | 10 | |

| Summative Assessment | | | | |
|---|---|---|---|---|
| **Bloom's Category** | **Continuous Assessment Tests** | | | **Terminal Examination (60)** |
| | **IAE-1 (7.5)** | **IAE-2 (7.5)** | **IAE-3 (10)** | |
| Remember | 5 | 5 | 5 | 10 |
| Understand | 5 | 5 | 5 | 20 |
| Apply | 20 | 20 | 20 | 30 |
| Analyze | 20 | 20 | 20 | 40 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

## STREAM -2 HEALTH CARE SYSTEMS (HCS)

| 20BME22 | Robotics in Medicine | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| **Nature of course** | Professional Core | | | | |
| **Pre requisites** | Sensors and Measurements | | | | |

**Course Objectives**

1. To provide basic understanding of robotics and their applications.
2. To demonstrate the need for various sensors and drives in robotics.
3. To provide knowledge about the robot kinematics, path planning and different trajectories.
4. To make students understand the basics of programming of robots, contemporary use and design of robots in practice and research.

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---|---|---|
| CO 1 | Understand the necessity of robots in various applications and the working of basic electric, electronic and other types of drives required in robots. | Understand |
| CO 2 | Identify a suitable sensor for a specific robot. | Apply |
| CO 3 | Derive the mathematical model of robotic systems and analyze its kinematic behavior. | Apply |
| CO 4 | Design robots for diverse environments encompassing all types of motions and paths with ideas for performing various robotic tasks with the application of programming skills. | Analyze |
| CO 5 | Design of different types of robots for various applications. | Understand |

**Course Contents**

| | | |
|---|---|---|
| **Unit – I** | **Introduction to Robotics and Drives for Robotics** | **9** |

Robots: Basics, Types-Application, Mobility, Terrain, components classification, performance characteristics. Drives: Electric, hydraulic and pneumatic drives

| | | |
|---|---|---|
| **Unit – II** | **Sensors for Robots** | **9** |

Tactile sensors - Proximity and range sensors - Acoustic sensors - Vision sensor systems -Image processing and analysis - Image data reduction – Segmentation – Feature extraction -Object recognition.

| | | |
|---|---|---|
| **Unit – III** | **Robot Kinematics and Dynamics** | **9** |

Kinematics of manipulators, rotational, translation and transformation, Homogeneous, Transformations, Denavat – Hartenberg Representation, Inverse Kinematics. Linearization of Robot Dynamics – State variable continuous and discrete models.

| | | |
|---|---|---|
| **Unit –IV** | **Path Planning and Programming of Robots** | **9** |

Types of trajectories, trajectory planning and avoidance of obstacles, path planning, skew motion, joint integrated motion and straight line motion. Robot programming: languages and software packages-MATLAB/Simulink, OpenRDK, Adams.

| | | |
|---|---|---|
| **Unit – V** | **Application of Robots** | **9** |

Applications in Biomedical Engineering–Bio Engineering Biologically Inspired Robots,Neural Engineering, Application in Rehabilitation–Interactive Therapy, Bionic Arm, Clinical and Surgical–Gynaecology, Orthopaedics, Neurosurgery.

**Total : 45 Periods**

**Text Books**


1. P. Groover, "Industrial Robotics: Technology, Programming and Applications", 2nd Edition, McGraw-Hill Publishers, 2012
2. John J. Craig, "Introduction to Robotics, Mechanics and Control", 3rd Edition, Pearson Education, 2010


**Reference Books**


1. Robert Schilling, "Fundamentals of Robotics-Analysis and control", Prentice Hall, 2003
2. W. Spong and M. Vidyasagar, "Robot Dynamics and Control," 2012, 2nd Edition, John Wiley & Sons, New York.
3. Lorenzo Sciavicco Bruno Siciliano , "Modelling and Control of Robot Manipulators", 2012, 1st Edition, Springer Science & Business Media, Berlin.
4. Peter Corke, "Robotics, Vision and Control: Fundamental Algorithms in MATLAB", Reprint 2013, 1 st Edition, Springer-Verlag Berlin Heidelberg.


**Additional / Web References**

**Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)**

| COs | Pos | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO2 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO3 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO4 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO5 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Formative assessment | | | |
|---|---|---|---|
| **Bloom's Level** | **Assessment Component** | **Marks** | **Total marks** |
| Analyze | Classroom or Online Quiz | 5 | 15 |
| Understand | Assignment | 10 | |

| Summative Assessment | | | | |
|---|---|---|---|---|
| **Bloom's Category** | **Continuous Assessment Tests** | | | **Terminal Examination (60)** |
| | **IAE-1 (7.5)** | **IAE-2 (7.5)** | **IAE-3 (10)** | |
| Remember | 5 | 5 | 5 | 10 |
| Understand | 5 | 5 | 5 | 20 |
| Apply | 20 | 20 | 20 | 30 |
| Analyze | 20 | 20 | 20 | 40 |

| | | | | |
|---|---|---|---|---|
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

| 20BME23 | MEDICAL DEVICE DESIGN AND PROTOTYPING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| **Nature of course** | Profession Elective | | | | |
| **Prerequisites** | Introduction to basic medical Science for engineers | | | | |

**Course Objectives**

1. Provides an overview of design and manufacturing technique for medical devices development.
2. Comprehend Finite element methods for implant design
3. Explore about Orthopaedic applications
4. Outline the equipments, instrumentations and control systems used in bio manufacturing.
5. Explain standard design and manufacturing programs, validation practices and regulatory requirement used in biomedical industry.

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---|---|---|
| CO 1 | Understand design and manufacturing technique for medical devices development | Understand |
| CO 2 | Apply Finite element methods for implant design | Apply |
| CO 3 | Understand about Orthopaedic applications | Understand |
| CO 4 | Comprehend various manufacturing process | Apply |
| CO 5 | Realize human factor engineering in medical system | Apply |

**Course Contents**

| Unit – I | Medical Device Design Standards and Regulations | 9 |
|---|---|---|

Generating Ideas and Concepts, Design Process versus Design Control, Implementation of Design Procedures, Material selection and Biocompatibility, Design Specification, Quality in Design, Detailed Design (hardware/ Software design), Computer-Aided Design, Design Evaluation (Validation and Verification), Obtaining Regulatory Approval to Market.

| Unit – II | Finite Element Methods in Implant Design | 9 |
|---|---|---|

Introduction to Finite Element Method, Finite element modelling of cells, tissues and organs Medical device design and prototyping, Customized and universal design of Implants and prosthesis.

| Unit – III | Orthopaedic Designs | 9 |
|---|---|---|

Design of orthopaedic Implants, orthoses and Assistive devices.

| Unit –IV | Manufacturing Process | 9 |
|---|---|---|

Additive manufacturing processes; Machining, forming, electro-discharge machining (EDM) and electrochemical machining (ECM), laser-based processing, casting and molding. Machines and equipment including tooling, fixturing, sensors systems, and control.

| Unit – V | Human Factors Engineering | 9 |
|---|---|---|

Human Factors, Human Factors Process-Specifying the User Interface, Anthropometry. Alarms and Signals. Additional Human Factors Design Considerations- Overview of Verification and Validation for Embedded Software in Medical System

**Total : 45 Periods**

**Text Books**

1 Handbook of Medical Device Design by Richard C. Fries, CRC Press ,2010

**Reference Books**

1. Design and Manufacture of Medical Devices by Paulo Davim, Woodhead Publishing,2012
2. Medical Device Design: Innovation from Concept to Market, by Peter J. Ogrodnik, Academic Press is an imprint of Elsevier
3. Introduction to Bio manufacturing, Margaret Bryans, Northeast Bio manufacturing centre
4. Paul H. King, Richard C. Fries, Arthur T. Johnson, Design of Biomedical Devices and Systems, Third Edition, ISBN 9781466569133

**Additional / Web References**

1. Additional / web Reference 01

**Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)**

| COs | Pos | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO2 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO3 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO4 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO5 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Formative assessment | | | |
|---|---|---|---|
| **Bloom's Level** | **Assessment Component** | **Marks** | **Total marks** |
| Analyze | Classroom or Online Quiz | 5 | 15 |
| Understand | Assignment | 10 | |

| Summative Assessment | | | | |
|---|---|---|---|---|
| **Bloom's Category** | **Continuous Assessment Tests** | | | **Terminal Examination (60)** |
| | **IAE-1 (7.5)** | **IAE-2 (7.5)** | **IAE-3 (10)** | |
| Remember | 5 | 5 | 5 | 10 |
| Understand | 5 | 5 | 5 | 20 |
| Apply | 20 | 20 | 20 | 30 |
| Analyze | 20 | 20 | 20 | 40 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

| 20BME25 | Telehealth Technology | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| **Nature of course** | Professional Core | | | | |
| **Pre requisites** | Sensors and Measurements | | | | |

**Course Objectives**

1. To impart the key principle of telemedicine and healthcare.
2. Explore various telemedical technology and its modern trend
3. Appreciate security aspects and telemedicine standards
4. Expound element of tele-radiology systems like image acquisition system, display system and communication networks.
5. Demonstrate the methods and techniques used in rural healthcare

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---|---|---|
| CO 1 | Understand the key principles of telemedicine-health and its technology | Understand |
| CO 2 | Apply technical aspects of tele-medical technology. | Apply |
| CO 3 | Reconnoiter Telemedicine standards for mobile telemedicine and its security role. | Apply |
| CO 4 | To study the need for digital imaging and picture archiving and communication systems in telemedicine application. | Analyze |
| CO 5 | Comprehend telemedicine applications for rural healthcare | Understand |

**Course Contents**

**Unit – I** **Telemedicine and Health** **9**

History and Evolution of telemedicine - Tele health - Tele care - Organs of telemedicine - Global and Indian scenario. Ethical and legal aspects of Telemedicine - Social and legal issues - Safety and regulatory issues - Advances in Telemedicine.

**Unit – II** **Telemedical Technology** **9**

Principles of Multimedia - Text, Audio, Video, data - Data communications and networks - PSTN – POTS – ANT – ISDN – Internet - Air/ wireless communications: GSM satellite - and Micro wave - Modulation techniques, Types of Antennae - Integration and operational issues - Communication infrastructure for telemedicine – LAN and WAN technology - Satellite communication. Mobile hand-held devices and mobile communication - Internet technology and telemedicine using world wide web (www) - Video and Audio conferencing - Clinical data – Local and centralized.

**Unit – III** **Telemedical Standards** **9**

Data Security and Standards: 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), Real-time Telemedicine integrating doctors / Hospitals, Clinical laboratory data, Radiological data, security and confidentially of medical records and access control, Cyber laws related to telemedicine.

**Unit –IV** **Picture Archiving and Communication System** **9**

Types of image formats, DICOM standard, PACS system: Block diagram, Storing & retrieving images, Algorithm for retrieving images, Compressions and its significance, Lossless data Storage and in-house communication, Computer aided diagnosis (CAD),Hospital information system - Doctors, paramedics, facilities available. Pharmaceutical information system

**Unit – V** **Telemedical Applications** **9**

Telemedicine access to health care services – Health education and self-care - Introduction to robotics surgery - Tele surgery - Tele cardiology, Tele oncology - Telemedicine in neurosciences - Electronic Documentation - e - health services, security and interoperability - Telemedicine access to health care services – health education and self-care - Business aspects - Project planning and costing - Usage of telemedicine.

**Total : 45 Periods**

**Text Books**

1. Sherry Emery, Telemedicine in Hospitals: Issues in Implementation, 2015, 1st edition, Routledge, Tayor and Francis Group, New York.
2. Norris, A.C. “Essentials of Telemedicine and Tele care”, Wiley, 2002

**Reference Books**

1. Bernard Fong, A.C.M. Fong, C.K. Li, Telemedicine Technologies: Information Technologies in Medicine and Telehealth, 2011, 1st edition, John Wiley & Sons Ltd, New York
2. Eren, Halit_ Webster, John G - Telemedicine and Electronic Medicine-CRC Press ,2016
3. Shashi Bhushan Gogia - Fundamentals of Telemedicine and Telehealth-Academic Press ,2019
4. H.K. Huang, “PACS and imaging informatics–Basic Principles & application”, Wiley-Blackwell.
5. Rifat Latifi, Charles R. Doarn, Ronald C. Merrell - Telemedicine, Telehealth and Telepresence_Principles, Strategies, Applications, and New Directions-Springer International Publishing_Springer ,2021.
6. Tarik A. Rashid, Chinmay Chakraborty, Kym Fraser - Advances in Telemedicine for Health Monitoring Technologies, design and applications-The Institution of Engineering and Technology,2020

**Additional / Web References**

**Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)**

| COs | Pos | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO2 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO3 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO4 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO5 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Formative assessment | | | |
|---|---|---|---|
| **Bloom’s Level** | **Assessment Component** | **Marks** | **Total marks** |
| Analyze | Classroom or Online Quiz | 5 | |

| | | | |
|---|---|---|---|
| Understand | Assignment | 10 | 15 |

| Summative Assessment | | | | |
|---|---|---|---|---|
| **Bloom's Category** | **Continuous Assessment Tests** | | | **Terminal Examination (60)** |
| | **IAE-1 (7.5)** | **IAE-2 (7.5)** | **IAE-3 (10)** | |
| Remember | 5 | 5 | 5 | 10 |
| Understand | 5 | 5 | 5 | 20 |
| Apply | 20 | 20 | 20 | 30 |
| Analyze | 20 | 20 | 20 | 40 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

CHAIRMAN - BOARD OF STUDIES

| 20BME26 | WEARABLE SYSTEMS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| **Nature of course** | Professional Electives | | | | |
| **Pre requisites** | Sensors and Instrumentation | | | | |

**Course Objectives**

The course is intended to

1. Know the sensor and signal processing requirement of wearable systems
2. Understand the level of energy involvement in wearable systems
3. Understand the communication and security aspects
4. Educate the wearability issues related to Body Sensor Networks
5. Learn the applications of wearable systems

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---|---|---|
| CO 1 | Identify the wearable sensors and its need for wearable systems | Understand |
| CO 2 | Interpret the energy requirement for wearable system | Apply |
| CO 3 | Express the need for wireless communication techniques | Understand |
| CO 4 | Predict the wearability issues related to Body Sensor Networks | Apply |
| CO 5 | Illustrate the applications of wearable systems | Understand |

**Course Contents**

**Unit – I** **Introduction to Sensors** **9**

Need for wearable systems, Characteristics of wearable systems, Sensors for wearable systems-Biomechanical Sensors -Inertia movement sensors, Physiological Sign Sensors-Respiration activity sensor, Inductive plethysmography, Impedance plethysmography, pneumography, Wearable ground reaction force sensor, GSR, Pulse Oximetry, Radiant thermal sensor, Gas Sensor, Bio compatibility.

**Unit – II** **Energy Harvesting for Self-Powered Wearable Devices** **9**

Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles

**Unit – III** **Wireless Health Systems** **9**

Need for wireless monitoring, Definition of Body area network, BAN and Healthcare, Technical Challenges-System security and reliability, BAN Architecture–Introduction, Wireless communication techniques

**Unit –IV** **Ergonomics for Wearable Body Sensor Networks** **9**

Wearability issues-physical shape and placement of sensor, Technical challenges - sensor design, signal acquisition, Constraint on sampling frequency for reduced energy consumption, Rejection of irrelevant information, Data mining

**Unit – V** **Applications of Wearable Systems** **9**

| |
|---|
| Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, Multi parameter monitoring, Neural recording, Gait analysis, Sports Medicine, Smart Fabrics |
| **Total : 45 Periods** |

**Text Books**

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

**Reference Books**

1. Hang,Yuan-Ting,"wearable medical sensors and systems",Springer-2013
2. Mehmet R. Yuce,Jamil Y.Khan, "Wireless Body Area Networks Technology, Implementation and Applications", Pan Stanford Publishing Pvt.Ltd, Singapore, 2012

**Additional / Web References**

https://www.youtube.com/watch?v=P7YWJuhVM1Q, „Wearable Electronic Textiles",Prof. Volakis, Chair Professor of Electrical Engineering at Ohio State University

**Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)**

| COs | Pos | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO2 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO3 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO4 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO5 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Formative assessment | | | |
|---|---|---|---|
| **Bloom's Level** | **Assessment Component** | **Marks** | **Total marks** |
| Analyze | Classroom or Online Quiz | 5 | 20 |
| Understand | Assignment | 15 | |

| Summative Assessment | | | | |
|---|---|---|---|---|
| **Bloom's Category** | **Continuous Assessment Tests** | | | **Terminal Examination (60)** |
| | **IAE-1 (7.5)** | **IAE-2 (7.5)** | **IAE-3 (10)** | |
| Remember | 5 | 5 | 5 | 10 |
| Understand | 5 | 5 | 5 | 20 |
| Apply | 20 | 20 | 20 | 30 |
| Analyze | 20 | 20 | 20 | 40 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

| 20BME27 | BODY AREA NETWORKS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| **Nature of course** | Professional Elective | | | | |
| **Pre requisites** | Nil | | | | |

**Course Objectives**

The course is intended to

1. To familiarize with Body Area Network [BAN]
2. To know the hardware requirement of BAN
3. To understand the communication and security aspects in the BAN
4. To know the applications of BAN in the field of medicine

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---|---|---|
| CO 1 | Deliberate introduction of BAN | Understand |
| CO 2 | Design a BAN for appropriate application in medicine | Apply |
| CO 3 | Assess the efficiency of communication and the security parameters | Evaluating |
| CO 4 | Illustrate the need for medical device regulation and regulations followed in various regions | Understand |
| CO 5 | Extend the concepts of BAN for medical applications | Understanding |

**Course Contents**

**Unit – I** **Introduction to BAN** **9**

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

**Unit – II** **Hardware For BAN** **9**

Processor-Low Power MCUs, Mobile Computing MCUs, Integrated processor with 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 arrhythmias monitoring, Multi patient monitoring systems, Multichannel Neural recording, Gait analysis, Sports Medicine, Electronic pill

**Total : 45 Periods**

**Text Books**

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

**Reference Books**

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

**Additional / Web References**

**Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)**

| COs | Pos | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO2 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO3 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO4 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO5 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Formative assessment | | | |
|---|---|---|---|
| **Bloom’s Level** | **Assessment Component** | **Marks** | **Total marks** |
| Analyze | Classroom or Online Quiz | 5 | 20 |
| Understand | Assignment | 15 | |

| Summative Assessment | | | | |
|---|---|---|---|---|
| **Bloom’s Category** | **Continuous Assessment Tests** | | | **Terminal Examination (60)** |
| | **IAE-1 (7.5)** | **IAE-2 (7.5)** | **IAE-3 (10)** | |
| Remember | 5 | 5 | 5 | 10 |
| Understand | 5 | 5 | 5 | 20 |
| Apply | 20 | 20 | 20 | 30 |
| Analyze | 20 | 20 | 20 | 40 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

| 20BME29 | DATA COMMUNICATION AND NETWORKING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| **Nature of course** | Professional Elective | | | | |
| **Pre requisites** | Nil | | | | |

**Course Objectives**

The course is intended to

1. Focus on information sharing and networks
2. Understand the MAC layer protocols
3. Study the IP addressing and routing protocols in network layer
4. Know the congestion control and resource allocation techniques
5. Educate the services provided by the application layer protocol

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---|---|---|
| CO 1 | Interpret the importance of layering, addressing and annotate the protocol stack of OSI and TCP/IP model | Understanding |
| CO 2 | Annotate MAC protocols (Ethernet, Token Ring and Wi-Fi) supported by Data Link layer to ensure hop-to-hop reliable communication | Understanding |
| CO 3 | Explain IP addressing and routing protocols to find shortest route to achieve reliable network-layer data transmission | Applying |
| CO 4 | Classify the transport layer protocols and explain the congest ion control or congestion avoidance techniques to ensure quality of service | Understanding |
| CO 5 | Analyze the functions and services provided by the application layer protocols (HTTP, SMTP and DNS). | Analyzing |

**Course Contents**

| | | |
|---|---|---|
| **Unit – I** | **Data Communications** | **9** |

Data Communication–Networks–The OSI Model– Layers in the OSI Model – TCP/IP Protocol Suite – Addressing–Transmission Media

| | | |
|---|---|---|
| **Unit – II** | **Data Link Layer** | **9** |

Framing–Error Detection and Correction– IEEE Standards (802.3,802.5,802.11)-MAC protocols and types

| | | |
|---|---|---|
| **Unit – III** | **Network Layer** | **9** |

Internetworking: Switching and Bridging–Basic Internetworking-IPv4-IPv6–Routing Techniques: Distance vector (RIP)–Link state (OSPF)-Interdomain Routing (BGP)

| | | |
|---|---|---|
| **Unit –IV** | **Transport Layer** | **9** |

Congestion Control and Resource Allocation: TCP Congestion Control–Congestion Avoidance Mechanisms–Quality of Service: Integrated Services–Differentiated Services

| | | |
|---|---|---|
| **Unit – V** | **Application Layer** | **9** |

Domain Name System-File Transfer-Web Services and SNMP-HTTP-Electronic Mail (SMTP, POP3, IMAP, MIME)

**Total : 45 Periods**

**Text Books**

1. Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", Fifth Edition,
   Morgan Kaufmann Publishers, 2011
2. Behrouz A. Forouzan, "Data Communications and Networking", Fourth Edition, Tata McGraw Hill, Reprint 2012

**Reference Books**

1. William Stallings, "Data Communication and Networks", Pearson Education, Tenth edition, 2014.
2. James .F. Kurouse & W. Rouse, "Computer Networking: A Top down Approach Featuring", Sixth edition, Pearson Education, 2013.

**Additional / Web References**

http://www.nptel.ac.in/downloads/106105080, Computer Networks, Prof.Sujoy Ghosh, IIT Kharagpur

**Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)**

| COs | Pos | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO2 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO3 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO4 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO5 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Formative assessment | | | |
|---|---|---|---|
| **Bloom's Level** | **Assessment Component** | **Marks** | **Total marks** |
| Analyze | Classroom or Online Quiz | 5 | 20 |
| Understand | Assignment | 15 | |

| Summative Assessment | | | | |
|---|---|---|---|---|
| **Bloom's Category** | **Continuous Assessment Tests** | | | **Terminal Examination (60)** |
| | **IAE-1 (7.5)** | **IAE-2 (7.5)** | **IAE-3 (10)** | |
| Remember | 5 | 5 | 5 | 10 |
| Understand | 5 | 5 | 5 | 20 |
| Apply | 20 | 20 | 20 | 30 |
| Analyze | 20 | 20 | 20 | 40 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

| 20BME30 | INTERNET OF THINGS IN MEDICINE | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| **Nature of course** | Professional Elective | | | | |
| **Pre requisites** | Nil | | | | |

**Course Objectives**

The course is intended to

1. Understand Smart Objects and IoT Architectures
2. Learn about various IOT-related protocols
3. Study the healthcare challenges in IoT
4. Understand the domain specific applications of IoT in healthcare
5. Study the IoT in medicine for popular applications

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---|---|---|
| CO 1 | Describe the concepts of Internet of Things | Understand |
| CO 2 | Interpret basic protocols in wireless sensor network | Understand |
| CO 3 | Illustrate the need and challenges of IoT | Understand |
| CO 4 | Relate IoT applications in Industry domain and analyze their performance | Analyzing |
| CO 5 | Compute the health care applications through IoT tools and Embedded systems | Applying |

**Course Contents**

| | | |
|---|---|---|
| **Unit – I** | **IoT and M2M** | **9** |

Defining IoT-Characteristics of IoT-Physical design of IoT-Logical design of IoT–Functional blocks of IoT-Communication models & APIs-Machine to Machine-Difference between IoT and M2M-Software define network

| | | |
|---|---|---|
| **Unit – II** | **Network and Communication Aspects** | **9** |

Wireless medium access issues-MAC protocol survey-Survey routing protocols– Sensor deployment & Node discovery-Data aggregation & dissemination

| | | |
|---|---|---|
| **Unit – III** | **Challenges in IoT** | **9** |

Design challenges-Development challenges-Security challenges–Health care challenges.

| | | |
|---|---|---|
| **Unit –IV** | **Domain Specific Applications of IoT** | **9** |

Home automation-Industry applications-Surveillance applications-Other IoT applications in health care

| | | |
|---|---|---|
| **Unit – V** | **Developing IoT Applications in Healthcare** | **9** |

Introduction to Python-Introduction to different IoT tools-Developing applications through IoT tools-Developing sensor based application through embedded system platform-Implementing IoT concepts with python

**Total : 45 Periods**

**Text Books**

1. Vijay Madisetti, Arshdeep Bahga, “Internet of Things: A Hands-On Approach”, Universities Press, 2015.
2. Venkata Krishna, Sasikumar Gurumoorthy, Mohammad S. Obaidat, “Internet of Things and Personalized Healthcare Systems”, Springer Briefs in Applied Sciences, and Technology, Forensic and Medical Bioinformatics, 2019.

**Reference Books**

1. Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice".
2. Olivier Hersent, David Boswarthick, Omar Elloumi , “The Internet of Things – Key applications and Protocols”, Wiley, 2012.

**Additional / Web References**

https://nptel.ac.in › courses, “Internet of Things” – Prof.Sudip Misra, IIT Kharagpur

**Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)**

| COs | Pos | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO2 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO3 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO4 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO5 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Formative assessment | | | |
|---|---|---|---|
| **Bloom’s Level** | **Assessment Component** | **Marks** | **Total marks** |
| Analyze | Classroom or Online Quiz | 5 | 20 |
| Understand | Assignment | 15 | |

| Summative Assessment | | | | |
|---|---|---|---|---|
| **Bloom’s Category** | **Continuous Assessment Tests** | | | **Terminal Examination (60)** |
| | **IAE-1 (7.5)** | **IAE-2 (7.5)** | **IAE-3 (10)** | |
| Remember | 5 | 5 | 5 | 10 |
| Understand | 5 | 5 | 5 | 20 |
| Apply | 20 | 20 | 20 | 30 |
| Analyze | 20 | 20 | 20 | 40 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

| 20BME32 | MEDICAL INFORMATICS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| **Nature of course** | Professional Elective | | | | |
| **Pre requisites** | Nil | | | | |

**Course Objectives**

1. Introduce the basic concepts in Biomedical Informatics.
2. Understand the applications of an electronic medical record system and medical standards.
3. Acquaint the students to clinical decision support systems.
4. Introduce the basics of bioinformatics, resources in the field and explore the various databases.

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---|---|---|
| CO 1 | Understand the basic concepts in Biomedical Informatics | Understand |
| | | Apply |
| CO 2 | Comprehend the applications of an electronic medical record system. | Apply |
| CO 3 | Apply the various aspects of health informatics and medical standards. | Analyze |
| CO 4 | Design and develop clinical decision support systems. | |
| CO 5 | Understand the basics of bioinformatics and the resources in the field. | Understand |

**Course Contents**

| | | |
|---|---|---|
| **Unit – I** | **Introduction to Biomedical Informatics** | **9** |

The Science and the Pragmatics - Biomedical Data - Their Acquisition, Storage, and Use - Computer Architectures for Health Care and Biomedicine - Overview of hospital information system - Patient history taking mechanisms - Patient data processing - Database Management - Communication of medical data across different hospital units - Networking and Integration of patient data.

| | | |
|---|---|---|
| **Unit – II** | **Computer Architectures and Software Engineering for Health Care and Biomedicine** | **9** |

Computer Architectures and Software Engineering for Health Care and Biomedicine 6 hours
Data from patients - Patient Record, Coding and classification – Standards - Natural Language Processing - Biomedical Imaging Informatics - Biosignal Analysis - Electronic Health Record Systems – Patient Centered Care Systems - Primary care - Clinical Departmental Systems - Nursing Information Systems

| | | |
|---|---|---|
| **Unit – III** | **Electronic Patient Record and Standards** | **9** |

Electronic Patient Record - Medical data formats – Medical Standards – HL7 – DICOM - LOINC - PACS - Medical Standards for Vocabulary - ICD 10 – DRG - MeSH, UMLS, SNOMED - Healthcare Standards - JCAHO, HIPAA.

| | | |
|---|---|---|
| **Unit – V** | **Biomedical Decision Making** | **9** |

| | | |
|---|---|---|
| Probabilistic Clinical Reasoning - Medical Knowledge and Decision Support - Methods for decision support - Clinical decision-support systems - Strategies for medical knowledge acquisition - Predictive tools for clinical decision support. | | |
| **Unit – V** | **Bioinformatics** | **9** |

| |
|---|
| Introduction to Bioinformatics- Biological information resources - Genome sequence acquisition and analysis - Retrieval of biological data - Data acquisition – databases - structure and annotation - Data mining and data characteristics. |
| **Total : 45 Periods** |

| |
|---|
| **Text Books** |
| 1.Edward H. Shortliffe and James J. Cimino, “Biomedical Informatics: Computer Applications in Health Care and Biomedicine (Health Informatics)”, 2014, 4th edition, Springer, New York. |
| **Reference Books** |
| 1.Rastogi, “Bioinformatics: Methods and Applications: Genomics, Proteomics and Drug Discovery”, 2013, 1st edition, Prentice Hall, New Delhi. |
| **Additional / Web References** |
| |

**Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)**

| COs | Pos | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO2 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO3 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO4 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO5 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Formative assessment | | | |
|---|---|---|---|
| **Bloom’s Level** | **Assessment Component** | **Marks** | **Total marks** |
| Analyze | Classroom or Online Quiz | 5 | 20 |
| Understand | Assignment | 15 | |

| Summative Assessment | | | | |
|---|---|---|---|---|
| **Bloom’s Category** | **Continuous Assessment Tests** | | | **Terminal Examination (60)** |
| | **IAE-1 (7.5)** | **IAE-2 (7.5)** | **IAE-3 (10)** | |
| Remember | 5 | 5 | 5 | 10 |
| Understand | 5 | 5 | 5 | 20 |
| Apply | 20 | 20 | 20 | 30 |
| Analyze | 20 | 20 | 20 | 40 |
| Evaluate | 0 | 0 | 0 | 0 |

CHAIRMAN - BOARD OF STUDIES

| | | | | |
|---|---|---|---|---|
| Create | 0 | 0 | 0 | 0 |

| 20BME34 | BIOINFORMATICS AND DRUG DESIGN | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| **Nature of course** | Professional Core | | | | |
| **Pre requisites** | | | | | |

**Course Objectives**

1. Apply basic knowledge of various computational algorithms on areas of applications in bioinformatics.
2. Analyze common problems in bioinformatics, alignment techniques, ethical issues, public data sources and evolutionary modelling.
3. Discover the practical use of tools for specific bioinformatic areas.
4. Apply knowledge of bioinformatics in a practical project.

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---|---|---|
| CO 1 | Evaluate the main databases at the NCBI and EMBL-EBI resources. | Understand |
| CO 2 | Compare the databases, tools, repositories and be able to use each one to extract specific information. | Apply |
| CO 3 | Demonstrate the selected tools at NCBI and EBI to run simple analyses on genomic sequences. | Apply |
| CO 5 | Evaluate the main databases at the NCBI and EMBL-EBI resources. | Understand |
| CO 4 | Develop the ability for critical assessment of scientific research publications in bioinformatics. | Apply |

**Course Contents**

| Unit – I | Introduction to Bioinformatics | 9 |
|---|---|---|

Scope and applications of bioinformatics, Evolutionary Basis - Sequence Homology, Sequence Identity, Sequence Similarity, Biological databases – File formats.

| Unit – II | Sequence Alignment | 9 |
|---|---|---|

Alignment of pairs of sequences, Introduction - Definition of sequence alignment, Methods - Dot matrix sequence comparison. Similarity Searches on Sequence Databases - FASTA and BLAST.

| Unit – III | Pairwise Sequence Alignment | 9 |
|---|---|---|

Dynamic programming algorithm for sequence alignment – Global Alignment: Needleman-Wunsch, Local Alignment: Smith-Waterman, Gap penalty, Assessing the significance of an Alignment.

| Unit –IV | Multiple Sequence Alignment | 9 |
|---|---|---|

Dynamic programming, progressive methods, Iterative methods, MSA using CLUSTAL W, PILEUP and CLUSTAL X, purpose and applications of multiple sequence alignment, phylogenetic trees.

| Unit – V | Scoring Matrices | 9 |
|---|---|---|

Similarity searches - PAM and BLOSUM matrix, Dayhoff mutation matrix, construction of PAM and BLOSUM matrix. Differences between PAM & BLOSUM.

**Total : 45 Periods**

**Text Books**

1. Bioinformatics and Functional Genomics by Pevsner J, 3rd Ed., 2019.
2. Introduction to Bioinformatics by Arthur M. Lesk, 2014

**Reference Books**

1. Artificial Neural Networks: Methods and Applications (Methods in Molecular Biology) by David J. Livingstone, 2011.

**Additional / Web References**

**Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)**

| COs | Pos | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO2 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO3 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO4 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO5 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Formative assessment | | | |
|---|---|---|---|
| **Bloom's Level** | **Assessment Component** | **Marks** | **Total marks** |
| Analyze | Classroom or Online Quiz | 5 | 20 |
| Understand | Assignment | 15 | |

| Summative Assessment | | | | |
|---|---|---|---|---|
| **Bloom's Category** | **Continuous Assessment Tests** | | | **Terminal Examination (60)** |
| | **IAE-1 (7.5)** | **IAE-2 (7.5)** | **IAE-3 (10)** | |
| Remember | 5 | 5 | 5 | 10 |
| Understand | 5 | 5 | 5 | 20 |
| Apply | 20 | 20 | 20 | 30 |
| Analyze | 20 | 20 | 20 | 40 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

## STREAM-3 BIOENGINEERING (BE)

| 20BME42 | REHABILITATION ENGINEERING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| **Nature of course** | Professional Elective | | | | |
| **Pre requisites** | Nil | | | | |

**Course Objectives**

1. To understand the rehabilitation concepts and Rehabilitation team members for future development and applications.
2. To study various Principles of Rehabilitation Engineering.
3. To understand different types of Therapeutic Exercise Technique.
4. To study the various orthotic devices and prosthetic devices to overcome orthopaedic problems.
5. To understand the development of wheel chair concepts

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---|---|---|
| CO 1 | Understand need and concepts of rehabilitation engineering in general. | Understand |
| CO 2 | Understand the concept of mobility and functioning of sensory augmentation. | Understand |
| CO 3 | Identify the key components and design of universal accessibility. | Apply |
| CO 4 | Analyse the design of orthotics and prosthetics of upper and lower extremities | Analyze |
| CO 5 | Design manual and power wheelchair | Apply |

**Course Contents**

| | | |
|---|---|---|
| **Unit – I** | **Engineering Concepts in Rehabilitation Engineering** | **9** |

Anthropometry: methods for static and dynamic measurements. Area measurements-measurement of characteristics and movement, measurement of muscular strength and capabilities. Measurement tools and processes in rehabilitation engineering: fundamental principles, structure, function. Measurement systems for performance and behaviour.

| | | |
|---|---|---|
| **Unit – II** | **Sensory Rehabilitation Engineering** | **9** |

Sensory augmentation and substitution, visual system, visual augmentation, tactual vision substitution, and auditory vision substitution. Auditory system: auditory augmentation, audiometer, hearing aids, cochlear implantation, visual auditory substitution, tactual auditory substitution. Tactual system: tactual augmentation, tactual substitution.

| | | |
|---|---|---|
| **Unit – III** | **Universal Design and Accessibility** | **9** |

Design Considerations, Total Quality Management in Rehabilitation Engineering, Steel as a Structural Material, Aluminium for Assistive Technology Design, Use of Composites for Assistive Technology Design, Design with Engineering Materials, Fabrication, Basic Electric Circuits. Barrier-Free Design, Elemental Resource Model, Factors Affecting Barrier-Free Design, Interior Space Design, Design for People with Disabilities, Accessible Transportation

| | | |
|---|---|---|
| **Unit –IV** | **Orthopaedic Prosthetics and Orthotics** | **9** |

| | | |
|---|---|---|
| | Upper-Extremity Prostheses, Upper-Extremity Orthoses, Lower-Extremity Prostheses, Lower-Extremity Orthoses, Functional Neuromuscular Stimulation, Ambulation Aids, Aids to Daily Living | |
| **Unit – V** | **Wheel chair Safety Standards and Testing** | **9** |
| | Categories of wheel chairs, wheel chair structure and component design – materials, frame design, wheels and casters. Ergonomics- wheel chair propulsion- kinetics, kinematics, net joined forces and movements, power wheel chair electrical systems- user interface, integrated control, power systems. Electromagnetic compatibility, Personal transportation- vehicle selection, lift mechanisms, wheel chair restraint mechanisms, hands controls | |
| | | **Total : 45 Periods** |

**Text Books**

1. Bronzino, Joseph, “Handbook of Biomedical Engineering”, 2nd ed., CRC Press, 2006.
2. Robinson C.J, Rehabilitation Engineering, CRC press, 1995.
3. Rory A Cooper, An introduction to Rehabilitation Engineering, Taylor & Francis, CRC Press, 2006)

**Reference Books**

1. H N Teodorecu, L.C.Jain, Intelligent Systems and Technologies in Rehabilitation Engineering, CRC, 2000.
2. Etienne Grandjean, H. Oldroyd, Fitting the task to the man, Taylor & Francis, 1988

**Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)**

| COs | Pos | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO2 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO3 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO4 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO5 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Formative assessment | | | |
|---|---|---|---|
| **Bloom’s Level** | **Assessment Component** | **Marks** | **Total marks** |
| Analyze | Classroom or Online Quiz | 5 | 20 |
| Understand | Assignment | 15 | |

CHAIRMAN - BOARD OF STUDIES

| Summative Assessment | | | | |
|---|---|---|---|---|
| Bloom's Category | Continuous Assessment Tests | | | Terminal Examination (60) |
| | IAE-1 (7.5) | IAE-2 (7.5) | IAE-3 (10) | |
| Remember | 5 | 5 | 5 | 10 |
| Understand | 5 | 5 | 5 | 20 |
| Apply | 20 | 20 | 20 | 30 |
| Analyze | 20 | 20 | 20 | 40 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

| 20BME43 | TISSUE ENGINEERING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| **Nature of course** | Professional Elective | | | | |
| **Pre requisites** | Nil | | | | |

**Course Objectives**

1. To learn the fundamentals of tissue engineering and tissue repairing
2.To acquire knowledge on clinical applications of tissue engineering
3.To understand the basic concept behind tissue engineering focusing on the stem cells, biomaterials and its applications

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---|---|---|
| CO 1 | Multidisciplinary aspects in tissue engineering to solve healthcare problems | Understand |
| CO 2 | Identify sources of cells, bioactive molecules and materials | Apply |
| CO 3 | Design and develop scaffolds using conventional and advanced fabrication methods | Apply |
| CO 4 | Evaluate biological outcomes of tissue engineering strategies | Apply |
| CO 5 | Describe the regulatory aspects to commercialize products | Understand |

**Course Contents**

**Unit – I** **Introduction and History** **9**

Introduction to tissue engineering: Basic definition; current scope of development; Tissue and organ banking; limitations of banking; types of tissues; organ and tissue culture invitro; origin of tissue engineering; history (with respect to artificial skin);

**Unit – II** **Tissue Architecture** **9**

Tissue types and Tissue components,Tissue repair,Engineering wound healing and sequence of events. Basic wound healing Applications of growth factors.scopesuse in therapeutics, cells as therapeutic agents, cell numbers and growth rates, measurement of cell characteristics morphology, numberviability,motility and functions. Measurement of tissue characteristics, appearance, cellular component,ECM component, mechanical measurements and physical properties.

**Unit – III** **Morphogenesis &Cell source** **9**

Morphogenesis and organ development in human; repair and regeneration; cell sources; stem cells and its types; Differentiation, differentiation and trans-differentiation; Intercellular communication-gap junctional and microvescular; Cell aggregation; adhesion dependence; Role of ECM in term of decellularizedallo-/xeno-genic tissues in tissue engineering

**Unit –IV** **Scaffolds and bioreactors** **9**

Classification of scaffold materials, criteria for ideal scaffold, various types of scaffolds, various types of bioreactor configurations for cell cultures and advantages/disadvantages of the same. Definition, 3- dimentionality; porosity and pore-size; fabrication technology: conventional (such as Solvent-casting particulate-leaching Gas foaming, electrospinning, fiber meshes/ fiber bonding, phase separation, freeze drying, solution casting) and solid free form technology (such as stereolithography, 3D printing, fused deposition modeling, phase-change jet printing)

**Unit – V** **Biomaterials and Transplantation of Engineered Cells and Tissues** **9**

Definition, ideal properties and types; biomimetics; Properties like -- mechanical property, wetability, biodegradability and surface property; Types -- polymeric (natural and synthetic), nano-materials, ceramic, composites, hydrogels and metallic

**Total : 45 Periods**

**Text Books**

1. Principles of Tissue Engineering, 4th Edition Robert Lanza, Robert Langer, Joseph P. Vacanti, Academic Press; 4 edition (2015)
2. 3D Bioprinting and Nanotechnology in Tissue Engineering and Regenerative Medicine Lijie Grace Zhang John Fisher Kam Leong, 1st Edition Academic Press (2015)

**Reference Books**

1. Ravi Birla, (2014) Introduction to Tissue Engineering: Applications and Challenges, WileyIEEE Press.
2. Robert A. Brown, (2012) Extreme Tissue Engineering: Concepts and Strategies for tissue fabrication, Wiley Blackwell

**Additional / Web References**

**Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)**

| COs | Pos | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO2 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO3 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO4 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO5 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Formative assessment | | | |
|---|---|---|---|
| **Bloom's Level** | **Assessment Component** | **Marks** | **Total marks** |
| Analyze | Classroom or Online Quiz | 5 | 20 |
| Understand | Assignment | 15 | |

| Summative Assessment | | | | |
|---|---|---|---|---|
| **Bloom's Category** | **Continuous Assessment Tests** | | | **Terminal Examination (60)** |
| | **IAE-1 (7.5)** | **IAE-2 (7.5)** | **IAE-3 (10)** | |
| Remember | 5 | 5 | 5 | 10 |
| Understand | 5 | 5 | 5 | 20 |
| Apply | 20 | 20 | 20 | 30 |
| Analyze | 20 | 20 | 20 | 40 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

| 20BME49 | BIOMEMS AND LAB-ON-CHIP | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| **Nature of course** | Professional Core | | | | |
| **Pre requisites** | Nil | | | | |

**Course Objectives**

1. Introduce the historical background of evolution of MEMS and Microsystems and their applications and highlight the scaling effects in miniaturizing devices.
2. Educate on the rudiments of various materials and fundamental concepts used in MEMS and microfluidics fabrication
3. Comprehend various fluidic systems in LoC devices and identify their usage in development of various electrochemical biosensors, paper-based microfluidics and chemical analysis.

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---|---|---|
| CO 1 | Introduced the historical background of evolution of MEMS and Microsystems with the scaling effects on different Physical domains. | Understand |
| CO 2 | Rudiments of scaling laws in MEMS. | Apply |
| CO 3 | Comprehensive understanding of basic Silicon and polymer materials and its fabrication techniques. | Apply |
| CO 4 | Highlight with various Fluidic systems for complete microfluidic device development. | Apply |
| CO 5 | Acquaint with various techniques of developing electrochemical LoC biosensors | Apply |

**Course Contents**

**Unit – I** **Introduction to MEMS** **9**

Historical background of Micro Electro Mechanical Systems-Types of MEMS devices-Applications of MEMS in healthcare industry, Microsystems and Miniaturization.

**Unit – II** **Scaling Laws in MEMS** **9**

Introduction to Scaling, Scaling in Geometry-Scaling in Rigid, Body Dynamics, Scaling in Electrostatic Forces, Scaling in Electromagnetic Forces, Scaling in Heat Transfer, Scaling in Fluid Mechanics/ Microfluidics.

**Unit – III** **Materials for MEMS and Microfabrication Technology** **9**

Substrates and wafers, Silicon and Silicon compounds, Polymers (SU8, PDMS), Thin film coating: PVD, CVD, Photolithography, Lift-off technique, Etching, Bulk micro machining, Surface micro machining, LIGA process.

**Unit –IV** **Microfluidics: Theory and Fabrication** **9**

Basic Microfluidics Theory: Fluidic parameters, Equation of motion, Transport modes in microfluidic systems; Micromachining of silicon, glass, rigid and soft polymers for micro total analysis systems, Soft Lithography: Molding Technology. Surface chemistry in polymer microfluidic system.

**Unit – V** **Fluidic Systems of Lab-on-Chip devices** **9**

Lab-On-a-Chip Platforms and Components – Fluidic Platforms-Pressure driven, Capillary flow, Segmented flow, Electrokinetics, Electrowetting on Dielectrics (EWOD), Centrifugal Microfluidics; Components of LoC Systems- Microvalves, Micropumps-mechanical (membrane type) and nonmechanical (electrical-electroosmosis, electrophoretic, DEP, EHD), Micromixers, Filters, Sensors.

**Total : 45 Periods**

**Text Books**

1. Tai-Ran Hsu, “MEMS & Microsystem, Design and manufacture”, 2017, 1st Edition, McGraw Hill, New York
2. Marc J. Madou, “Fundamentals of Microfabrication: The Science of Miniaturization”, 2012, 2nd edition, CRC Press, Florida, USA.
3. Jaime Castillo-León, Winnie E. Svendsen (eds.) “Lab-on-a-Chip Devices and Micro-Total Analysis Systems_ A Practical Guide”, 2015, Springer International Publishing

**Reference Books**

1. Gary S. May and Simon Sze, “Fundamentals of semiconductor fabrication”, 2010, 1st edition John Wiley & Sons, New Jersey, USA.
2. Francis E. H. Tay, “Microfluidics and Biomems application”, 2013, 1st Edition, Springer, Berlin.
3. Albert Folch, “Introduction to Biomems”,2016, 1st Edition, CRC Press, Florida.
4. Edwin Oosterbroek and Albert van den Berg, “Lab-on-a-Chip: Miniaturized Systems for (Bio) Chemical Analysis and Synthesis”, 2011, 1st edition, Elsevier Science, Amsterdam, Netherlands.

**Additional / Web References**

**Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)**

| COs | Pos | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO2 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO3 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO4 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO5 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Formative assessment | | | |
|---|---|---|---|
| **Bloom’s Level** | **Assessment Component** | **Marks** | **Total marks** |
| Analyze | Classroom or Online Quiz | 5 | 20 |
| Understand | Assignment | 15 | |

| Summative Assessment | | | | |
|---|---|---|---|---|
| **Bloom’s Category** | **Continuous Assessment Tests** | | | **Terminal Examination (60)** |
| | **IAE-1 (7.5)** | **IAE-2 (7.5)** | **IAE-3 (10)** | |
| Remember | 5 | 5 | 5 | 10 |
| Understand | 5 | 5 | 5 | 20 |
| Apply | 20 | 20 | 20 | 30 |
| Analyze | 20 | 20 | 20 | 40 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

| 20BME51 | PHYSIOLOGICAL SYSTEM MODELING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| **Nature of course** | Professional Core | | | | |
| **Pre requisites** | Nil | | | | |

**Course Objectives**

1. To introduce the basic system concepts and differences between an engineering and physiological control systems.
2. To acquaint students with different mathematical techniques applied in analysing a system and the various types of nonlinear modelling approaches.
3. To teach neuronal membrane dynamics and to understand the procedures for testing, validation and interpretation of physiological models.
4. To study the cardiovascular model and apply the modelling methods to multi input and multi output systems.

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---|---|---|
| CO 1 | Understand the basic system concepts and differences between an engineering and physiological control systems. | Understand |
| CO 2 | Apply different mathematical techniques to analyze a system. | Apply |
| CO 3 | Comprehend the various nonlinear modelling approaches. | Apply |
| CO 4 | Understand the neuronal membrane dynamics. | Understand |
| CO 5 | Apply the procedures for testing, validation and interpretation of physiological models. | Apply |

**Course Contents**

**Unit – I** **System Modeling in Physiology** **9**

The problem of system modeling in physiology - Need for modeling - Conceptual and mathematical models – Modeling - experiments and simulation - Feedback control systems - Difference between engineering and physiological control systems.

**Unit – II** **Physiological Modeling** **9**

Deductive and Inductive modeling - Characteristics of a reliable physiological model - Modeling a simple reflex - Mathematical modeling.

**Unit – III** **Nonlinear Modeling** **9**

System Identification, Model Specification, Model estimation. Types of nonlinear modeling approaches. Non parametric modeling. Volterra and Wiener models. Volterra Kernels. Modeling the vertebrate retina. Analysis of estimation errors.

**Unit –IV** **Modeling of Neuronal Systems** **9**

A general model of the nerve membrane - Action potential and synaptic dynamics - Functional integration in the single neuron -Neuronal systems with point process inputs - Conduction in nerve fibres - Voltage clamp experiment - Hodgkin Huxley (H-H) model - Circuit analog of the H-H nerve membrane model.

**Unit – V** **Systems Identification in Physiology** **9**

System characteristics -System parameters - System functional properties -Input characteristics - Experimental considerations -Data preparation -Data consolidation -Model specification and estimation tasks - Model validation and interpretation.

**Total : 45 Periods**

**Text Books**

1. Michael C.K. Khoo, "Physiological Control Systems: Analysis, Simulation and Estimation,"2011, 1st edition, Prentice Hall of India, New Delhi.

**Reference Books**

1. Suresh Devasahayam, "Signal Processing and Physiological Systems Modeling", 2013, 1st edition, Springer, New York.
2. Joseph D. Bronzino and Donald R. Peterson, "The Biomedical Engineering Handbook", 2015, 4 thedition, CRC Press, Florida.

**Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)**

| COs | Pos | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO2 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO3 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO4 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO5 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Formative assessment | | | |
|---|---|---|---|
| **Bloom's Level** | **Assessment Component** | **Marks** | **Total marks** |
| Analyze | Classroom or Online Quiz | 5 | 20 |
| Understand | Assignment | 15 | |

| Summative Assessment | | | | |
|---|---|---|---|---|
| **Bloom's Category** | **Continuous Assessment Tests** | | | **Terminal Examination (60)** |
| | **IAE-1 (7.5)** | **IAE-2 (7.5)** | **IAE-3 (10)** | |
| Remember | 5 | 5 | 5 | 10 |
| Understand | 5 | 5 | 5 | 20 |
| Apply | 20 | 20 | 20 | 30 |
| Analyze | 20 | 20 | 20 | 40 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

| 20BME52 | VIRTUAL INSTRUMENTATION | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| **Nature of course** | Professional Elective | | | | |
| **Pre requisites** | Nil | | | | |

**Course Objectives**

The course is intended to

1. Introduce virtual instrumentation concepts and applications
2. Understand the programming principles in virtual instrumentation using LabVIEW
3. Train to program virtual instrumentation software for biomedical applications

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---|---|---|
| CO 1 | Explain the graphical programming and textural programming in virtual instrumentation using LabVIEW environment | Understanding |
| CO 2 | Demonstrate the programming principles in virtual instrumentation using LabVIEW | Analyzing |
| CO 3 | Develop the programming in LabVIEW using loops and structures | Applying |
| CO 4 | Develop the configuration of data acquisition system using the Analog and digital hardwares. | Applying |
| CO 5 | Apply virtual instrumentation concept for signal processing, image processing, mechanical and embedded system applications | Applying |

**Course Contents**

**Unit – I Basics of Virtual Instrumentation** **9**

Introduction- Virtual Instrument versus Traditional Instrument, Advantages, Comparison of Graphical Programming and Textual Programming-LabVIEW environment: Front Panel, Block Diagram, Data Flow techniques

**Unit – II Programming Principles** **9**

Creating simple VI- Data Types-Numeric, String, Boolean-Mechanical Operation of Boolean, Arrays, Clusters, Waveforms graphs and waveform charts - Array Functions- Cluster Functions- Debugging Techniques, Documentation, Context Help Window-Sub VI-Creation

**Unit – III Loops and Structures** **9**

FOR – WHILE loop - Case, Sequence, event structures- Formula nodes- local and global variables

**Unit –IV Data Acquisition System** **9**

Instrument control – GPIB – VISA – instrument drivers-serial port communication. Data Acquisition: Review of Transducer and Signal conditioning, DAQ hardware- Analog inputs – Analog outputs- Digital I/O- DAQ assistant and configurations

**Unit – V Applications of Virtual Instrumentation** **9**

Signal Processing and Analysis, Image acquisition and processing–Biomedical Startup Kit–Motion control–Control Design and Simulation Tools –Simulation Interface Toolkit –Embedded Module –GSD Applications

**Total : 45 Periods**

**Text Books**

4. Jovitha Jerome "Virtual Instrumentation using labview" Prentice Hall of India, NewDelhi, 2010.
5. Sanjay Gupta and Joseph john "Virtual Instrumentation using labview principles and practices of graphical programming"Tata McGraw Hill Education Private Limited, Second Edition 2017.

**Reference Books**

1. Gary W.Johnson and Richard Jennings, "LabVIEW Graphical Programming", McGraw Hill, 4th Edition, New York, 2011.
2. Jeffrey Travis and Jim Kring, "LabVIEW for everyone", 3rd edition, Dorling Kindersley, 2009.
3. John Essick "Hands-On Introduction to LabVIEW for Scientists and Engineers" illustrated, OUP USA, 2018.
4. Lisa K. Wells "LabVIEW: User's Guide", Prentice-Hall 1995

**Additional / Web References**

http://www.ni.com/academic/students/learn-labview/

**Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)**

| COs | Pos | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO2 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO3 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO4 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO5 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Formative assessment | | | |
|---|---|---|---|
| **Bloom's Level** | **Assessment Component** | **Marks** | **Total marks** |
| Analyze | Classroom or Online Quiz | 5 | 20 |
| Understand | Assignment | 15 | |

| Summative Assessment | | | | |
|---|---|---|---|---|
| **Bloom's Category** | **Continuous Assessment Tests** | | | **Terminal Examination (60)** |
| | **IAE-1 (7.5)** | **IAE-2 (7.5)** | **IAE-3 (10)** | |
| Remember | 5 | 5 | 5 | 10 |
| Understand | 5 | 5 | 5 | 20 |
| Apply | 20 | 20 | 20 | 30 |
| Analyze | 20 | 20 | 20 | 40 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

| 20BME53 | MEDICAL OPTICS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| **Nature of course** | Professional Elective | | | | |
| **Pre requisites** | Medical Physics | | | | |

**Course Objectives**

The course is intended to

1. Understand the basic concept of photonics
2. Acquire knowledge about the impact and interaction of light with biological tissue
3. Understand practical applications of optics related to medicine
4. Explore OCT and other Non-Thermal Diagnostic Applications
5. Exemplify photonics and its therapeutic applications

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---|---|---|
| CO 1 | Explain the basic properties of light sources | Understanding |
| CO 2 | Demonstrate knowledge of the fundamentals of optical properties of tissues | Analyzing |
| CO 3 | Describe surgical applications of laser | Understanding |
| CO 4 | Understand Non-Thermal Diagnostic Applications | Understanding |
| CO 5 | Apply the concepts of laser and light to therapeutic applications with its safety procedures | Applying |

**Course Contents**

**Unit – I** **Instrumentation in Photonics** **9**

Review of basic properties of light–Reflection**,** Refraction, Scattering, fluorescence and Phosphorescence-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, optical tweezers.

**Unit – II** **Optical Properties of the Tissues** **9**

Light transport inside the tissue, optical properties of tissue. Laser Characteristics as applied to medicine and biology-Laser tissue Interaction-Chemical, Thermal, Electromechanical. Photo ablative processes

**Unit – III** **Surgical Applications of Lasers** **9**

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

**Unit –IV** **Non-Thermal Diagnostic Applications** **9**

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

**Unit – V** **Therapeutic Applications** **9**

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

**Total : 45 Periods**

**Text Books**

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

**Reference Books**

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

**Additional / Web References**

**Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)**

| COs | Pos | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO2 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO3 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO4 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO5 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Formative assessment | | | |
|---|---|---|---|
| **Bloom’s Level** | **Assessment Component** | **Marks** | **Total marks** |
| Analyze | Classroom or Online Quiz | 5 | 20 |
| Understand | Assignment | 15 | |

| Summative Assessment | | | | |
|---|---|---|---|---|
| **Bloom’s Category** | **Continuous Assessment Tests** | | | **Terminal Examination (60)** |
| | **IAE-1 (7.5)** | **IAE-2 (7.5)** | **IAE-3 (10)** | |
| Remember | 5 | 5 | 5 | 10 |
| Understand | 5 | 5 | 5 | 20 |
| Apply | 20 | 20 | 20 | 30 |
| Analyze | 20 | 20 | 20 | 40 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

| 20BMO04 | Healthcare Data Analytics | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| **Nature of course** | Open Elective | | | | |
| **Prerequisites** | Basic Statistics and Probability | | | | |

**Course Objectives**

The course is intended to

1. Explore the key components of healthcare analytics systems that enable healthcare organizations (HCOs) and analytics strategy techniques
2. Gain the basic knowledge about sources of medical-related data and various components of Electronic Health Records (EHR)
3. Describe how to create an SPSS data file for statistical analysis and how to manage missing data points
4. Learn how to conduct parametric or non-parametric test
5. Learn when to use an analysis of variance (ANOVA) test and how to build a multivariate analysis of covariance (ANCOVA) model.

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---|---|---|
| CO 1 | Describe the various components of healthcare analytics systems | Understanding |
| CO 2 | Explain the various sources of medical data and Electronic Health Records. | Understanding |
| CO 3 | Create data-file for statistical analysis using SPSS software | Apply |
| CO 4 | Perform parametric and non-parametric tests using SPSS software | Apply |
| CO 5 | Conduct ANOVA test and bale to build ANCOVA model. | Apply |

**Course Contents**

**Unit – I** Fundamentals of Healthcare Analytics **9**

Fundamental objective of healthcare analytics, Analytics Capabilities for Quality and Performance Improvement, Components of Healthcare Analytics, Analytics Strategy Framework, with a Focus on Quality/Performance Improvement, Developing an Analytics Strategy, and Applications of Healthcare Analytics.

**Unit – II** Healthcare Data Sources and Basic Analytics **9**

Types and sources of medical-related data, medical Electronic Health Records-Components-Benefits-Challenges of Using EHR Data- Coding Systems, International Classification of Diseases (ICD), Current Procedural Terminology (CPT), International Classification of Functioning, Disability, and Health (ICF), Barriers to Adopting HER data, Phenotyping Algorithms.

**Unit – III** Introduction to Medical Statistics **9**

Introduction to SPSS, creating an SPSS data file, Hypothesis testing, and P values, SPSS data management capabilities, Managing SPSS output, SPSS help commands, Golden rules for reporting numbers, Parametric, and non-parametric statistics, transforming skewed variables, Reporting descriptive statistics.

**Unit – IV** parametric or non-parametric statistical tests **9**

Comparing the means of two independent samples, One- and two-sided tests of significance, Effect sizes, Study design, Influence of sample size, Two-sample t-test, Confidence intervals, Reporting the results from two-sample t-tests, Rank-based non-parametric tests.

**Unit – V** Analysis of variance **9**

Building ANOVA and ANCOVA models, ANOVA models, One-way analysis of variance, Effect size for ANOVA, post-hoc tests for ANOVA, Reporting the results of a one-way ANOVA, Factorial ANOVA models, an example of a three-way ANOVA, Analysis of covariance (ANCOVA), Testing the model assumptions of ANOVA/ANCOVA.

**Total: 45 Periods**

**Text Books**

1. Trevor L. Strome, “Healthcare Analytics for Quality and Performance Improvement”, Wiley and Sons 2013.
2. Chandan K. Reddy and Charu C. Aggarwal, Healthcare Data Analytics, CRC Press, 2015.
3. Belinda Barton, Jennifer Peat “Medical Statistics A Guide to SPSS, Data Analysis and Critical Appraisal”, Wiley Blackwell, 2014

**Reference Books**

4. Kun Chang Lee, Sanjiban Sekhar Roy, Pijush Samui, Vijay Kumar Data Analytics in Biomedical Engineering and Healthcare, Academic Press, 2021
5. Christo El Morr, Hossam Ali-Hassan Analytics in Healthcare: A Practical Introduction, Springer 2019

**Additional / Web References**

1. https://www.youtube.com/watch?v=zMdPAwXX8M&list=PLtkf1CzQAYcE6Ob6Yv6PLFQFIhvR7nWl8
2. https://www.udemy.com/course/spss-for-research/

**Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)**

| COs | POs | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | |
| CO 1 | 3 | 1 | 2 | | | 1 | | | | | 2 | 2 | 1 | 2 | |
| CO 2 | 3 | 1 | 2 | | | 1 | | | | | 2 | 2 | 1 | 2 | |
| CO 3 | 3 | 3 | 3 | 1 | 3 | 2 | | | | | 2 | 2 | 1 | 2 | |
| CO 4 | 3 | 3 | 3 | 1 | 3 | 2 | | | | | 2 | 2 | 1 | 2 | |
| CO 5 | 3 | 3 | 3 | 1 | 3 | 2 | | | | | 2 | 2 | 1 | 2 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

**Formative assessment**

| Bloom’s Level | Assessment Component | Marks | Total marks |
|---|---|---|---|
| Remember | Online Quiz | 5 | 15 |
| Understand | Tutorial Class / Assignment | 5 | |
| | Attendance | 5 | |

**Summative Assessment**

| Bloom’s Category | Internal Assessment Examinations | | | Final Examination (60) |
|---|---|---|---|---|
| | IAE – 1 (5) | IAE – 2 (10) | IAE – 3 (10) | |
| Remember | 10 | 10 | 10 | 20 |
| Understand | 10 | 10 | 10 | 20 |
| Apply | 30 | 30 | 30 | 60 |
| Analyze | | | | |
| Evaluate | | | | |
| Create | | | | |

**Stream -2 Health Care Systems (HCS)**

| 20BME21 | Human Assist Devices | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| **Nature of course** | Professional Electives | | | | |
| **Pre requisites** | Biosensors and Biomedical Instrumentation | | | | |

**Course Objectives**

The course is intended to know the principle, design and application of various human assist devices which includes extracorporeal devices, artificial heart, cardiac assist devices, artificial kidney and hearing aids. Additionally, a brief introduction to design aspects of prosthetic and orthotic devices for the disability including sensory augmentations and substitutions.

**Course Outcomes**

On successful completion of the course, students will be able to

| CO. No | Course Outcome | Bloom's Level |
|---|---|---|
| CO 1 | Interpret the various mechanical techniques that will help in assisting the heart functions | Understanding |
| CO 2 | Explain the working principles and parameters of the dialysis unit | Understanding |
| CO 3 | Indicate the methodologies to assess the hearing loss. | Understanding |
| CO 4 | Infer the various orthotic devices and prosthetic devices to overcome orthopedic problems | Understanding |
| CO 5 | Discuss the sensory impairments and its substitutions | Understanding |

**Course Contents**

**Unit – I** **Cardiac Assist Devices** **9**

Principle of External counter pulsation techniques, intra-aortic balloon pump, Cardiac catheterization, cardio pulmonary resuscitation, prosthetic heart valves.

**Unit – II** **Hemodialyzers** **9**

Artificial kidney, Dialysis action, hemodialyzer unit, membrane dialysis, portable dialyzer monitoring and functional parameters

**Unit – III** **Hearing Aids** **9**

Common tests – audiograms, air conduction, bone conduction, masking techniques, SISI, Hearing aids – principles, drawbacks in the conventional unit, DSP based hearing aids.

**Unit – IV** **Prosthetic And Orthotic Devices** **9**

Hand and arm replacement – different types of models, externally powered limb prosthesis, feedback in orthotic system, functional electrical stimulation, sensory assist devices

**Unit – V** **Sensory Augmentation and Substitutions** **9**

Classification of visual impairments, Prevention and cure of visual impairments, Visual augmentation, Tactile vision Substitution, Auditory substitution and augmentation, Assistive device for visual impaired

**Total : 45 Periods**

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**Text Books**

1. John Webster "Encyclopedia of medical devices and instrumentation" Vol. II, III ,IV,V , Wiley –
2. D.S. Sunder, "Rehabilitation Medicine", 3rd Edition, Jaypee Medical Publication, 2010.

**Reference Books**

1. Paul A. Iaizzo "Hand book of cardiac Anatomy, Physiology and Devices" Second Edition, Springer.
2. Jeffrey H. Shuhaiber, "Ventricular assist devices" Intech publications

**Additional / Web References**

1. https://www.youtube.com/watch?v=1mu6C288ZQ8, "Mechanical circulatory support" by Dr.Arie Blitz MD – Harrington – Mclaughlin heart and vascular institute, University hospitals.
2. https://www.youtube.com/watch?v=fKlY2SKi_dk," Hemodialysis" Dr.Kevin Nash , Well bound of Evanston in Skokie, Illinois.

**Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)**

| COs | Pos | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| CO1 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO2 | 3 | 2 | 2 | 2 | | | | | | | | | | 2 | |
| CO3 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO4 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO5 | 3 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| | 3 | High | | | | 2 | Medium | | | | | 1 | Low | | |

| Formative assessment | | | |
|---|---|---|---|
| **Bloom's Level** | **Assessment Component** | **Marks** | **Total marks** |
| | Attendance | 5 | 15 |
| Understand | Assignment | 10 | |

| Summative Assessment | | | | |
|---|---|---|---|---|
| **Bloom's Category** | **Continuous Assessment Tests** | | | **Terminal Examination (60)** |
| | **IAE-1 (5)** | **IAE-2 (10)** | **IAE-3 (10)** | |
| Remember | 5 | 5 | 5 | 10 |
| Understand | 5 | 5 | 5 | 20 |
| Apply | 20 | 20 | 20 | 30 |
| Analyze | 20 | 20 | 20 | 40 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |