# B.E. ELECTRICAL AND ELECTRONICS ENGINEERING

# CURRICULUM AND SYLLABI 2018

# (FULL TIME PROGRAMME)

## Department of Electrical and Electronics Engineering

## FACULTY OF ENGINEERING


**KARPAGAM ACADEMYOFHIGHER EDUCATION**

**(Deemed to be University)**

**(Established Under Section 3 of UGC Act, 1956)**

**Pollachi Main Road, Eachanari Post,**

**Coimbatore- 641021, India.**

**DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING**
**FACULTY OF ENGINEERING**
**UG PROGRAM (CBCS) – B.E –EEE (FULL TIME)**
**(2018–2019 Batch and onwards)**

| SEMESTER I | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Course Code | Course Title | Objectives & Outcomes | | Instruction hours/week | | | Credits | Maximum Marks | | |
| | | PEO | PO | L | T | P | | CIA | ESE | Total |
| | | | | | | | | 40 | 60 | 100 |
| 18BEEE101 | Mathematics-I (Calculus and Differential Equations) | 1,2 | a,b,e,l | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| 18BEEE102 | Waves, Optics and Introduction to Quantum Mechanics | 2 | i,j,l | 2 | 0 | 2 | 3 | 40 | 60 | 100 |
| 18BEEE103 | English | 1,2 | a,g,j,k, l | 3 | 1 | 3 | 5 | 40 | 60 | 100 |
| 18BEEE104 | Programming For Problem Solving (With C) | 1 | a,b,c, d,e,l | 3 | 0 | 4 | 5 | 40 | 60 | 100 |
| | | | TOTAL | 11 | 2 | 9 | 17 | 160 | 240 | 400 |

| SEMESTER II | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Course Code | Course Title | Objectives & Outcomes | | Instruction hours/week | | | Credits | Maximum Marks | | |
| | | PEO | PO | L | T | P | | CIA | ESE | Total |
| | | | | | | | | 40 | 60 | 100 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 18BEEE201 | Mathematics-II (Linear Algebra, Transform calculus and Numerical Method) | 2 | a,b,c,e,l | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| 18BEEE202 | Chemistry-I | 1,2 | a,b,c,e,l | 3 | 1 | 3 | 6 | 40 | 60 | 100 |
| 18BEEE203 | Basic Electrical Engineering | 1,2 | a,b,c,e, g,l | 3 | 1 | 2 | 5 | 40 | 60 | 100 |
| 18BEEE211 | Workshop/ Manufacturing Practices | 1,2 | a,c,d,e,f ,j | 1 | 0 | 4 | 3 | 40 | 60 | 100 |
| 18BEEE212 | Engineering Graphics& Design | 1,2 | c,d | 1 | 0 | 4 | 3 | 40 | 60 | 100 |
| | | | **TOTAL** | **11** | **3** | **13** | **21** | **200** | **300** | **500** |

| Course code | Name of the course | Objectives and out comes | | Instruction hours / week | | | Credit(s) | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | PEOs | POs | L | T | P | | CIA | ESE | Total |
| | | | | | | | | 40 | 60 | 100 |
| **SEMESTER – III** | | | | | | | | | | |
| 18BEEE301 | Electrical Circuit Analysis | 1 | a,b,c,d, e,l | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| 18BEEE302 | Analog Electronics | 2 | a,b,c,d, e,l | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEEE303 | Electrical Machines – I | 1 | a,b,c,d, e,j | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEEE304 | Electromagnetic Fields | 1 | a,b,c,d, e,j | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| 18BEEE305 | Engineering Mechanics | 2 | a,c,d,f | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| 18BEEE311 | Analog Electronics Laboratory | 2 | a,d,e,k,l | 0 | 0 | 2 | 1 | 40 | 60 | 100 |
| 18BEEE312 | Electrical Machines Laboratory - I | 1 | a,d,e,k,l | 0 | 0 | 2 | 1 | 40 | 60 | 100 |
| | | | | | | | | | | |
| **Semester Total** | | | | **15** | **3** | **4** | **20** | **280** | **420** | **700** |
| **SEMESTER – IV** | | | | | | | | | | |
| 18BEEE401 | Digital Electronics | 2 | a,d,e | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEEE402 | Electrical Machines – II | 1 | a,b,c,d, e,g,l | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEEE403 | Power Electronics | 2 | a,b,c,d, e,g | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEEE404 | Signals and Systems | 1 | a,b,c,d, e,g,l | 2 | 1 | 0 | 3 | 40 | 60 | 100 |
| 18BEEE405 | Mathematics – III (Probability and Statistics) | 1 | a,b ,d,i | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| 18BEEE406 | Environmental Studies | 1 | a,c,e,f, g,h,l | 2 | 1 | 0 | 3 | 40 | 60 | 100 |
| 18BEEE411 | Digital Electronics Laboratory | 2 | a,d,e,k, l | 0 | 0 | 2 | 1 | 40 | 60 | 100 |
| 18BEEE412 | Power Electronics Laboratory | 2 | a,c,d,j, k,l | 0 | 0 | 2 | 1 | 40 | 60 | 100 |
| 18BEEE413 | Electrical machines Lab-II | 1 | a,b,c,d, e,l | 0 | 0 | 2 | 1 | 40 | 60 | 100 |
| | | | | | | | | | | |
| **Semester Total** | | | | **16** | **3** | **6** | **22** | **360** | **540** | **900** |

| Course code | Name of the course | Objectives and out comes | | Instruction hours / week | | | Credit(s) | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | PEOs | POs | L | T | P | | CIA | ESE | Total |
| | | | | | | | | 40 | 60 | 100 |
| **SEMESTER - V** | | | | | | | | | | |
| 18BEEE501 | Power Systems – I | 2 | a,b,c,d,e,g,l | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEEE502 | Control Systems | 1 | a,b,c,d,e,l | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEEE503 | Microprocessors | 1 | a,c,e,h,i,k,l | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEEE504 | Engineering Economics and Financial Management | 1 | a,e,f,i | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEEE5E_ _ | Program Elective - I | | | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BE_ _5OE_ _ | Open Elective-I | | | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEEE511 | Power Systems Laboratory – I | 2 | a,c,d,j,k,l | 0 | 0 | 2 | 1 | 40 | 60 | 100 |
| 18BEEE512 | Control Systems Laboratory | 1 | c,d,e,f,i,j | 0 | 0 | 2 | 1 | 40 | 60 | 100 |
| 18BEEE513 | Microprocessors Laboratory | 1 | a,c,d,j,k,l | 0 | 0 | 2 | 1 | 40 | 60 | 100 |
| **Semester Total** | | | | **18** | **0** | **6** | **21** | **360** | **540** | **900** |
| **SEMESTER – VI** | | | | | | | | | | |
| 18BEEE601 | Total Quality Management | - | b,e,f,g,h,i,j | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEEE602 | Power Systems – II | 1 | a,b,c,d,e,g,l | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEEE641 | Measurements and Instrumentation | 1 | a,b,c,d,e,l | 2 | 0 | 2 | 3 | 40 | 60 | 100 |
| 18BEEE6E_ _ | Program Elective - II | | | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEEE6E_ _ | Program Elective - III | | | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BE_ _6OE_ _ | Open Elective-II | | | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEEE611 | Power Systems Laboratory – II | 1 | a,c,d,j,k,l | 0 | 0 | 2 | 1 | 40 | 60 | 100 |
| 18BEEE612 | Electronics Design Laboratory | 2 | a,d,e,k,l | 1 | 0 | 4 | 3 | 40 | 60 | 100 |
| **Semester Total** | | | | **18** | **0** | **8** | **22** | **320** | **480** | **800** |

| Course code | Name of the course | Objectives and out comes | | Instruction hours / week | | | Credit(s) | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | PEOs | POs | L | T | P | | CIA | ESE | Total |
| | | | | | | | | 40 | 60 | 100 |
| **SEMESTER - VII** | | | | | | | | | | |
| 18BEEE701 | Professional Ethics | - | a,b,d g,k,l | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEEE7E_ _ | Program Elective -IV | | | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEEE7E_ _ | Program Elective -V | | | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BE_ _7OE_ _ | Open Elective-III | | | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BE_ _7OE__ | Open Elective-IV | | | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEEE791 | Project Stage-I | 1,2 | - | 0 | 0 | 6 | 3 | 80 | 120 | 200 |
| **Semester Total** | | | | **15** | **0** | **6** | **18** | **280** | **420** | **700** |
| **SEMESTER – VIII** | | | | | | | | | | |
| 18BEEE8E_ _ | Program Elective -VI | | | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BE _ _8OE_ _ | Open Elective-V | | | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BE_ _ 8OE_ _ | Open Elective-VI | | | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEEE891 | Project Stage-II | 1,2 | - | 0 | 0 | 16 | 8 | 80 | 120 | 200 |
| **Semester Total** | | | | **9** | **0** | **16** | **17** | **200** | **300** | **500** |
| **Program Total** | | | | **113** | **11** | **68** | **158** | **2160** | **3240** | **5400** |

**TOTAL CREDITS: 158**

## PROFESSIONAL ELECTIVE COURSES

| SEMESTER V | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Course Code | Course Title | Objectives & Outcomes | | Instruction hours/week | | | Credits | Maximum Marks | | |
| | | PEO | PO | L | T | P | | CIA | ESE | Total |
| | | | | | | | | 40 | 60 | 100 |
| 18BEEE5E01 | Electrical Machine Design | 1 | a,c,d,g | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEEE5E02 | Industrial Automation | 1 | a,c,d,e,k,m,n | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEEE5E03 | Sensor and Transducer | 1 | a,b,c,e,i | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| **SEMESTER VI** | | | | | | | | | | |
| Course Code | Course Title | Objectives & Outcomes | | Instruction hours/week | | | Credits | Maximum Marks | | |
| | | PEO | PO | L | T | P | | CIA | ESE | Total |
| | | | | | | | | 40 | 60 | 100 |
| 18BEEE6E01 | Digital Control Systems | 1 | b,c,h,i | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEEE6E02 | Digital Signal Processing | 1 | a,b,c,d,e,g,l,m | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEEE6E03 | Computer Architecture | 1 | a,c,e | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEEE6E04 | Electromagnetic Waves | 1 | a,b,c,d,e,g | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEEE6E05 | Computational Electromagnetics | 1 | a,b,c,d,e,l | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEEE6E06 | Control Systems Design | 1 | a,c,e,h,l | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEEE6E07 | Industrial Electrical Systems | 1 | a,b,d | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEEE6E08 | Electrical Drives | 1 | a,c,d,e,h,l | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEEE6E09 | Line Commutated and Active Rectifiers | 2 | a,c,d,e,g | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEEE6E10 | High Voltage Engineering | 2 | a,b,c,d,e,g,l | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEEE6E11 | Electrical Energy Conservation and Auditing | 2 | b,e,f,g,h,i,j,n | 3 | 0 | 0 | 3 | 40 | 60 | 100 |

| SEMESTER VII | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Course Code | Course Title | Objectives & Outcomes | | Instruction hours/week | | | Credits | Maximum Marks | | |
| | | PEO | PO | L | T | P | | CIA | ESE | Total |
| | | | | | | | | 40 | 60 | 100 |
| 18BEEE7E01 | Wind and Solar Energy Systems | 2 | a,b,c, d,e,g,l | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEEE7E02 | Electrical and Hybrid Vehicles | 2 | a,c,d,h ,m,n | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEEE7E03 | Power System Protection | 2 | a,b,c,d ,e,g,l | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEEE7E04 | HVDC Transmission Systems | 2 | a,b,c, h,i,l | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEEE7E05 | Power Quality and FACTS | 2 | a,b,c, d,e,j,l | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEEE7E06 | Power System Dynamics and Control | 2 | a,c,e | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| SEMESTER VIII | | | | | | | | | | |
| Course Code | Course Title | Objectives & Outcomes | | Instruction hours/week | | | Credits | Maximum Marks | | |
| | | PEO | PO | L | T | P | | CIA | ESE | Total |
| | | | | | | | | 40 | 60 | 100 |
| 18BEEE8E01 | Advanced Electric Drives | 1 | a,b,c,d, e,g | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEEE8E02 | Power System Stability | 2 | d,e | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEEE8E03 | Power Generation Systems | 2 | c,d,e,g ,h,i | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEEE8E04 | Virtual Instrumentation | 1 | a,b,e,h ,l,m,n | 3 | 0 | 0 | 3 | 40 | 60 | 100 |

## LIST OF OPEN ELECTIVES

## COURSE OFFERED BY OTHER DEPARTMENT

| SUB. CODE | TITLE OF THECOURSE | PEO | PO | L | T | P | C | CIA | ESE | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|
| **AUTOMOBILE ENGINEERING** | | | | | | | | | | |
| 18BEAEOE01 | Automobile Engineering | 1,2 | a,b,d,g | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEAEOE02 | Two And Three Wheeler Technology | 1,2 | a,b,d, | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEAEOE03 | Vehicle Maintenance | I | a,b,c | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEAEOE04 | Modern Vehicle Technology | 1,2, | a,b,c | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEAEOE05 | Fleet Management | 1,2 | a,b,g,h,j | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| **BIOMEDICAL ENGINEERING** | | | | | | | | | | |
| 18BEBMEOE01 | Robotics in medicine | 1,2, | a,b,c | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEBMEOE02 | Virtual Reality and Augmented Reality | 1,2 | a,b,d,g,h | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEBMEOE03 | Artificial organs and Implants | 1 | a,b,g,h,j | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| **BIOTECHNOLOGY** | | | | | | | | | | |
| 18BTBTOE01 | Bioreactor Design | 1,2, | a,b,c, | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BTBTOE02 | Food Processing and Preservation | 1,2 | a,b,d | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BTBTOE03 | Basic Bioinformatics | 1 | a,b,c, | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BTBTOE04 | Fundamentals of Nano biotechnology | 1 | a,b,c,d,g,h,j | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| **CHEMICAL ENGINEERING** | | | | | | | | | | |
| 18BTCEOE01 | Energy Management in Chemical Industries | 1,2 | a,b,c | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BTCEOE02 | Fertilizer Technology | 1,2 | a,d,g,h,j | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BTCEOE03 | Industrial wastewater treatment | 1 | a,b,c,d | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BTCEOE04 | Solid and Hazardous waste management | 1 | a,b, g,h,j | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| **CIVIL ENGINEERING** | | | | | | | | | | |
| 18BECEOE01 | Housing, Plan and Management | 1,2 | a,b,c,d | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BECEOE02 | Building Services | 1,2 | a,b,c,d | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BECEOE03 | Repair and Rehabilitation of Structures | 1,2 | a,b,d | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BECEOE04 | Computer Aided Civil Engineering Drawing | 1 | a,b,c | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| **COMPUTER SCIENCE AND ENGINEERING** | | | | | | | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 18BECSOE01 | Internet Programming | 1,2 | a,b,c,g,h | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BECSOE02 | Multimedia and Animation | 1,2 | a,b,c,g,h,j | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BECSOE03 | PC Hardware and Trouble shooting | 1 | a,b,c,d ,j | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BECSOE04 | Java Programming | 1,2 | a,b,c,d, | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BECSOE05 | Machine Learning | 1,2 | a,b,g,h, | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| **ELECTRONICS AND COMMUNICATION ENGINEERING** | | | | | | | | | | |
| 18BEECOE01 | Real Time Embedded Systems | 1,2 | a,b,c,d | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEECOE02 | Consumer Electronics | 1 | a,b,c,j | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEECOE03 | Neural Networks and its Applications | 1 | a,b,c,d | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEECOE04 | Fuzzy Logic and its Applications | 1,2 | a,b,d | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEECOE05 | Principles of Modern Communication System | 1,2 | a,d,g,h,j | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| **FOOD TECHNOLOGY** | | | | | | | | | | |
| 18BTFTOE01 | Processing of Food Materials | 1,2 | a,b,c,d | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BTFTOE02 | Nutrition and Dietetics | 1 | a,b,c,g,h,j | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BTFTOE03 | Ready to Eat Foods | 1,2, | a,b,c,d | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BTFTOE04 | Agricultural Waste and Byproducts Utilization | 1,2 | a,b,c,g,h | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| **MECHANICAL ENGINEERING** | | | | | | | | | | |
| 18BEMEOE01 | Computer Aided Design | 1 | a,b,c,d | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEMEOE02 | Industrial Safety and Environment | 1 | a,b,d,g | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEMEOE03 | Transport Phenomena | 1,2 | a,b,c,d | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEMEOE04 | Introduction to Biomechanics | 1,2 | a,b,c,d,g,h,j | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| **SCIENCE AND HUIMANITIES** | | | | | | | | | | |
| 18BESHOE01 | Solid Waste Management | 1,2 | a,b,c,g | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BESHOE02 | Green Chemistry | 1 | a,b,c,g,h,j | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BESHOE03 | Applied Electrochemistry | 1,2, | a,b,c, | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BESHOE04 | Industrial Chemistry | 1,2 | a,b,c,d,g,h,j | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BESHOE05 | Technical writing | 1 | a,b,d | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BESHOE06 | Geophysics | 1 | a,b,c, | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BESHOE07 | Engineering Acoustics | 1,2 | a,b,c,d,g,h,j | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BESHOE08 | Industrial Mathematics I | 1,2 | a,b,d,g,h | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BESHOE09 | Industrial Mathematics II | 1,2 | a,c,d,h,j | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BESHOE10 | Fuzzy Mathematics | 1 | a,b,c | 3 | 0 | 0 | 3 | 40 | 60 | 100 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 18BESHOE11 | Mathematical Physics | 1 | a,g,h,j | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BESHOE12 | Linear Algebra | 1,2 | a,b, g,h,j | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| **COURSES OFFERED TO OTHER DEPARTMENT** | | | | | | | | | | |
| 18BEEEOE01 | Electric Hybrid Vehicle | 2 | a,c,d,h,m,n | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEEEOE02 | Energy Management & Energy Auditing | 2 | b,e,f,g,h,i,j,n | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEEEOE03 | Programmable Logic Controller | 1,2 | a,b,d,e,l | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 18BEEEOE04 | Renewable Energy Resources | 1 | a,b,c,d,e,g,l | 3 | 0 | 0 | 3 | 40 | 60 | 100 |

**--Skill Development

**--Employability

**--Entrepreneurship

**PROGRAM OUTCOMES:** On successful completion of the programme,

| | |
|---|---|
| a | Apply the Mathematical knowledge and the basics of Science and Engineering to solve the problems pertaining to Electronics and Instrumentation Engineering. |
| b | Identify and formulate Electrical and Electronics Engineering problems from research literature and be ability to analyze the problem using first principles of Mathematics and Engineering Sciences. |
| c | Come out with solutions for the complex problems and to design system components or process that fulfill the particular needs taking into account public health and safety and the social, cultural and environmental issues. |
| d | Draw well-founded conclusions applying the knowledge acquired from research and research methods including design of experiments, analysis and interpretation of data and synthesis of information and to arrive at significant conclusion. |
| e | Form, select and apply relevant techniques, resources and Engineering and IT tools for Engineering activities like electronic prototyping, modeling and control of systems and also being conscious of the limitations. |
| f | Understand the role and responsibility of the Professional Electrical and Electronics Engineer and to assess societal, health, safety issues based on the reasoning received from the contextual knowledge. |
| g | Be aware of the impact of professional Engineering solutions in societal and environmental contexts and exhibit the knowledge and the need for Sustainable Development. |
| h | Apply the principles of Professional Ethics to adhere to the norms of the engineering practice and to discharge ethical responsibilities. |
| i | Function actively and efficiently as an individual or a member/leader of different teams and multidisciplinary projects. |
| j | Communicate efficiently the engineering facts with a wide range of engineering community and others, to understand and prepare reports and design documents; to make effective presentations and to frame and follow instructions. |
| k | Demonstrate the acquisition of the body of engineering knowledge and insight and Management Principles and to apply them as member / leader in teams and multidisciplinary environments. |
| l | Recognize the need for self and life-long learning, keeping pace with technological challenges in the broadest sense. |

**PROGRAM SPECIFIC OUTCOMES:**

| | |
|---|---|
| m | Apply the Mathematical knowledge and the basics of Science and Engineering to solve the problems pertaining to Electronics and Instrumentation Engineering |

| | |
|---|---|
| n | Identify and formulate Electrical and Electronics Engineering problems from research literature and be able to analyze the problem using first principles of Mathematics and Engineering Sciences. |

**PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)**

| | |
|---|---|
| PEO 1 | Have successful technical and professional careers in their chosen fields such as circuit theory, Field theory, control theory and computational platforms. |
| PEO 2 | Engross in life long process of learning to keep themselves abreast of new developments in the field of Electronics and their applications in power engineering |

**MAPPING**

| PROGRAMME EDUCATIONAL OBJECTIVES | PROGRAM OUTCOMES & PROGRAM SPECIFIC OUTCOMES | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **a** | **b** | **c** | **d** | **e** | **f** | **g** | **h** | **i** | **j** | **k** | **l** | **m** | **n** |
| **1** | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | ✓ | ✓ | ✓ |
| **2** | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | | ✓ | | | ✓ | ✓ |

**18BEEE101** **Semester-I**

**MATHEMATICS –I** **4H-4C**

**(Calculus and Differential Equations)**

**Instruction Hours/week: L:3 T:1 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objectives**

- To understand geometrical aspects of curvature and elegant application of differential calculus and improper integrals, Gamma, Beta and Error functions which are needed in engineering applications.
- The goal of this course is for students to gain proficiency in calculus computations. In calculus, we use three main tools for analyzing and describing the behavior of functions: limits, derivatives and vector calculus.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.
- To make the student acquire sound knowledge of techniques in solving ordinary differential equations and partial differential equations.
- To introduce sequence and series which is central to many applications in engineering.
- To study the algebraic manipulationa.

**Course Outcomes**

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

1. To apply differential and integral calculus to notions of curvature and to improper integrals. Apart from various applications, they will have a basic understanding of Beta and Gamma functions.
2. The tool of power series and Fourier series for learning advanced Engineering Mathematics.
3. To deal with functions of several variables that is essential in most branches of engineering.
4. To find an appropriate method for a given integral and use Green, Gauss and Stokes theorems to simplify calculations of integrals and prove simple results.
5. To understand the ideas of differential equations and facility in solving simple standard examples.
6. To improve facility in algebraic manipulation

**UNIT I - Calculus**

Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

**UNIT II - Multivariable Calculus: Differentiation**

Limit, continuity and partial derivatives, directional derivatives, total derivative, Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, curl and divergence.

**UNIT III - Multivariable Calculus: Integration**

Multiple Integration: double and triple integrals (Cartesian and polar), change of order of integration in double integrals, Applications: areas and volumes, Center of mass and Gravity (constant and variable

densities). Theorems of Green, Gauss and Stokes,Simple applications involving cubes and rectangular parallelepipeds.

**UNIT IV- Differential Equations**

Introduction to Ordinary differential equations: Linear ordinary differential equations of second and higher order with constant coefficients. Introduction to Partial differential equations: Linear Partial differential equations of second and higher order with constant coefficients.

**UNIT V - Sequences and Series**

Convergence of sequence and series, tests for convergence, power series, Taylor's series. Series for exponential, trigonometric and logarithmic functions; Fourier series: Half range sine and cosine series, Parseval's theorem

**SUGGESTED READINGS**


1. B.S. Grewal, (2010), Higher Engineering Mathematics, 36th Edition, Khanna Publishers.
2. Veerarajan T, (2008),Engineering Mathematics for first year,Tata McGraw-Hill, New Delhi.
3. Ramana B.V, (2010),Higher Engineering Mathematics, 11th Reprint, Tata McGraw Hill New Delhi.
4. N.P. Bali and Manish Goyal, (2010), A text book of Engineering Mathematics, Laxmi Publications.
5. Hemamalini. P.T, (2014), Engineering Mathematics, McGraw Hill Education (India) Private Limited, New Delhi.
6. W. E. Boyce and R. C. DiPrima(2009), Elementary Differential Equations and Boundary Value Problems, 9th EditionWiley India.
7. G.B. Thomas and R.L. Finney, (2002),Calculus and Analytic geometry, 9th Edition,Pearson.
8. G.F. Simmons and S.G. Krantz,(2007), Differential Equations, Tata McGraw Hill.
9. Erwin kreyszig, (2006),Advanced Engineering Mathematics, 9th Edition,John Wiley & Sons.

**Semester-I**

**18BEEE102 WAVES, OPTICS AND INTRODUCTION TO QUANTUM MECHANICS 7H-5C**

**(Theory & Lab.)**

**Instruction Hours/week: L:3 T:1 P:3** **Marks:** Internal:**40** External:**60** Total:**100**

**End Semester Exam:**3 Hours

**(i) Theory**

**Course Objective:**

- To become familiarize on the fundamentals of waves.
- To extend the deep understanding of wave optics through different methods.
- To divulge knowledge on the basics of laser and optical fiber with appropriate applications.
- To disseminate the fundamentals of quantum physics and their applications in modern equipments.
- To inculcate the characteristics of electronic materials through basics.
- To study the basics of conductors, semiconductors and insulators through various models.

**Course Outcomes**

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

1. Analyse the idea of waves and their types.
2. Extend the basic ideas of wave optics to study interference and diffraction.
3. Introduce the characteristics of laser for engineering applications.
4. Develop the idea of quantum mechanics through applications.
5. Illustrate the basics of conductors, semiconductors and insulators through various models.
6. Apply the knowledge inputs of the course for engineering applications.

**Unit 1 - Waves**

Mechanical and electrical simple harmonic oscillators, damped harmonic oscillator, impedance, steady state motion of damped Harmonic oscillator

**Non-dispersive transverse and longitudinal waves:**

Transverse wave on a string, the wave equation on a string, Harmonic waves, reflection and transmission of waves at a boundary, impedance matching, standing waves and their Eigen frequencies, longitudinal waves and the wave equation for them, acoustics waves.

**Unit 2 - Wave Optics**

Huygens' principle, superposition of waves and interference of light by wave front splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer, Farunhofer diffraction from a single slit and a circular aperture, the Rayleigh criterion for limit of resolution and its application to vision; Diffraction gratings and their resolving power

**Unit 3 - Lasers**

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

**Unit 4 - Introduction to Quantum Mechanics**

Introduction to quantum theory – Black body radiation - dual nature of matter and radiation – de Broglie wavelength, uncertainty principle –Schrödinger's wave equation – time dependent and time independent equations – particle in one dimensional box- physical significance of wave function, scanning electron microscope.

**Unit 5 - Introduction to Solids and Semiconductors**

Free electron theory of metals, Fermi level, density of energy states, Bloch's theorem for particles in a periodic potential, Kronig-Penney model and origin of energy bands. Types of electronic materials: metals, semiconductors, and insulators- Intrinsic and extrinsic semiconductors(no need derivation).

**SUGGESTED READINGS**


1. H. J. Pain(2006), The physics of vibrations and waves**,** Wiley.
2. A.Ghatak(2012) , Optics, McGraw Hill Education.
3. M.N. Avadhanulu and PG Kshirsagar,(2011), A Text book of Engineering Physics, S.Chand and company, Ltd., New Delhi.
4. I.G. Main,(2093)**,** Vibrations and waves in physics**,** Cambridge University Press
5. Gaur, R.K. and Gupta,(2011), S.C, Engineering Physics, DhanpatRaiPublications,New Delhi.
6. E. Hecht,(2008), Optics, Pearson Education.
7. D. J. Griffiths,(2014)**,** Quantum mechanics**,** Pearson Education.
8. D. A. Neamen,(2097), Semiconductor Physics and Devices, Times Mirror High Education Group.
9. B.G. Streetman,(2095), Solid State Electronic Devices, Prentice Hall of India.

**(ii) Laboratory**

**Course Objective**

- To develop basic laboratory skills and demonstrating the application of physical principles.
- To prepare for the lab experiment and perform individually a wide spectrum of experiments.
- To present experimental data in various appropriate forms like tabulation, and plots.
- To analyze, Interpret and Summarize experimental results.
- To communicate clearly understanding of various experimental principles, instruments/setup, and procedure.
- To learn the band gap of semiconductor

**Course Outcomes:**

1. The students will have the knowledge on Physics practical experiments and that knowledge will be used by them in different engineering and technology applications.
2. Prepare for the lab experiment and perform individually a wide spectrum of experiments.
3. Present experimental data in various appropriate forms like tabulation, and plots.
4. Analyze, Interpret and Summarize experimental results.
5. Communicate clearly understanding of various experimental principles, instruments/setup, and procedure.
6. Prepare to develop the skills for understanding basic electric circuits.

**LIST OF EXPERIMENTS – PHYSICS**

1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of disc
2. Non-uniform bending - Determination of young's modulus
3. Uniform bending – Determination of young's modulus
4. Lee's disc Determination of thermal conductivity of a bad conductor
5. Potentiometer-Determination of thermo e.m.f of a thermocouple
6. Laser- Determination of the wave length of the laser using grating
7. Air wedge - Determination of thickness of a thin sheet/wire
8. Optical fibre -Determination of Numerical Aperture and acceptance angle
9. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids
10. Determination of Band gap of a semiconductor.
11. Spectrometer- Determination of wavelength using grating.
12. Viscosity of liquids-Determination of co-efficient of viscosity of a liquid by Poiseuille's flow

**B.E Electrical and Electronics Engineering** **2019-2020**

**Semester-I**

**18BEEE103** **ENGLISH** **4H-3C**

**Instruction Hours/week: L:2 T:0 P:2** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objectives**

- To enable students to attain fluency and accuracy to inculcate proficiency in professional communication to meet the growing demand in the field of Global communication.
- To help students acquire their ability to speak effectively in real life situations.
- To inculcate the habit of reading and to develop their effective reading skills.
- To ensure that students use dictionary to improve their active and passive vocabulary.
- To enable students to improve their lexical, grammatical and communicative competence.
- To enable the students to prepare for oral communication in formal contexts.

**Course Outcomes**

Students undergoing this course will be able to

1. Use English language for communication: verbal & non –verbal.
2. Enrich comprehension and acquisition of speaking & writing ability.
3. Gain confidence in using English language in real life situations.
4. Improve word power: lexical, grammatical and communication competence.
5. To guide the students to write business letters and other forms of technical writing.
6. To enable students to prepare for oral communication in formal contexts.

**Unit I -Basic Writing Skills**

Sentence Structures - Use of phrases and clauses in sentences - Importance of proper punctuation - Creating coherence- Organizing principles of paragraphs in documents - Techniques for writing precisely

**Unit 1I - Vocabulary Building**

The concept of Word Formation - Root words from foreign languages and their use in English - Acquaintance, with prefixes and suffixes from foreign languages in English to form derivatives. - Synonyms, antonyms, and standard abbreviations.

**Unit III - Grammar and Usage**

Subject-verb agreement - Noun-pronoun agreement - Misplaced modifiers – Articles – Prepositions – Redundancies - Clichés

**Unit IV - Listening and Reading Skills**

Note taking- viewing model interviews – listening to informal conversations – improving listening / reading comprehension – reading model prose / poems – reading exercise

**Unit** V.-**Writing Practices**

Comprehension - Précis Writing - Essay Writing Listening Comprehension - Common Everyday Situations: Conversations and Dialogues - Communication at Workplace – Interviews - Formal Presentations

**Note:** Students shall have hands on training in improving listening skill in the language laboratory @ 2 periods per each unit.

**SUGGESTED READINGS**


1. Sangeeta Sharma , Meenakshi Raman, (2015), Technical Communication: Principles And Practice, 2nd Edition, OUP, New Delhi..
2. Sanjay Kumar and PushpLata(2011)., Communication Skills , Oxford University Press,
3. Liz Hamp - Lyons and Ben Heasly(2006)., Study Writing, Cambridge University Press,
4. F.T. Wood., (2007).Remedial English Grammar, Macmillan,

**Semester-I**

**18BEEE104** **PROGRAMMING FOR PROBLEM SOLVING (WITH C)** **7H-5C**

**(Theory & Lab.)**

**Instruction Hours/week: L:3 T:0 P:4** **Marks:** Internal:**40** External:**60** Total:**100**

**End Semester Exam:**3 Hours

## Course Objectives

- Identify and understand the working of key components of a computer program.
- Identify and understand the various kinds of keywords and different data types of C programming
- Understand, analyze and implement software development tools using algorithm,
- Understand, analyze and implement software development tools using pseudo codes and programming structure
- Acquire and analyse the roots of equations
- Study, analyze and understand logical structure of a computer program, and different construct to develop a program in "C" language

## Course Outcomes:

The course will enable the students.

1. To formulate simple algorithms for arithmetic and logical problems.
2. To translate the algorithms to programs(in C language).
3. To test and execute the programs and correct syntax and logical errors.
4. To implement conditional branching, iteration and recursion.
5. To decompose a problem in to functions and synthesize a complete program usingdivide and conquer approach. and use arrays, pointers and structures to formulate algorithms and programs.
6. To apply programming to solve matrix addition and multiplication problems and searching and sorting problems.

## Unit I - Introduction to Programming

Introduction to the idea of algorithm; Introduction to Programming Flowchart/pseudo code, the compilation process, object code and executables, Variables including data types, Mapping o variables to memory locations, Syntax and logical error

**Unit II - Arithmetic expressions, precedence, Conditional Branching, Loops and Arrays**

Writing and evaluation of conditionals and consequent branching, Iteration and loops.
**Arrays:** Arrays1-D,2-D,Characterarraysand Strings.

**Unit III – Basic Algorithms**

Searching: Linear and Binary, Basic Sorting Algorithms, Finding roots of equations.

**Unit IV - Function and Recursion**

Functions including using built in libraries, Parameter passing, Call by value, Passing Arrays to functions,Call by reference. Introduction to Recursion;Base condition, example programs such as Factorial, Fibonacci series,Quick sort,Ackerman function.

**Unit V – Structures and Pointers**

Structures, type def, Array of structures; notional introduction to pointers including self-referential structures.Filehandling in C

**SUGGESTED READINGS**


1. E. Balagurusamy, (2017), Computing Fundamentals and C Programming, TMH Education, 5th Edition.
2. E. Balaguruswamy,(2017),Programming in ANSIC, Tata Mc Graw-Hill, 7th Edition.
3. ByronGottfried, (2017),Schaum's Outline of Programming with C, McGraw-Hill, 3rd Edition.
4. BrianW.KernighanandDennisM.Ritchie,(2015),TheCProgrammingLanguage,Prentice HallofIndia, 2nd Edition.

**(ii) Laboratory**

**Course Objectives**

- To provide an awareness to Computing and C Programming
- To know the correct and efficient ways of solving problems
- To learn to develop algorithm for simple problem solving
- To know different errors in programming
- To acquire knowledge in array and strings programming
- To get more knowledge in branches and structures

**Laboratory Outcomes:**

1. To formulate the algorithms for simple problems
2. To translate given algorithms to a working and correct program
3. To be able to correct syntax errors as reported by the compilers
4. To be able to identify and correct logical error and write iterative as well as recursive programs
5. To be able to represent data in arrays, strings and structures and manipulate them through a program
6. To be able to declare pointers of different types and use them in defining self- referential structures. and to create, read and write to and from simple text files.

**List of Experiments**

**Tutorial 1:** Problem solving using computers:
**Lab1:**Familiarization with programming environment
**Tutorial2:**Variable types and type conversions:
**Lab2:**Simple computational problems using arithmetic expressions
**Tutorial 3:**Branching and logical expressions:
**Lab 3:**Problems involving if-then-else structures
**Tutorial4:**Loops, while and for loops:
**Lab4:**Iterative problems. Sum of series
**Tutorial5:**1DArrays: searching, sorting:
**Lab5:**1DArraymanipulation
**Tutorial 6:**2D arrays and Strings, memory structure:
**Lab 6:**Matrixproblems, String operations
**Tutorial7:**Functions, call by value:
**Lab7:**Simple functions
**Tutorial 8 &9:**Numerical methods(Root finding, numerical differentiation, numerical integration)
**Lab8and 9:**Numerical methods problems
**Tutorial10:** Recursion, structure of recursive calls:
**Lab10:**Recursive functions
**Tutorial11:**Pointers explained

**Lab11:** Implementing and accessing array of structures
**Tutorial12:**File handling:
**Lab12:**File operation

**B.E Electrical and Electronics Engineering** **2019-2020**

**Semester-II**

**18BEEE201** **MATHEMATICS – II 4H-4C**

**(Linear Algebra, Transform Calculus and Numerical Method)**

**Instruction Hours/week: L:3 T:1 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objectives**

- The objective of this course is to familiarize the prospective engineers with techniques in Linear Algebra, Transform calculus and Numerical methods.
- The syllabus is designed to develop the use of Matrix algebra techniques which is needed by Engineers for practical applications.
- It aims to equip the students in numerical methods to solve engineering problems, Fundamentals of numerical methods/algorithms to solve systems of different mathematical equations will be introduced.
- To learn numerical methods to obtain approximate solutions to mathematical problem.
- To learn Basic concepts of Laplace transforms.
- To study about transforms and PDE

**Course Outcomes**
The students will learn:

1. To solve the problems in engineering using Matrix algebra Techniques.
2. Derive numerical methods for various mathematical operations and tasks such as interpolation, differentiation and integration.
3. To analyze and evaluate the accuracy of solution for ordinary differential equations.
4. To implement numerical methods to solve Partial differential equations.
5. To solve problems using Laplace Transforms.
6. To improve facility in numerical manipulation.

**UNIT I - Matrices**

Inverse and rank of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, Orthogonal transformation. Simple Problems using Scilab.

**UNIT II - Numerical Methods**

Solution of polynomial and transcendental equations – Bisection method, Newton-Raphson method and Regula-Falsi method. Finite differences, Interpolation using Newton's forward and backward difference formulae. Central difference interpolation: Gauss's forward and backward formulae. Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules.

**UNIT III - Numerical Methods**

Ordinary differential equations: Taylor's series, Euler and modified Euler's methods. RungeKutta method of fourth order for solving first and second order equations. Milne's And Adam's predicator-corrector methods.

**UNIT IV -Numerical Methods**

Partial differential equations: Finite difference solution two Dimensional Laplace equation and Poisson equation, Implicit and explicit methods for one Dimensional heat equation(Bender-Schmidt and Crank-Nicholson methods), Finite difference Explicit method for wave equation.

**UNIT V - Transform Calculus**

Laplace Transform, Properties of Laplace Transform, Laplace transform of periodic functions. Finding inverse Laplace transform by different methods, convolution theorem. Evaluation of Integrals by Laplace transform, solving ODEs and PDEs by Laplace Transform method.

**SUGGESTED READINGS**


1. P.Kandasamy,K.Thilagavathy., K.Gunavathy (2008), Numerical Methods,S.Chand Ltd,.
2. B.S. Grewal, (2010), Higher Engineering Mathematics, 36th Edition, Khanna Publishers
3. D. Poole, (2005),Linear Algebra: A Modern Introduction, 2nd Edition,Brooks/Cole.
4. N.P. Bali and Manish Goyal, (2008), A text book of Engineering Mathematics, Laxmi Publications.
5. Hemamalini. P.T, (2014), Engineering Mathematics, McGraw Hill Education (India) Private Limited, New Delhi.
6. V. Krishnamurthy, V. P. Mainra and J. L. Arora,(2005), An introduction to Linear Algebra, Affiliated East-West press.

**Semester-II**

**18BEEE202** **CHEMISTRY –I** **7H-6C**

**(Theory & Lab.)**

**Instruction Hours/week: L:3 T:1 P:3** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**(i) Concepts in chemistry for engineering**

**Course Objective**

- To understand the terminologies of atomic and molecular structure
- To study the basics of Periodic properties, Intermolecular forces
- To study about spectroscopic technique
- To understand the thermodynamic functions
- To comprehend the basic organic chemistry and to synthesis simple drug.
- To understand the chemical equilibria functions

**Course Outcomes**

1. Analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
2. Rationalise periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity.
3. Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques
4. Rationalise bulk properties and processes using thermodynamic considerations.
5. List major chemical reactions that are used in the synthesis of molecules.
6. Integrate the chemical principles in the projects undertaken in field of engineering and technology

**UNIT I - Atomic and molecular structure**

Schrodinger equation. Particle in a box solutions and their applications. Equations for atomic and molecular orbitals. Energy level diagrams of diatomic molecules. Pi-molecular orbitals of butadiene and benzene and aromaticity.Introduction to Crystal field theory.

**UNIT II - Periodic properties, Intermolecular forces and potential energy surfaces**

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers. Ionic, dipolar and van Der Waals interactions.Equations of state of real gases and critical phenomena.

**UNIT III - Spectroscopic techniques and applications**

Spectroscopy (Principles and Instrumentation only).Electronic spectroscopy.Vibrational and rotational spectroscopy.Applications. Surface characterization techniques SEM and TEM. Fluorescence and its applications in medicine.

**UNIT IV - Use of free energy in chemical equilibria**

Thermodynamic functions: energy, entropy and free energy. Significance of entropy and free energies.Free energy and emf.Cell potentials, the Nernst equation and applications.Acid base, oxidation, reduction and solubility equilibria.Use of free energy considerations in metallurgy through Ellingham diagrams.

**UNIT V - Organic reactions and synthesis of a drug molecule**

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

**SUGGESTED READINGS**


1. B. H. Mahan, (2010).University chemistry, Pearson Education,
2. M. J. Sienko and R. A. Plane, Chemistry: Principles and Applications.
3. C. N. Banwell, (1994)Fundamentals of Molecular Spectroscopy, McGraw-Hill,.
4. B. L. Tembe, Kamaluddin and M. S. Krishnan, Engineering Chemistry (NPTEL Web-book)
5. P. W. Atkins, (2009).Physical Chemistry, Oxford University Press,
6. K. P. C. Volhardt and N. E. Schore, (2014).5th Edition, Organic Chemistry: Structure and Function, W.H. Freeman,
7. P C Jain & Monica Jain, (2015).Engineering Chemistry, DhanpatRai Publishing Company,

**Semester-II**

**18BEEE203** **BASIC ELECTRICAL ENGINEERING** **7H-5C**

**(Theory & Lab.)**

**Instruction Hours/week: L:3 T:1 P:2** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**i)Theory**

**Course Objectives**

- To impart the basic knowledge about the Electric circuits.
- To understand the working of Electrical Machines and Transformers.
- To understand the working of Power Converters and components of low-voltage electrical installations.
- To understand the star and delta connections in AC circuits
- To arrive and analyse the energy consumption calculations and PF improvement
- To understand the RLC circulit combinations and its resonance

**Course Outcomes**

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

1. To understand and analyse basic electric and magnetic circuits.
2. Attributing the electric circuits with DC and AC excitation by applying various circuit laws.
3. Attributing the electrical machines and transformer.
4. Evaluate the various digital circuits in real time applications.
5. Analysis various semiconductor devices in real time applications.
6. Reproduce the Measuring Instruments and Electrical Installation.

**UNIT I - DC Circuits**

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

**UNIT II - AC Circuits**

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

**UNIT III - Electrical Machines**

Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed

control of induction motor. Single-phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators.

**UNIT IV - Transformers And Power Converters**

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency.Auto-transformer and three-phase transformer connections. Overviews of DC-DC buck and boost converters, duty ratio control. Introduction to Single-phase and three-phase voltage source inverters.

**UNIT V - Electrical Installations**

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

**SUGGESTED READINGS**


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

**(i) Laboratory**

**Course Objective**

- To impart the basic knowledge about the Electric circuits.
- To understand the working of Electrical Machines and Transformers.
- To observe the speed control experiments in DC motor
- To acquire the knowledge of energy consumption measurements in single phase system
- To observe and analyse the electrical parameters in R load
- To experiment the basic laws in voltage and current

**Course Outcomes (Cos)**

At the end of this course, students will demonstrate the ability

1. To understand and analyze basic electric and magnetic circuits.
2. Getting basic practical knowledge about the Electric circuits.
3. Getting knowledge about the testing of Electrical Machines and Transformers.
4. To observe the speed control experiments in DC moto
5. To study the working principles of electrical machines and power converters.
6. Gathered knowledeg of commercial system energy calculations

**List of Experiments**

1. Experimental verification of electrical circuit problems using Ohms law and Kirchoff's law.
2. Measurement of electrical quantities – voltage, current, power & power factor in R load.
3. Speed control of DC shunt motor
4. Draw the equivalent circuit of single phase Transformer by conducting OC &SC Test.
5. Measurement of energy using single phase energy meter.

**SUGGESTED READING**


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

**Semester-II**

**18BEEE211** **WORKSHOP / MANUFACTURING PRACTICES LABORATORY** **5H-3C**

**Instruction Hours/week: L:1 T:0 P:4** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objectives**

- to prepare the students to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- to prepare the students to communicate effectively and to use the techniques, skills, and modern engineering tools necessary for engineering practice
- To prepare for understanding operations of CNC machines
- To prapare for assembling different componenets in engineering division
- To prepare for carpenter working tools handling
- To prepare students for handling the tools in engineering and furnace division

**Course Outcomes**

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

1. Upon completion of this course, the students will gain knowledge of the different manufacturing processes which are commonly employed in the industry, to fabricate components using different materials.
2. Students will be able to fabricate components with their own hands.
3. They will also get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.
4. By assembling different components, they will be able to produce small devices of their interest.
5. Acquire knowledge of various different tools handling in engineering division
6. Knowledge gathering in casting and welding process too

**i) Lectures & videos: (10 PERIODS)**

**Detailed contents**

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

**ii) Workshop Practice: (60 PERIODS)**

1. Machine shop **(10 Periods)**
2. Fitting shop **(8 Periods)**
3. Carpentry **(6 Periods)**
4. Electrical & Electronics**(8 Periods)**
5. Welding shop **( 8 hours (Arc welding 4 Periods + gas welding 4 Periods)**
6. Casting **(8 Periods)**
7. Smithy **(6 Periods)**
8. Plastic moulding & Glass Cutting **(3 Periods)**
9. Plumbing Exercises **(3 Periods)**

***SUGGESTED READINGS***


1. Jeyachandran, K. and Balasubramanian, S, (2007), A Premier on Engineering Practices Laboratory, Anuradha Publications, Kumbakonam.
2. Jeyapoovan, T., Saravanapandian, M, (2006), Engineering Practices Lab Manual, Vikas Puplishing House Pvt. Ltd, Chennai.
3. Bawa, H.S, Workshop Practice, (2007), Tata McGraw – Hill Publishing Company Limited, New Delhi.
4. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K, (2008&2010), Elements of Workshop Technology", Vol. I and Vol. II, Media promoters and publishers private limited.
5. Gowri P. Hariharan and A. Suresh Babu, (2008), Manufacturing Technology – I, Pearson Education.
6. Kalpakjian S. And Steven S. Schmid, (2002), Manufacturing Engineering and Technology, Pearson Education India Edition.
7. Roy A. Lindberg,( 1998), Processes and Materials of Manufacture, Prentice Hall India.
8. Rao P.N., (2017),Manufacturing Technology, Vol. I and Vol. II, Tata McGrawHill House.

**Semester-II**

**18BEEE212 ENGINEERING GRAPHICS AND DESIGN 5H-3C**

**Instruction Hours/week: L:1 T:0 P:4** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objectives**

- to prepare the students to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- to prepare the students to communicate effectively and to use the techniques, skills, and modern engineering tools necessary for engineering practice
- To prepare the students for creating drawings in engineering
- To prepare the students for getting experience in engineering graphics
- To prepare the students for getting experience in engineering solid modelling and computer aided design
- To prepare the students to get better understandings in projection of solids

**Course Outcomes:**

1. Introduction to engineering design and its place in society
2. Exposure to the visual aspects of engineering design
3. Exposure to the visual aspects of engineering graphics standards
4. Exposure to solid modeling and computer-aided geometric design .
5. Exposure to creating working drawings and engineering communication
6. Exposure to known about projection of solids

**UNIT I - INTRODUCTION**

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Layout of drawing sheets, sizes of drawing sheets, different types of lines used in drawing practice geometric constructions, principles of dimensioning– linear, angular, aligned system, unidirectional system, parallel dimensioning, chain dimensioning, location dimension and size dimension. Conic sections including the Ellipse, Parabola and Hyperbola (eccentricity method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales

**UNIT II - ORTHOGRAPHIC PROJECTIONS**

Principles of Orthographic Projections- Need for importance of multiple views and their placement – First angle projection – layout views – Developing visualization skills through free hand sketching of multiple views from pictorial views of objects.

## UNIT III - PROJECTION OF POINTS, LINES AND PLANE SURFACES

Projections of Points and lines located in the first quadrant inclined to both planes - Determination of true lengths and true inclinations; Projection of polygonal surface and circular lamina inclined to both reference planes

## UNIT IV - PROJECTION OF SOLIDS

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

## UNIT V - ISOMETRIC PROJECTIONS & COMPUTER GRAPHICS

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple solids, truncated prisms, pyramids, cylinders and cones; Conversion of Isometric Views to Orthographic Views and Vice-versa

Overview of Computer Graphics, listing the computer technologies that impact on graphical communication, demonstrating knowledge of the theory of CAD software, Introduction to 3D modeling packages

### *SUGGESTED READINGS*


1. Venugopal K and Prabhu Raja V, (2010),Engineering Graphics, New Age International Publishers.
2. C M Agrawal and Basant Agrawal, (2012), Engineering Graphics, Tata McGraw Hill, New Delhi.
3. James D. Bethune, (2015), Engineering Graphics with AutoCAD Pearson Education.
4. Narayana, K.L. & P Kannaiah, (2008), text book on Engineering Drawing, Scitech Publishers.
5. Bureau of Indian Standards, (2003)., Engineering Drawing Practices for Schools and Colleges SP 46, BIS, New Delhi
6. Shah, M.B. & Rana B.C., (2008), Engineering Drawing and Computer Graphics, Pearson Education.
7. Bhatt N.D., Panchal V.M. & Ingle P.R, (2014), Engineering Drawing, Charotar Publishing House.

Semester – III

**18BEEE301 ELECTRICAL CIRCUIT ANALYSIS 4H-4C**

**Instruction Hours / week: L: 3 T: 1 P: 0** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3 Hours

**Course Objectives**

- To gain knowledge on the principles and procedure for the Analysis of Circuits.
- To enable the students to understand the DC circuit analysis and network theorems.
- To learn the Sinusoidal steady state analysis.
- To Obtain the solution of first and Second order system
- To learn and analyse the electrical circuits using Laplace Transforms.
- To understand transients and resonance in RLC circuits and coupled circuits.

**Course Outcomes (COs)**

At the end of this course, students will demonstrate the ability to

1. Apply network theorems for the analysis of electrical circuits.
2. Obtain the solution of first and Second order system
3. Analyse the electrical circuits using Laplace Transforms.
4. Obtain the transient and steady-state response of electrical circuits.
5. Analyse circuits in the sinusoidal steady-state (single-phase and three-phase).
6. Analyse two port circuit behavior.

**UNIT I NETWORK THEOREMS (10)**

Superposition theorem, Thevenin theorem, Norton theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem. Analysis with dependent current and voltage sources. Node and Mesh Analysis. Concept of duality and dual networks.

**UNIT II SOLUTION OF FIRST AND SECOND ORDER NETWORKS (8)**

Solution of first and second order differential equations for Series and parallel R-L, R-C, RL-C circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response.

**UNIT III SINUSOIDAL STEADY STATE ANALYSIS (8)**

Representation of sine function as rotating phasor, phasor diagrams, impedances and admittances, AC circuit analysis, effective or RMS values, average power and complex power. Three-phase circuits. Mutual coupled circuits, Dot Convention in coupled circuits, Ideal Transformer.

**UNIT-IV ELECTRICAL CIRCUIT ANALYSIS USING LAPLACE TRANSFORMS (8)**

Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform for standard inputs, convolution integral, inverse Laplace transform, transformed network with initial conditions. Transfer function representation. Poles and Zeros. Frequency response (magnitude and phase plots), series and parallel resonances

**UNIT- V TWO PORT NETWORK AND NETWORK FUNCTIONS (6)**

Two Port Networks, terminal pairs, relationship of two port variables, impedance parameters, admittance parameters, transmission parameters and hybrid parameters, interconnections of two port networks.

**SUGGESTED READINGS**


1. M. E. Van Valkenburg, "Network Analysis", Prentice Hall, 2006.
2. D. Roy Choudhury, "Networks and Systems", New Age International Publications, 1998.
3. W. H. Hayt and J. E. Kemmerly, "Engineering Circuit Analysis", McGraw Hill Education, 2013.
4. C. K. Alexander and M. N. O. Sadiku, "Electric Circuits", McGraw Hill Education, 2004.
5. K. V. V. Murthy and M. S. Kamath, "Basic Circuit Analysis", Jaico Publishers, 1999.

**Semester – III**

**18BEEE302 ANALOG ELECTRONICS 3H-3C**

**Instruction Hours / week: L: 3 T: 0 P: 0** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3 Hours

**Course Objectives**

- Understand electronic systems with a continuously variable signal
- Understand proportional relationship between a signal and a voltage or current that represents the signal.
- To learn function of basic component's use in linear circuits.
- Understand component symbol, working principle, classification and specification.
- To get more understanding about amplifies and oscillators
- To learn different theorems for simplification of basic linear electronics circuits.

**Course Outcomes (COs)**

At the end of this course, students will demonstrate the ability to

1. Illustrate the structure, operation and characteristics of PN junction diode and its applications
2. Understand the characteristics of transistors
3. Design and analyze various rectifier and amplifier circuits
4. lustrate the concepts of various positive and negative feedback amplifiers and derive its parameters
5. Design sinusoidal and non-sinusoidal oscillators.
6. Understand the functioning of OP-AMP and design OP-AMP based circuits.

UNIT I DIODE CIRCUITS (4)

P-N junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, Zener diodes, clamping and clipping circuits.

UNIT II BJT CIRCUITS (8)

Structure and I-V characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits, current mirror; common-emitter, common-base and common collector amplifiers; Small signal equivalent circuits, high-frequency equivalent circuits

UNIT III MOSFET CIRCUITS (8)

MOSFET structure and I-V characteristics. MOSFET as a switch. MOSFET as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, transconductance, high frequency equivalent circuit.

UNIT-IV DIFFERENTIAL, MULTI-STAGE AND OPERATIONAL AMPLIFIERS (8)

Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product)

UNIT- V LINEAR AND NON LINEAR APPLICATIONS OF OP-AMP (14)

Idealized analysis of op-amp circuits. Inverting and non-inverting amplifier, differential amplifier, instrumentation amplifier, integrator, active filter, P, PI and PID controllers and lead/lag compensator using an op-amp, voltage regulator, oscillators (Wein bridge and phase shift).Analog to Digital Conversion. Hysteretic Comparator, Zero Crossing Detector, Square-wave and triangular-wave generators. Precision rectifier, peak detector. Monoshot.

**SUGGESTED READINGS**


1. A. S. Sedra and K. C. Smith, "Microelectronic Circuits", New York, Oxford University Press,1998.
2. J. V. Wait, L. P. Huelsman and G. A. Korn, "Introduction to Operational Amplifier theory and applications", McGraw Hill U. S., 1992.
4. P. Horowitz and W. Hill, "The Art of Electronics", Cambridge University Press, 1989.
5. P. R. Gray, R. G. Meyer and S. Lewis, "Analysis and Design of Analog Integrated Circuits", John Wiley & Sons, 2001.

**Semester – III**

**18BEEE303 ELECTRICAL MACHINES-I 3H-3C**

**Instruction Hours / week: L: 3 T: 0 P: 0** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3 Hours

**Course Objective**

- To study the working principles of electrical machines using the concepts of electromechanical energy conversion principles and derive expressions for generated voltage and torque developed in all Electrical Machines.
- To study the concepts of magnetic fields
- To study the concepts of magnetic circuits.
- To study the working principles of DC machines as Generator types, determination of their no- load/load characteristics, starting and methods of speed control of motors.
- To estimate various losses taking place in D . C . Motor
- To s t u d y t h e different testing methods to arrive at their performance.

**Course Outcomes (COs)**

At the end of this course, students will demonstrate the ability to

1. Understand the concepts of magnetic fields
2. Understand the concepts of magnetic circuits.
3. Understand the operation of dc machines.
4. Analyse the differences in operation of different dc machine configurations.
5. Analyse the single phase transformers circuits.
6. Analyse the three phase transformers circuits.

**UNIT I MAGNETIC FIELDS AND MAGNETIC CIRCUITS (15)**

Review of magnetic circuits - MMF, flux, reluctance, inductance; review of Ampere Law and Biot Savart Law; Visualization of magnetic fields produced by a bar magnet and a current carrying coil - through air and through a combination of iron and air; influence of highly permeable materials on the magnetic flux lines.

B-H curve of magnetic materials; flux-linkage vs current characteristic of magnetic circuits; linear and nonlinear magnetic circuits; energy stored in the magnetic circuit; force as a partial derivative of stored energy with respect to position of a moving element; torque as a partial derivative of stored energy with respect to angular position of a rotating element. Examples galvanometer coil, relay contact, lifting magnet, rotating element with eccentricity or saliency

**UNIT II DC MACHINES (8)**

Basic construction of a DC machine, magnetic structure - stator yoke, stator poles, pole-faces or shoes, air gap and armature core, visualization of magnetic field produced by the field winding excitation with armature winding open, air gap flux density distribution, flux per pole, induced EMF in an armature coil. Armature winding and commutation - Elementary armature coil and commutator, lap and wave windings, construction of commutator, linear

commutation Derivation of back EMF equation, armature MMF wave, derivation of torque equation, armature reaction, air gap flux density distribution with armature reaction.

**UNIT-III DC MACHINE - MOTORING AND GENERATION (7)**

Armature circuit equation for motoring and generation, Types of field excitations - separately excited, shunt and series. Open circuit characteristic of separately excited DC generator, back EMF with armature reaction, voltage build-up in a shunt generator, critical field resistance and critical speed. V-I characteristics and torque-speed characteristics of separately excited, shunt and series motors. Speed control through armature voltage. Losses, load testing and back-to-back testing of DC machines

**UNIT- IV SINGLE PHASE TRANSFORMERS (6)**

Principle, construction and operation of single-phase transformers, equivalent circuit, phasor diagram, voltage regulation, losses and efficiency Testing - open circuit and short circuit tests, polarity test, back-to-back test, separation of hysteresis and eddy current losses. Parallel operation of single phase transformers.

**UNIT V THREE PHASE TRANSFORMERS (6)**

Three-phase transformer - construction, types of connection and their comparative features. Parallel operation of three-phase transformers, Autotransformers - construction, principle, applications and comparison with two winding transformer, Magnetizing current, harmonics in magnetization current, Phase conversion - Scott connection, three-phase to six-phase conversion, Tap-changing transformers - No-load and on-load tap-changing of transformers, Three-winding transformers. Cooling of transformers.

**SUGGESTED READINGS**

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013.
2. A. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2004.
3. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
4. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
5. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.

**Semester – III**

**18BEEE304 ELECTROMAGNETIC FIELDS 4H-4C**

**Instruction Hours / week: L: 3 T: 1 P: 0** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3 Hours

**Course Objectives**

- To introduce the basic mathematical concepts related to electromagnetic vector fields
- To impart knowledge on the concepts of electrostatics, electrical potential, energy density and their applications.
- To impart knowledge on the concepts of magnetostatics, magnetic flux density, scalar and vector potential and its applications.
- To impart knowledge on the concepts of Faraday's law, induced emf and Maxwell's equations
- To impart the knowledge of electric and magnetic fields
- To impart knowledge on the concepts of Concepts of electromagnetic waves and Pointing vector.

**Course Outcomes (COs)**

At the end of the course, students will demonstrate the ability

1.To understand the basic laws of electromagnetism.

2.To obtain the electric and magnetic fields for simple configurations under static conditions.

3.To understand the concept of Conductors, Dielectrics and Capacitance.

4.To analyse time varying electric and magnetic fields.

5.To understand Maxwell's equation in different forms and different media.

6.To understand the propagation of EM waves.

**UNIT I REVIEW OF VECTOR CALCULUS AND STATIC ELECTRIC FIELD (12)**

Vector algebra-addition, subtraction, components of vectors, scalar and vector multiplications, triple products, three orthogonal coordinate systems (rectangular, cylindrical and spherical). Vector calculus differentiation, partial differentiation, integration,vector operatordel, gradient, divergence and curl; integral theorems of vectors. Conversion of a vector from one coordinate system to another.Coulomb's law, Electric field intensity, Electrical field due to point charges. Line, Surface and Volume charge distributions. Gauss law and its applications. Absolute Electric potential, Potential difference, Calculation of potential differences for different configurations. Electric dipole, Electrostatic Energy and Energy density.

**UNIT II CONDUCTORS, DIELECTRICS AND CAPACITANCE (6)**

Current and current density, Ohms Law in Point form, Continuity of current, Boundary conditions of perfect dielectric materials. Permittivity of dielectric materials, Capacitance, Capacitance of a two wire line, Poisson's equation, Laplace's equation, Solution of Laplace and Poisson's equation, Application of Laplace's and Poisson's equations.

**UNIT-III STATIC MAGNETIC FIELDS (6)**

Biot-Savart Law, Ampere Law, Magnetic flux and magnetic flux density, Scalar and Vector Magnetic potentials. Steady magnetic fields produced by current carrying conductors.

**UNIT- IV MAGNETIC FORCES, MATERIALS AND INDUCTANCE (6)**

Force on a moving charge, Force on a differential current element, Force between differential current elements, Nature of magnetic materials, Magnetization and permeability, Magnetic boundary conditions, Magnetic circuits, inductances and mutual inductances.

**UNIT V TIME VARYING FIELDS AND MAXWELL'S EQUATIONS (12)**

Faraday's law for Electromagnetic induction, Displacement current, Point form of Maxwell's equation, Integral form of Maxwell's equations, Motional Electromotive forces. Boundary Conditions. Derivation of Wave Equation, Uniform Plane Waves, Maxwell's equation in Phasor form, Wave equation in Phasor form, Plane waves in free space and in a homogenous material. Wave equation for a conducting medium, Plane waves in lossy dielectrics, Propagation in good conductors, Skin effect. Poynting theorem.

**SUGGESTED READINGS**


1. M. N. O. Sadiku, "Elements of Electromagnetics", Oxford University Publication, 2014.
2. A. Pramanik, "Electromagnetism - Theory and applications", PHI Learning Pvt. Ltd, New Delhi, 2009.
3. A. Pramanik, "Electromagnetism-Problems with solution", Prentice Hall India, 2012.

**Semester – III**

**18BEEE305 ENGINEERING MECHANICS 4H-4C**

**Instruction Hours / week: L: 3 T: 1 P: 0** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3 Hours

**Course Objectives**

1. To develop capacity to predict the effect of force and motion in the course of carrying out the design functions of engineering.
2. To study the forces acting on a rigid bodies
3. To study the moment of inertia on different figures
4. To study the motion and determine its kinematics of particles
5. To study about the centroid and composite of areas
6. To arrive the equilibrium of rigid body studies

**Course Outcomes:**

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

1. Draw free body diagrams and determine the resultant of system of forces.
2. Determine the reactions when forces are acting on rigid bodies.
3. Determine the centroid and second moment of area of sections.
4. Analyze statically determinate planar frames.
5. Analyze the motion and determine projectile motion characteristics.
6. Apply Newton's laws and conservation laws to motion of rigid bodies.

**UNIT I STATICS OF PARTICLES 12**

Forces – system of forces – concurrent forces in plane and space– resultant – problems involving the equilibrium of a particle–free body diagram–equilibrium of particle in space.

**UNIT II STATICS OF RIGID BODIES IN TWO DIMENSIONS 12**

Rigid bodies–moment of force about an axis–moments and couples–equivalent system of coplanar forces–Rigid body in equilibrium–problems involving equilibrium of rigid body–types of supports–reactions of beams.

**UNIT III CENTROID, CENTRE OF GRAVITY AND MOMENT OF INERTIA 12**

Centroids of areas, composite areas, determination of moment of inertia of plane figures, radius of gyration – mass moment of inertia of simple solids.

**UNIT IV KINEMATICS OF PARTICLES 12**

Introduction – plane, rectilinear motion – time dependent motion – rectangular coordinates – projectile motion.

Concept of conservation of momentum – Impulse–Momentum principle.

**UNIT V KINETICS OF PARTICLES AND FRICTION 12**

KINETICS OF PARTICLES: Equations of motion–rectilinear motion–Newton's II law – work done by a force – Energy – potential energy–kinetic energy–conservation of energy–work energy method.

Laws of friction – coefficient of friction–problems involving dry friction – ladder friction and screw friction.

**Suggested Readings:**

1. Beer F P and Johnson E.R Vector Mechanics for Engineers–Statics and Dynamics Tata Mc–Graw Hill Publishing Co. Ltd., New Delhi 2012.
2. Rajasekaran.S and Sankarasubramanian G Engineering Mechanics–Statics and Dynamics Vikas Publishing House Pvt. Ltd., New Delhi 2009.
3. Bansal R K Engineering Mechanics Laxmi Publications Pvt. Ltd., New Delhi 2006

4. Young D H and Timashenko S Engineering Mechanics Tata McGraw–Hill, New Delhi 2006
5. Jivan Khachane and Ruchi Shrivastava Engineering Mechanics: Statics and Dynamics ANE Books, New Delhi 2006

**Semester – III**

**18BEEE311 ANALOG ELECTRONICS LABORATORY 2H-1C**

**Instruction Hours / week: L: 0 T: 0 P: 2** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3 Hours

**Course Objectives**

- To understand Basic Analog Circuits and their applications using Active Devices
- To learn basic function of single stage amplifier, multistage amplifier and power Amplifier and their working principle.
- To undersatnd the equivalent circuit of MOSFET and sketch the V-I characteristics.
- To undersatnd the Darlington amplifier and develop the circuit.
- To understand basic construction of feedback circuits and their application in Oscillators
- Understand basic amplifier and oscillator circuits and their application in analog circuits.

**Course Outcomes (COs)**

1. Determine the output wave forms of Full Wave Rectifiers with and without filters.
2. Draw the equivalent circuit of MOSFET and sketch the V-I characteristics.
3. Design the Darlington amplifier and develop the circuit.
4. Compare the theoretical and practical frequency response of Wein bridge oscillators.
5. Design of Astable and Monostable multivibrators for generation of different waveforms
6. Design of clipper and clamper.

**List of Experiments**

1. Half Wave and Full Wave Rectifiers, Filters, Power supplies
2. Darlington Amplifier.
3. Differential Amplifiers- Transfer characteristic, CMRR Measurement
4. Clipper. Clamper and Wave Shaping.
5. Wein Bridge Oscillator.
6. Triangular Wave Generator
7. MOSFET as Amplifier.
8. Inverting and non–inverting amplifiers, Adder and comparator using Op–Amps.
9. Integrator and Differentiator using Op–Amps.
10. Study of Analog to Digital Converter and Digital to Analog Converter: Verification of A/D conversion using dedicated ICs.

**Semester – III**

**18BEEE312 ELECTRICAL MACHINES LABORATORY –I 2H-1C**

**Instruction Hours / week: L: 0 T: 0 P: 2** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3 Hours

**Course Objectives**

- To experimentally verify the principle of operation, performance and characteristics of DC Motors, DC Generators and Transformers.
- To study the operation of DC motor starters, different connections of Transformers.
- To study the load characteristics of DC shunt, series and compound motor and identify its maximum efficiency operating point
- To study the efficiency of DC machines in different methods
- Sketch the load characteristics of single phase transformer, separate the different losses and find the efficiency
- To study the importance of stumpners test

**Course Outcomes (COs)**

1. Analyze the characteristics of DC shunt generator DC compound generator and calculate critical resistance and critical speed
2. Examine load characteristics of DC shunt, series and compound motor and identify its maximum efficiency operating point
3. Estimate the efficiency of DC machines in different methods
4. Sketch the load characteristics of single phase transformer, separate the different losses and find the efficiency
5. Predetermine the equivalent circuit parameters of single phase transformer in two different methods and compare the results
6. Estimate the efficiency of transformer.

**LIST OF EXPERIMENTS**

1. Open circuit characteristics and load test on separately excited DC generator.
2. Open circuit characteristics and load test on DC compound generator.
3. Open circuit characteristics and load test on DC shunt generator.
4. Load test on DC shunt motor.
5. Load test on DC series motor.
6. Load test on DC compound motor.
7. Swinburne's test and speed control on DC shunt motor.
8. OC and SC tests on single phase transformer.
9. Load test on single phase transformer.
10. Sumpner's test.

**Semester – IV**

**18BEEE401 DIGITAL ELECTRONICS 3H-3C**

**Instruction Hours / week: L: 3 T: 0 P: 0** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3 Hours

**Course Objectives**

- To present the Digital fundamentals, Boolean algebra and its applications in digital systems
- To familiarize with the design of various combinational digital circuits using logic gates
- To introduce the analysis and design procedures for synchronous and asynchronous sequential circuits
- To study the design of an asynchronous sequential circuit and describe the race conditions, hazards and errors in digital circuits
- To explain the various semiconductor memories and related technology
- To introduce the electronic circuits involved in the making of logic gates

**Course Outcomes (COs)**

1. At the end of this course, students will demonstrate the ability to Recall the use of number systems and its conversion and compare the operation, characteristics of digital logic families
2. Apply the minimal SOP and POS forms of logic expression using K map and implement it with the combinational logic
3. Analyze and design a synchronous sequential circuit to obtain a state table, state diagram for the time sequence of all the variables
4. Analyze and design an asynchronous sequential circuit and describe the race conditions, hazards and errors in digital circuits
5. Understanding the concepts of ROM, RAM and CAM
6. Understanding the concepts of PLD and CPLD.

**UNIT I FUNDAMENTALS OF DIGITAL SYSTEMS AND LOGIC FAMILIES (7)**

Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic,one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital lCs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-statelogic.

**UNIT II COMBINATIONAL DIGITALCIRCUITS (7)**

Standard representation for logic functions, K-map representation, simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer,De-Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder,serialadder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices,Q-M method of function realization.

**UNIT III SEQUENTIAL CIRCUITS AND SYSTEMS (7)**

A 1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J- K-T and D type's flipflops, applications of flipflops, shiftregisters, applications of shiftregisters, serial to

parallel converter, parallel to serial converter, ring counter, sequence generator, ripple(Asynchronous) counters, synchronous counters, counters design using flip flops,specialcounter IC's, asynchronous sequential counters, applications of counters.

**UNIT-IV A/D AND D/A CONVERTERS (7)**

Digital to analog converters: weighted resistor/converter, R-2R Ladder D/Aconverter, specifications for D/A converters, examples of D/A converter lCs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using voltagetofrequencyandvoltagetotimeconversion,specificationsofA/Dconverters, example of A/D converter ICs.

**UNIT- V SEMICONDUCTOR MEMORIES AND PROGRAMMABLE LOGIC DEVICES. (7)**

Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory(RAM), content addressable memory (CAM), charge de coupled device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS),Fundamentals of Field Programmable Gate Array (FPGA).

**SUGGESTED READINGS**

1. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, 2009.
2. M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016.
3. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.

Semester – IV

**18BEEE402 ELECTRICAL MACHINES – II 3H-3C**

**Instruction Hours / week: L: 3 T: 0 P: 0** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3 Hours

**Course Objectives**

- To learn Construction and performance of salient and non–salient type synchronous generators.
- To get the knowledge of operation and performance of synchronous motor.
- To study and understand the concept of AC machine windings.
- To study and understand the concepts of rotating magnetic fields.
- To study the operation and performance of 3 Phase induction motors and its starting and speed control.
- To study the Construction, principle of operation and performance of single phase induction motors and few special machines

**Course Outcomes (COs)**

At the end of this course, students will demonstrate the ability to

1. Understand the concept of AC machine windings.
2. Understand the concepts of rotating magnetic fields.
3. Understand the operation of ac machines.
4. Analyse performance characteristics Induction Machines.
5. To understand the different types of single phase induction motor based on its starting methods.
6. Understand the operation of synchronous motor and analyze the performance of motor under different loading and excitation conditions.

**UNIT I FUNDAMENTALS OF AC MACHINE WINDINGS (8)**

Physical arrangement of windings in stator and cylindrical rotor; slots for windings; singleturn coil - active portion and overhang; full-pitch coils, concentrated winding, distributed winding, winding axis, 3D visualization of the above winding types, Air-gap MMF distribution with fixed current through winding - concentrated and distributed, Sinusoidally distributed winding, winding distribution factor.

**UNIT II PULSATING AND REVOLVING MAGNETIC FIELDS (6)**

Constant magnetic field, pulsating magnetic field - alternating current in windings with spatial displacement, Magnetic field produced by a single winding - fixed current and alternating current. Pulsating fields produced by spatially displaced windings, Windings spatially shifted by 90 degrees, Addition of pulsating magnetic fields, Three windings spatially shifted by 120 degrees (carrying three-phase balanced currents), revolving magnetic field.

**UNIT III INDUCTION MACHINES (12)**

Construction, Types (squirrel cage and slip-ring), Torque Slip Characteristics, Starting and Maximum Torque. Equivalent circuit. Phasor Diagram, Losses and Efficiency. Effect of parameter variation on torque speed characteristics (variation of rotor and stator resistances,

stator voltage, frequency). Methods of starting, braking and speed control for induction motors. Generator operation. Self-excitation. Doubly-Fed Induction Machines.

**UNIT-IV SINGLE-PHASE INDUCTION MOTORS (6)**

Constructional features, double revolving field theory, equivalent circuit, determination of parameters. Split-phase starting methods and applications.

**UNIT- V SYNCHRONOUS MACHINES (10)**

Constructional features, cylindrical rotor synchronous machine - generated EMF, equivalent circuit and phasor diagram, armature reaction, synchronous impedance, voltage regulation. Operating characteristics of synchronous machines, V-curves. Salient pole machine - two reaction theory, analysis of phasor diagram, power angle characteristics. Parallel operation of alternators - synchronization and load division.

**SUGGESTED READINGS**

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", McGraw Hill Education, 2013.
2. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
3. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
4. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.
6. P. C. Sen, "Principles of Electric Machines and Power Electronics", John Wiley & Sons,2007.

**Semester – IV**

**18BEEE403 POWER ELECTRONICS 3H-3C**

**Instruction Hours / week: L: 3 T: 0 P: 0** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3 Hours

**Course Objectives**

- Different types of power semiconductor devices and their switching Operation, characteristics and performance parameters of controlled rectifiers
- Operation, switching techniques and basics topologies of DC-DC switching
- To study and analyse the controlled rectifier circuits
- Different modulation techniques of pulse width modulated inverters and to regulators.
- Operation of AC voltage controller and various configurations
- Understand harmonic reduction methods.

**Course Outcomes (COs)**

At the end of this course students will demonstrate the ability to

1.Understand the differences between signal level .

2. Understand the differences between power level devices.

3.Analyse controlled rectifier circuits.

4.Analyse the operation of DC-DC choppers.

5.Analyse the operation of voltage source inverters.

6.Understand different modulation techniques.

**UNIT I POWER SWITCHING DEVICES (8)**

Diode, Thyristor, MOSFET, IGBT: I-V Characteristics; Firing circuit for thyristor; Voltage and current commutation of a thyristor; Gate drive circuits for MOSFET and IGBT.

**UNIT II THYRISTOR RECTIFIERS (7)**

Single-phase half-wave and full-wave rectifiers, Single-phase full-bridge thyristor rectifier with R-load and highly inductive load; Three-phase full-bridge thyristor rectifier with R-load and highly inductive load; Input current wave shape and power factor.

**UNIT III DC-DC BUCK AND BOOST CONVERTER (10)**

Elementary chopper with an active switch and diode, concepts of duty ratio and average voltage, power circuit of a buck converter, analysis and waveforms at steady state, duty ratio control of output voltage. Power circuit of a boost converter, analysis and waveforms at steady state, relation between duty ratio and average output voltage.

**UNIT- IV SINGLE-PHASE VOLTAGE SOURCE INVERTER (10)**

Power circuit of single-phase voltage source inverter, switch states and instantaneous output voltage, square wave operation of the inverter, concept of average voltage over a switching cycle, bipolar sinusoidal modulation and unipolar sinusoidal modulation, modulation index and output voltage.

## UNIT V THREE-PHASE VOLTAGE SOURCE INVERTER (8)

Power circuit of a three-phase voltage source inverter, switch states, instantaneous output voltages, average output voltages over a sub-cycle, three-phase sinusoidal modulation

**SUGGESTED READINGS**

1. M. H. Rashid, “Power electronics: circuits, devices, and applications”, Pearson Education India, 2009.
2. N. Mohan and T. M. Undeland, “Power Electronics: Converters, Applications and Design”, John Wiley & Sons, 2007.
3. R. W. Erickson and D. Maksimovic, “Fundamentals of Power Electronics”, Springer Science & Business Media, 2007.
4. L. Umanand, “Power Electronics: Essentials and Applications”, Wiley India, 2009.

**Semester – IV**

**18BEEE404 SIGNALS AND SYSTEMS 3H-3C**

**Instruction Hours / week: L: 2 T: 1 P: 0** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3 Hours

**Course Objectives**

- To know the methods of characterization of LTI systems in time domain.
- To study the systems in complex frequency domain
- To study and understand sampling theorem and its implications.
- To analyze continuous time signals and system in the Fourier and Laplace domain.
- To study the various response of different systems
- To analyze discrete time signals and system in the Fourier and Z transform domain.

**Course Outcomes (COs)**

At the end of this course, students will demonstrate the ability to

1.Classify different types of signals and systems

2.Understand the concepts of continuous time and discrete time systems.

3.Analyse systems in complex frequency domain.

4.Understand sampling theorem and its implications.

5.Apply Z transform to solve problems on DT systems

6.Compute Discrete Fourier transform using Fast Fourier transform

**UNIT I INTRODUCTION TO SIGNALS AND SYSTEMS (3)**

Signals and systems as seen in everyday life, and in various branches of engineering and science. Signal properties: periodicity, absolute integrability, determinism and stochastic character. Some special signals of importance: the unit step, the unit impulse, the sinusoid, the complex exponential, some special time-limited signals; continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realiability. Examples.

**UNIT II BEHAVIOR OF CONTINUOUS AND DISCRETE-TIME LTI SYSTEMS (8)**

Impulse response and step response, convolution, input-output behavior with a periodic convergent inputs, cascade interconnections. Characterization of causality and stability of LTI systems. System representation through differential equations and difference equations. State-space Representation of systems. State-Space Analysis, Multi-input, multi-output representation. State Transition Matrix and its Role. Periodic inputs to an LTI system, the notion of a frequency response and its relation to the impulse response.

**UNIT III FOURIER TRANSFORMS (5)**

Fourier series representation of periodic signals, Waveform Symmetries, Calculation of Fourier Coefficients. Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The DiscreteTime Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem.

**UNIT IV LAPLACE AND Z-TRANSFORMS (5)**

Review of the Laplace Transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behavior. The z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z-domain analysis.

**UNIT-V SAMPLING AND RECONSTRUCTION (4)**

The Sampling Theorem and its implications. Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects. Relation between continuous and discrete time systems. Introduction to the applications of signal and system theory: modulation for communication, filtering, feedback control systems.

**SUGGESTED READINGS**

1. A. V. Oppenheim, A. S. Willsky and S. H. Nawab, “Signals and systems”, Prentice Hall India, 1997.
2. J. G. Proakis and D. G. Manolakis, “Digital Signal Processing: Principles, Algorithms,and Applications”, Pearson, 2006.
3. H. P. Hsu, “Signals and systems”, Schaum’s series, McGraw Hill Education, 2010.
4. S. Haykin and B. V. Veen, “Signals and Systems”, John Wiley and Sons, 2007.
5. A. V. Oppenheim and R. W. Schafer, “Discrete-Time Signal Processing”, Prentice Hall, 2009.
6. M. J. Robert “Fundamentals of Signals and Systems”, McGraw Hill Education,2007.
7. B. P. Lathi, “Linear Systems and Signals”, Oxford University Press, 2009.

**SEMESTER IV**

**18BEEE405** **Mathematics –III**

**( Probability And Statistics )** **4H-4C**

**Instruction Hours/week: L:3 T:1 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objectives**

The objective of this course is to familiarize the students with statistical techniques.

- It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling various problems in the discipline.
- To gain knowledge in measures of central tendency.
- Acquire skills in handling situations involving more than one random variable and functions of random variables.
- To study statistical methods of the sample data
- Be introduced to the notion of sampling distributions and have acquired knowledge of statistical techniques useful in making rational decision in management problems.
- Be exposed to statistical methods designed to contribute to the process of making scientific judgments in the face of uncertainty and variation.

**Course Outcomes**

1. To apply statistical methods designed to contribute to the process of making scientific judgments in the face of uncertainty and variation.
2. To learn the ideas of probability, random variables and various discrete and continuous probability distributions and their properties.
3. To apply the basic ideas of statistics including measures of central tendency, correlation and regression.
4. To acquire knowledge in statistical methods of the sample data.
5. To analysis and perform Test of Hypothesis as well as calculate confidence interval for a population parameter for single sample and two sample cases.
6. To understand the concept of the sampling distribution of a statistic and in particular describes the behavior of the sample mean and hypothesis testing.

**UNIT I - Basic Probability**

Probability spaces, conditional probability, ayes' rule, independence; Discrete random variables, Independent random variables, the multinomial distribution, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum,
Correlation coefficient, Chebyshev's Inequality.

**UNIT II - Random Variables**

Continuous random variables and their properties, distribution functions and densities,normal, exponential and gamma densities. Bivariate distributions and their properties, conditionaldensities,

**UNIT III - Basic Statistics**

Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions:Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation.

**UNIT IV - Applied Statistics**

Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for singleproportion, difference of proportions, single mean, difference of means, and difference of standard deviations.

**UNIT V - Small samples**

Test for single mean, difference of means and correlation coefficients, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.

**SUGGESTED READINGS**


1. Erwin kreyszig, (2014), Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons.
2. Bali N., Goyal M. (2010), A text book of Engineering Mathematics, 7th Edition, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd),
3. P.G.Hoel, S. C. Port and C. J. Stone,(2003) Introduction to Probability Theory, UniversalBook Stall
4. S. Ross, (2002)A First Course in Probability, 6th Edition, Pearson Education India
5. Veerarajan T, (2010)Engineering Mathematics (for semester III), Tata McGraw-Hill.

**Semester-IV**

| **18BEEE406** | **ENVIRONMENTAL STUDIES** | **3H-3C** |
|---|---|---|

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objectives**

- To create the awareness about environmental problems among people.
- To develop an attitude of concern for the environment.
- To study the systems concepts and methodologies to analyze and understand interactions between social and environmental processes.
- To study the reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world
- To motivate public to participate in environment protection and improvement.
- To study the conservation of biodiversity

**Course Outcomes (COs)**

1. Master core concepts and methods from ecological and physical sciences and their application in environmental problem solving.
2. Appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems.
3. Understand the transnational character of environmental problems and ways of addressing them, including interactions across local to global scales.
4. Apply systems concepts and methodologies to analyze and understand interactions between social and environmental processes.
5. Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world.
6. Demonstrate proficiency in quantitative methods, qualitative analysis, critical thinking, and written and oral communication needed to conduct high-level work as interdisciplinary scholars and/or practitioners.

## Unit I – INTRODUCTION - ENVIRONMENTAL STUDIES & ECOSYSTEMS

Environment Definition, Scope and importance; Ecosystem, Structure and functions of ecosystem. Energy flow, Food chains and food webs, Ecological succession. Classification of ecosystem. Forest ecosystem, Grassl and Ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

## Unit II - NATURAL RESOURCES - RENEWABLE AND NON-RENEWABLE RESOURCES

Natural resources - Renewable and Non – Renewable resources.Land resources and land use change, Land degradation, soil erosion and desertification. Forest resources -Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.Water resources- Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water.Use of alternate energy sources, growing energy needs, case studies.Role of an individual in conservation of natural resources.Equitable use of resources for sustainable lifestyles.

**Unit III - BIODIVERSITY AND ITS CONSERVATION**

Levels of biological diversity - genetic, species and ecosystem diversity.Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value. Bio-geographical classification of India.Biodiversity patterns (global, National and local levels).Hot-spots of biodiversity.India as a mega-diversity nation.Endangered and endemic species of India.Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts.Conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.

**Unit IV - ENVIRONMENTAL POLLUTION**

Definition, causes, effects and control measures of Air pollution, Water pollution, Soil pollution, Noise pollution.Nuclear hazards and human health risks.Solid waste management and control measures of urban and industrial wastes.Role of an individual in prevention of pollution.Case studies.

**Unit V - SOCIAL ISSUES AND THE ENVIRONMENT**

Concept of sustainability and sustainable development.Water conservation -Rain water harvesting, watershed management.Climate change, global warming, ozone layer depletion,acid rain andits impacts on human communities and agriculture. Environment Laws (Environment Protection Act, Air Act, Water Act, Wildlife Protection Act, Forest Conservation Act).International agreements (Montreal and Kyoto protocols).Resettlement and rehabilitation of project affected persons. Disaster management (floods, earthquake, cyclones and landslides).Environmental Movements (Chipko, Silent valley, Bishnois of Rajasthan). Environmental ethics: Role of Indian and other religions and cultures in environmental conservation. Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).Human population growth: Impacts on environment, human health and welfare.

**Suggested Readings**


1. Anonymous. 2004. A text book for Environmental Studies, University Grants Commission and Bharat Vidypeeth Institute of Environmental Education Research, New Delhi.
2. AnubhaKaushik., and Kaushik, C.P. 2004. Perspectives in Environmental Studies. New Age International Pvt. Ltd. Publications, New Delhi.
3. Arvind Kumar. 2004. A Textbook of Environmental Science. APH Publishing Corporation, New Delhi.
4. Daniel, B. Botkin., and Edward, A. Keller. 1995. Environmental Science John Wiley and Sons, Inc., New York.
5. Mishra, D.D. 2010. Fundamental Concepts in Environmental Studies. S.Chand& CompanyPvt. Ltd., New Delhi.
6. Odum,E.P., Odum, H.T. and Andrews, J. 1971. Fundamentals of Ecology. Philadelphia: Saunders.
7. Rajagopalan, R. 2016.Environmental Studies: From Crisis to Cure, Oxford University Press**.**
8. Sing, J.S., Sing. S.P. and Gupta, S.R. 2014. Ecology, Environmental Science and Conservation. S. Chand & Publishing Company, New Delhi.
9. Singh, M.P., Singh, B.S., and Soma, S. Dey. 2004. Conservation of Biodiversity and Natural Resources.Daya Publishing House, New Delhi.
10. Tripathy. S.N.,andSunakar Panda. (2004). Fundamentals of Environmental Studies (2nd ed.). Vrianda Publications Private Ltd, New Delhi.
11. Verma, P.S., and Agarwal V.K. 2001. Environmental Biology (Principles of Ecology).S.Chand and Company Ltd, New Delhi.

12. Uberoi, N.K. 2005. Environmental Studies. Excel Books Publications, New Delhi.

**Semester – IV**

**18BEEE411 DIGITAL ELECTRONICS LABORATORY 2H-1C**

**Instruction Hours / week: L: 0 T: 0 P: 2** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3 Hours

**Course Objectives**

On completion of the course, students are able to:

- Understand combinational and logical digital circuits and their differences.
- Students will be introduced to Flip-flop, shifts register, counters.
- To learn symbol, working principle of basic Digital electronics circuits for data processing application.
- To study the multiplexer, demultiplexer circuits and demonstrate 555 timer in Monostable and Astable operation.
- To study the Design and demonstrate inverting amplifier, non-inverting amplifier, adder, comparator, integrator and differentiator circuits using Op-Amp.
- At the end of this course, students should be able to recognize and analyze the basic digital circuits.

**Course Outcomes (COs)**

1.Verify the truth table of Logic Gates and Flip Flops.

2.Apply Boolean functions to implement adder, subtractor circuits and convert Excess 3 to BCD, Binary to Gray code and vice versa.

3.Design parity generator, parity checker, encoder and decoder circuits.

4.Design and implement 4-bit modulo synchronous, Asynchronous counters and implement 4-bit shift registers in SISO, SIPO, PISO, PIPO modes.

5. Explain multiplexer, demultiplexer circuits and demonstrate 555 timer in Monostable and Astable operation.

6. Design and demonstrate inverting amplifier, non-inverting amplifier, adder, comparator, integrator and differentiator circuits using Op-Amp.

**LIST OF EXPERIMENTS**

1. Verification of truth table of Logic Gates and Flip Flops.
2. Implementation of Boolean Functions, Adder and Subtractor circuits.
3. a. Code converters, Excess 3, 2's Complement, Binary to gray code, Parity generator and parity checker using suitable ICs.
   b. Encoders and Decoders.
4. Counters: Design and implementation of 4–bit modulo counters as synchronous and asynchronous types using FF IC's and specific counter IC.
5. Shift Registers: Design and implementation of 4–bit shift registers in SISO, SIPO, PISO, PIPO modes using suitable IC's.

6. Multiplexer and De–multiplexer (4:1, 8:1 and 1:4, 1:8)
7. Construction and verification of 4 bit ripple counter and Mod-10 / Mod-12 Ripple counters
8.Design and implementation of 3-bit synchronous up/down counter

**Semester – IV**

**18BEEE412 POWER ELECTRONICS LABORATORY 2H-1C**

**Instruction Hours / week: L: 0 T: 0 P: 2** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3 Hours

**Course Objectives**

- To study the characteristics of switching devices and its applications in rectifier inverter, chopper and resonant converter.
- To study about power electronic circuits
- To study about industrial control of power electronic circuits
- To study about the various characteristic of SCR and TRIAC
- To study about the various characteristic of PWM inverter
- To study power electronic circuits for different loads

**Course Outcomes (COs)**

At the end of this course, students will demonstrate the ability to

1. The students will be able to demonstrate the all power semiconductor devices.
2. To expose students to operation and characteristics of power semiconductor devices and passive components, their practical application in power electronics.
3. To provide a practical exposure to operating principles, design and synthesis of different power electronic converters.
4. To introduce students to industrial control of power electronic circuits as well as safe electrical connection and measurement practices.
5. Able to analyze power electronics circuits
6. Able to apply power electronic circuits for different loads

**LIST OF EXPERIMENTS**

1. Demonstrate the characteristics of SCR.
2. Demonstrate the characteristics of MOSFET.
3. Demonstrate the characteristics of IGBT.
4. Demonstrate the characteristics of TRIAC
5. Implementation of single phase half controlled converter using SCR.
6. Implementation of single phase fully controlled convertor using SCR
7. Implementation of DC-DC Boost convertor using MOSFET.
8. Implementation of DC-DC Buck convertor using MOSFET.
9. Implementation of Single phase induction motor using PWM inverter
10. Implementation of three phase induction motor using PWM inverter

**Semester – IV**

**18BEEE413 ELECTRICAL MACHINES LABORATORY –II 2H-1C**

**Instruction Hours / week: L: 0 T: 0 P: 2** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3 Hours

**Course Objectives**

- To expose the students to the operation of synchronous machines and induction motors and give them experimental skills
- To study the operation of synchronous motor on infinite bus for different excitation condition
- To Study the performance of single phase induction motor by conducting direct and indirect testing
- To study the performance of three phase induction motor by conducting direct and indirect testing
- To study the importance of various components in alternators
- To study the importance need of ZPF methods

**Course Outcomes (COs)**

1. Compare the different indirect testing methods to predetermine the voltage regulation of three phase salient and non-salient pole alternator
2. Determine the positive, negative and zero sequence impedance of alternators
3. Analyze the operation of synchronous motor on infinite bus for different excitation condition
4. Assess the performance of three phase induction motor by conducting direct and indirect testing
5. Assess the performance of single phase induction motor by conducting direct and indirect testing
6. Choose the appropriate induction motor starter for various industrial and commercial applications

**LIST OF EXPERIMENTS**

1. Regulation of Alternator by EMF and MMF Methods

2. Load test on three phase Alternator

3. Regulation of salient pole Alternator by Slip Test

4. Regulation of Alternator by ZPF method

5.Parallel operation of alternator with bus bar

6. V and Inverted V curves of Synchronous Motor

7. Equivalent Circuit of three phase Induction Motor

8. Load Test on three phase Induction Motor

9. Performance characteristics of three phase Induction Motor by Circle Diagram

10. Load Test on single phase Induction Motor

11. Speed control of Induction Motor

12. Study of different types of starting of Induction Motors

SEMESTER – V

**18BEEE501 POWER SYSTEMS-I 3H-3C**

**Instruction Hours / week: L:3 T: 0 P: 0** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3 Hours

**Course Objectives**

- To study the structure of electric power system and to develop expressions for the computation of transmission line parameters.
- To obtain the equivalent circuits for the transmission lines based on distance and to determine voltage regulation and efficiency.
- To study the types, construction of cabilitys and methods to improve the efficiency.
- To study the fault currents for different types of faults
- To study the generation of over-voltages and insulation coordination.
- To understand the mechanical design of transmission lines and to analyze voltage distribution in insulator strings to improve the efficiency.

**Course Outcomes (COs)**

At the end of this course, students will demonstrate the ability to

1.Understand the concepts of power systems.
2. Understand the various power system components.
3. Evaluate fault currents for different types of faults.
4. Understand the generation of over-voltages and insulation coordination.
5. Understand basic protection schemes.
6. Understand concepts of HVdc power transmission and renewable energy generation.

**UNIT I BASIC CONCEPTS (4)**

Evolution of Power Systems and Present-Day Scenario. Structure of a power system: Bulk Power Grids and Micro-grids.

Generation: Conventional and Renewable Energy Sources. Distributed Energy Resources. Energy Storage. Transmission and Distribution Systems: Line diagrams, transmission and distribution voltage levels and topologies (meshed and radial systems). Synchronous Grids and Asynchronous (DC) interconnections. Review of Three-phase systems. Analysis of simple three-phase circuits. Power Transfer in AC circuits and Reactive Power.

**UNIT II POWER SYSTEM COMPONENTS (15)**

Overhead Transmission Lines and Cables: Electrical and Magnetic Fields around conductors, Corona. Parameters of lines and cables. Capacitance and Inductance calculations for simple configurations. Travelling-wave Equations. Sinusoidal Steady state representation of Lines: Short, medium and long lines. Power Transfer, Voltage profile and Reactive Power. Characteristics of transmission lines. Surge Impedance Loading. Series and Shunt Compensation of transmission lines.

Transformers: Three-phase connections and Phase-shifts. Three-winding transformers, autotransformers, Neutral Grounding transformers. Tap-Changing in transformers. Transformer Parameters. Single phase equivalent of three-phase transformers.

Synchronous Machines: Steady-state performance characteristics. Operation when connected to infinite bus. Real and Reactive Power Capability Curve of generators. Typical waveform under balanced terminal short circuit conditions – steady state, transient and sub-transient equivalent circuits. Loads: Types, Voltage and Frequency Dependence of Loads. Per-unit System and per-unit calculations.

**UNIT III OVER-VOLTAGES AND INSULATION REQUIREMENTS (4)**

Generation of Over-voltages: Lightning and Switching Surges. Protection against Overvoltages, Insulation Coordination. Propagation of Surges. Voltages produced by traveling surges. Bewley Diagrams.

**UNIT-IV FAULT ANALYSIS AND PROTECTION SYSTEMS (4)**

Method of Symmetrical Components (positive, negative and zero sequences). Balanced and Unbalanced Faults. Representation of generators, lines and transformers in sequence networks. Computation of Fault Currents. Neutral Grounding. Switchgear: Types of Circuit Breakers. Attributes of Protection schemes, Back-up Protection.Protection schemes (Over-current, directional, distance protection, differential protection) and their application.

**UNIT V INTRODUCTION TO DC TRANSMISSION & RENEWABLE ENERGY SYSTEMS (9)**

DC Transmission Systems: Line-Commutated Converters (LCC) and Voltage Source Converters (VSC). LCC and VSC based dc link, Real Power Flow control in a dc link. Comparison of ac and dc transmission. Solar PV systems: I-V and P-V characteristics of PV panels, power electronic interface of PV to the grid. Wind Energy Systems: Power curve of wind turbine. Fixed and variable speed turbines. Permanent Magnetic Synchronous Generators and Induction Generators. Power Electronics interfaces of wind generators to the grid.

**SUGGESTED READINGS**

1. J. Grainger and W. D. Stevenson, “Power System Analysis”, McGraw Hill Education, 1994.
2. O. I. Elgerd, “Electric Energy Systems Theory”, McGraw Hill Education, 1995.
3. A. R. Bergen and V. Vittal, “Power System Analysis”, Pearson Education Inc., 1999.
4. D. P. Kothari and I. J. Nagrath, “Modern Power System Analysis”, McGraw Hill Education, 2003.
5. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, “Electric Power Systems”, Wiley, 2012.

**Semester – V**

**18BEEE502 CONTROL SYSTEMS 3H-3C**

**Instruction Hours / week: L:3 T: 0 P: 0** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3 Hours

**Course Objectives**

- To understand the use of transfer function models for analysis physical systems and introduce the control system components.
- To provide adequate knowledge in the time response of systems and steady state error analysis.
- To accord basic knowledge in obtaining the open loop and closed–loop frequency responses of systems.
- To introduce stability analysis
- To introduce state variable representation of physical systems
- To introduce the design of compensators.

**Course Outcomes (COs)**

1. Derive the transfer function of electrical and mechanical systems using various reduction techniques
2. Analyze the response of the control system by investigating steady state error and time domain specifications
3. Construct the root locus to find the stability of the system and explain the effects of different types of controller
4. Construct the frequency response of the system using various plots and correlate the time and frequency domain specifications and effect of compensation
5. Design the different types of compensators using frequency response plots to stabilize the control system
6. Explain the state variable representation of physical systems with the effects of state feedback its assessment for linear-time invariant systems.

**UNIT I INTRODUCTION TO CONTROL PROBLEM (4)**

Industrial Control examples. Mathematical models of physical systems. Control hardware and their models. Transfer function models of linear time-invariant systems. Feedback Control: Open-Loop and Closed-loop systems. Benefits of Feedback. Block diagram algebra.

**UNIT II TIME RESPONSE ANALYSIS (10)**

Standard test signals. Time response of first and second order systems for standard test inputs. Application of initial and final value theorem. Design specifications for second-order systems based on the time-response.

Concept of Stability. Routh-Hurwitz Criteria. Relative Stability analysis. Root-Locus technique. Construction of Root-loci.

**UNIT III FREQUENCY-RESPONSE ANALYSIS (6)**

Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion. Relative stability using Nyquist criterion – gain and phase margin. Closed-loop frequency response.

**UNIT-IV INTRODUCTION TO CONTROLLER DESIGN (10)**

Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems. Root-loci method of feedback controller design.

Design specifications in frequency-domain. Frequency-domain methods of design. Application of Proportional, Integral and Derivative Controllers, Lead and Lag compensation in designs. Analog and Digital implementation of controllers.

**UNIT V STATE VARIABLE ANALYSIS AND NON LINEAR CONTROL (11 )**

Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations. Eigen values and Stability Analysis. Concept of controllability and observability. Pole-placement by state feedback.

Discrete-time systems. Difference Equations. State-space models of linear discrete-time systems. Stability of linear discrete-time systems.

Performance Indices. Regulator problem, Tracking Problem. Nonlinear system–Basic concepts and analysis.

**SUGGESTED READINGS**

1. M. Gopal, “Control Systems: Principles and Design”, McGraw Hill Education, 1997.
2. B. C. Kuo, “Automatic Control System”, Prentice Hall, 1995.
3. K. Ogata, “Modern Control Engineering”, Prentice Hall, 1991.
4. I. J. Nagrath and M. Gopal, “Control Systems Engineering”, New Age International, 2009

**Semester – V**

**18BEEE503 MICROPROCESSORS 3H-3C**

**Instruction Hours / week: L:3 T: 0 P: 0** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3 Hours

**Course Objectives**

Students will learn

- Architecture of µP8085.
- Addressing modes & instruction set of 8085.
- Need & use of Interrupt structure 8085.
- Simple applications development with programming 8085.

- To Architecture of µP8051.
- Addressing modes & instruction set of 8051.

**Course Outcomes (COs)**

1. At the end of this course, students will demonstrate the ability to Explain about the architecture of 8051 microprocessor, pin configuration, interrupts and the timing diagram of 8085
2. Develop the assembly language program using mnemonics and corresponding machine code based on architecture of 8051 microprocessor
3. Define the 8051 microcontroller with its architecture, pinouts, memory organization, interupts and compare the programming concepts with 8051
4. Illustrate the interfacing of 8085 with various peripheral devices for transmission, reception and control of data
5. Make use of the data conversion technique such as ADC and DAC and to interface with 8085 processor and 8051 microcontroller
6. Develop the microcontroller assembly language program for various real time applications

**UNIT I FUNDAMENTALS OF MICROPROCESSORS (7)**

Fundamentals of Microprocessor Architecture. 8-bitMicroprocessor and Microcontroller architecture, Comparison of 8-bit microcontrollers, 16-bit and 32-bit microcontrollers. Definition of embedded system and its characteristics, Role of microcontrollers in embedded Systems. Overview of the 8051 family.

**UNIT II THE 8051 ARCHITECTURE (7)**

Internal Block Diagram, CPU, ALU, address, data and control bus, Working registers, SFRs, Clock and RESET circuits, Stack and Stack Pointer, Program Counter, I/O ports, Memory Structures, Data and Program Memory, Timing diagrams and Execution Cycles

**UNIT III INSTRUCTION SET AND PROGRAMMING (8)**

Addressing modes: Introduction, Instruction syntax, Data types, Subroutines Immediate addressing, Register addressing, Direct addressing, Indirect addressing, Relative addressing,

Indexed addressing, Bit inherent addressing, bit direct addressing. 8051 Instruction set, Instruction timings. Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instruction. Assembly language programs, C language programs. Assemblers and compilers. Programming and debugging tools.

**UNIT-IV MEMORY AND I/O INTERFACING (6)**

Memory and I/O expansion buses, control signals, memory wait states. Interfacing of peripheral devices such as General Purpose I/O, ADC, DAC, timers, counters, memory devices.

**UNIT V EXTERNAL COMMUNICATION INTERFACE AND APPLICATIONS (12)**

Synchronous and Asynchronous Communication. RS232, SPI, I2C. Introduction and interfacing to protocols like Blue-tooth and Zig-bee. LED, LCD and keyboard interfacing. Stepper motor interfacing, DC Motor interfacing, sensor interfacing.

**SUGGESTED READINGS**

1. M. A.Mazidi, J. G. Mazidi and R. D. McKinlay, “The8051Microcontroller and Embedded Systems: Using Assembly and C”,Pearson Education, 2007.
2. K. J. Ayala, “8051 Microcontroller”, Delmar Cengage Learning,2004.
3. R. Kamal, “Embedded System”, McGraw Hill Education,2009.
4. R. S. Gaonkar, “, Microprocessor Architecture: Programming and Applications with the 8085”, Penram International Publishing, 1996
5. D. A. Patterson and J. H. Hennessy, "Computer Organization and Design: The Hardware/Software interface”, Morgan Kaufman Publishers, 2013.
6. D. V. Hall, “Microprocessors & Interfacing”, McGraw Hill Higher Education,

Semester – V

## 18BEEE504 ENGINEERING ECONOMICS AND FINANCIAL MANAGEMENT 3H-3C

**Instruction Hours / week: L:3 T: 0 P: 0** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3 Hours

**Course Objectives**

- To know the fundamentals of cost analysis and economics.
- To learn about the basics of economics and cost analysis related to engineering so as to take economically sound decisions.
- To make the students to understand capital market, break-even point analysis and depreciation
- To know economic evaluation and financial analysis of investments and projects.
- To know the financial management and stock exchanges.

**Course Outcomes (COs)**

At the end of this course, students will demonstrate the ability to

1. Understand the principles and basic concepts.
2. Understand the fundamentals of cost analysis and economics.
3. Understand the methodology of engineering economy and source of finance
4. Perform economic evaluation and financial analysis of investments and projects.
5. Analyse the financial management and stock exchanges.
6. Analyse the capital market, break even point analysis and depreciation for a project.

**UNIT I FUNDAMENTALS OF ENGINEERING ECONOMICS 9**

Introduction to Engineering Economics – Definition and Scope – Significance of Engineering Economics- Demand and supply analysis-Definition – Law of Demand – Elasticity of Demand – Demand Forecasting. Supply – Law of supply – Elasticity of Supply.

**UNIT II FINANCIAL MANAGEMENT 9**

Objectives and functions of financial management – financial statements, working capital management– factors influencing working capital requirements – estimation of working capital. Capital budgeting - Need for Capital Budgeting – Project Appraisal Methods - Payback Period – ARR – Time Value of Money.

**UNIT III CAPITAL MARKET 9**

Stock Exchanges – Functions – Listing of Companies – Role of SEBI – Capital Market Reforms. Money and banking - Money – Functions –Inflation and deflation – Commercial Bank and its functions – Central bank and its functions.

**UNIT IV NEW ECONOMIC ENVIRONMENT 9**

National Income – concepts – methods of calculating national income - Economic systems, economic Liberalization –Privatization – Globalization. An overview of International Trade – World Trade Organization – Intellectual Property Rights.

**UNIT V COST ANALYSIS AND BREAK EVEN ANALYSIS 9**

Cost analysis - Basic cost concepts – FC, VC, TC, MC – Cost output in the short and long run. Depreciation - meaning – Causes – Methods of computing Depreciation (simple problems in Straight

Line Method, Written Down Vale Method). Meaning – Break Even Analysis - Managerial uses of BEA.

**SUGGESTED READINGS**


**1.** Ramachandra Aryasri .A, and V. V.Ramana Murthy Tata McGraw Hill,–,New Delhi 2007

2. Varshney R. L., and K.L Maheshwari Managerial Economics Sultan Chand & Sons, New Delhi 2001.

3. M.L.Jhingan Principles of Economics Konark Publications 2010.

4. Prasanna Chandra Fundamentals of Financial Management Tata McGraw Hill, New Delhi. 2007

Semester – V

**18BEEE511 POWER SYSTEMS LABORATORY-I 2H-1C**

**Instruction Hours / week: L:0 T: 0 P: 2** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3 Hours

**Course Objectives**

Students will learn

- The various line parameters
- The voltage regulation and efficiency of different types of transmission lines.
- A network under symmetrical fault conditions and interpret the results
- A network under unsymmetrical fault conditions and interpret the results
- The Bus impedance and admittance Matrix
- Acquire software development skills and experience in the usage of standard package necessary for analysis and simulation of power system required for its planning, operation and control.

**Course Outcomes (COs)**

1. Analyze the various line parameters
2. Evaluate the voltage regulation and efficiency of different types of transmission lines.
3. Analyze a network under symmetrical fault conditions and interpret the results
4. Analyze a network under unsymmetrical fault conditions and interpret the results
5. Evaluate the Bus impedance Matrix
6. Evaluate the Bus admittance Matrix

**LIST OF EXPERIMENTS**

1. Visit Local Substation.
2. Computation of Line Parameters.
3. Find the Voltage Regulation And Efficiency Of A Medium Transmission Line Using Nominal T Method Through Scilab
4. Find the Voltage Regulation And Efficiency Of A Medium Transmission Line Using Nominal Pi Method Through Scilab
5. Find the Voltage Regulation And Efficiency Of a Short Transmission Line through Sci lab
6. Formation of Bus Impedance Matrix
7. Formation of Bus Admittance Matrix
8. Symmetrical Fault Analysis
9. Unsymmetrical Fault Analysis

Semester – V

**18BEEE512 CONTROL SYSTEMS LABORATORY 2H-1C**

**Instruction Hours / week: L:0 T: 0 P: 2** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3 Hours

**Course Objectives**

Students will learn

- To provide a platform for understanding the basic concepts of linear control theory and its application to practical systems
- The transfer functions of DC Shunt Motor.
- To find the frequency response of different compensators
- To find the step response of P Controller.
- To find the step response of PI & PID Controller.
- To identify the type of damping from the given Characteristic equation.
- The speed control of Dc motor..

**Course Outcomes (COs)**

- Determine the transfer function of DC Shunt Motor.
- Ability to find the frequency response of different compensators
- Ability to find the step response of P Controller.
- Ability to find the step response of PI & PID Controller.
- Ability to identify the type of damping from the given Characteristic equation.
- Evaluate the speed control of Dc motor.

**LIST OF EXPERIMENTS**

1. Transfer function of separately Excited DC generator.
2. Transfer function of armature controlled DC shunt motor.
3. Transfer function of field controlled DC shunt motor.
4. Transfer function of AC servomotor.
5. Step response of P, PI, and PID controllers.
6. Identification of type of damping from the given characteristic equation of second order system.
7. Simulation of step response & step response of second order under damped system using ‘C’ and Scilab.
8. Frequency response of Lead compensator network.
9. Frequency response of Lag compensator network.
10. DC Motor speed control.

**Semester – V**

**18BEEE513 MICROPROCESSORS LABORATORY 2H-1C**

**Instruction Hours / week: L:0 T: 0 P: 2** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3 Hours

## OBJECTIVES

On completion of the course, students are able to:

- To understand the basic architecture of 8- bit microprocessors.
- Able to write programs on 8085 microprocessor based systems.
- Identify the addressing modes of an instruction.
- Develop programming skills in assembly language.
- To know the different interfacing system with 8085
- To know the different interfacing system with 8051

## COURSE OUTCOMES(COs)

1. Apply the basic arithmetic and logical operations using 8085 microprocessor with the help of assembly language programming
2. Analyze the performance of different weighted and non weighted codes, its conversions with logic diagram using 8085 microprocessor
3. Illustrate the interfacing of 8085 with various peripheral devices for serial and parallel communication of data
4. Demonstrate the basic instructions with 8051 microcontroller execution including conditional jumps, looping and calling subroutines
5. Make use of the basic conversion techniques of ADC and DAC to interface it with 8085 processor and 8051 microcontroller
6. Develop a model using processor to apply computing platform and software for engineering problems

## LIST OF EXPERIMENTS

**8-bit Microprocessor**

**8085 Microprocessor**

1. Simple arithmetic operations

- Multi precision addition / subtraction / multiplication / division

2. Programming with control instructions

- Increment / Decrement
- Ascending / Descending order
- Maximum / Minimum of numbers

- Rotate instructions.
- Hex / ASCII / BCD code conversions

3. Interface Experiments
   - A/D Interfacing
   - D/A Interfacing
   - Traffic light controller
4. Simple Interfacing experiments using 8251, 8279 and 8254
5. Programming practice on assembler and simulator tools.

**8051 Microcontroller**

6. Demonstration of basic instructions with 8051 Micro controller execution, including
   - Conditional jumps, looping
   - Calling subroutines
   - Stack parameter testing
7. Parallel port programming with 8051 using port 1 facility
   - Stepper motor and D/A converter
8. Programming Exercise on
   - RAM direct addressing
   - Bit addressing
9. Programming practice using simulation tools and C - compiler
   - Initialize timer
   - Enable interrupts
10. Study of micro controllers with flash memory.

**Semester-VI**

**18BEEE601 TOTAL QUALITY MANAGEMENT 3H-3C**

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objective**

- To understand the Total Quality Management concept and principles and the various tools available to achieve Total Quality Management.
- To understand the statistical approach for quality control.
- To create an awareness about the ISO and QS certification process and its need for the industries.
- To learn the concepts of total quality management.
- To learn the concepts of total education
- To learn problems in the quality improvement process,SPC etc

**Course Outcome**

At the end of this course, students will demonstrate the ability to

1. Understand the principles and basic concepts.
2. Understnd the fundamentals of quality controls.
3. Explain the concepts of total quality management.
4. Explain the concepts of total education
5. Diagnose problems in the quality improvement process,SPC etc.
6. Diagnose problems in the production planning,control and decision making.

**UNIT I INTRODUCTION**

Definition of Quality, Dimensions of Quality, Quality Planning, Quality Costs-Analysis Techniques For Quality Costs, Basic concepts of Total Quality Management, Historical Review, Principles of TQM, Leadership–Concepts, Role of Senior Management, Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers to TQM Implementation.

**UNIT II TQM PRINCIPLES**

Customer satisfaction– Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement– Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits, Continuous Process Improvement–Juran Trilogy, PDSA Cycle, 5S, Kaizen, Supplier Partnership– Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures– Basic Concepts, Strategy, Performance Measure.

**UNIT III STATISTICAL PROCESS CONTROL(SPC)**

The seven tools of quality, Statistical Fundamentals–Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Process capability, Concept of six sigma, New seven Management tools.

**UNIT IV TQM TOOLS**

Bench marking–Reasons to Benchmark, Bench marking Process, Quality Function Deployment(QFD)

– House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM)–Concept, Improvement Needs, FMEA–Stages of FMEA.

**UNIT V QUALITY SYSTEMS**

Need for ISO 9000 and Other Quality Systems, ISO 9000:2000 Quality System–Elements, Implementation of Quality System, Documentation, Quality Auditing, QS9000, ISO 14000–Concept, Requirements and Benefits.

**Suggested Readings**


1. Dale H. Besterfiled Total Quality Management Pearson Education 2003
2. James R.Evans& William M.Lidsay The Management and Control of Quality South-Western (Thomson Learning) 2002
3. L. Suganthi, Anand A. Samuel Total Quality Management PHI Learning 2011
4. Shridhara Bhat K, Total Quality Management – Text and Cases, Himalaya Publishing House, First Edition 2002.
5. B. Janakiraman, R. K. Gopal Total Quality Management: Text And Cases PHI Learning Pvt 2006.

**Semester – VI**

**18BEEE602 POWER SYSTEMS – II 3H-3C**

**Instruction Hours / week: L:3 T: 0 P: 0** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3 Hours

**Course Objectives**

- To model the power system under steady state operating condition
- To understand and apply iterative techniques for power flow analysis
- To model and carry out short circuit studies on power system
- To model and analyze stability problems in power system
- To study the monitoring and control of a power systems.
- To study the basics of power system economics.

**Course Outcomes (COs)**

At the end of this course, students will demonstrate the ability to

1.Use numerical methods to analyse a power system in steady state.
2. Understand stability constraints in a synchronous grid.
3. Understand methods to control the voltage, frequency.
4. Understand methods to control the power flow.
5. Understand the monitoring and control of a power system.
6. Understand the basics of power system economics.

**UNIT I POWER FLOW ANALYSIS (7 )**

Review of the structure of a Power System and its components. Analysis of Power Flows: Formation of Bus Admittance Matrix. Real and reactive power balance equations at a node. Load and Generator Specifications. Application of numerical methods for solution of nonlinear algebraic equations – Gauss Seidel and Newton-Raphson methods for the solution of the power flow equations. Computational Issues in Large-scale Power Systems.

**UNIT II STABILITY CONSTRAINTS IN SYNCHRONOUS GRIDS (8)**

Swing Equations of a synchronous machine connected to an infinite bus. Power angle curve. Description of the phenomena of loss of synchronism in a single-machine infinite bus system following a disturbance like a three--phase fault. Analysis using numerical integration of swing equations (using methods like Forward Euler, Runge-Kutta 4th order methods), as well as the Equal Area Criterion. Impact of stability constraints on Power System Operation. Effect of generation rescheduling and series compensation of transmission lines on stability.

**UNIT III CONTROL OF FREQUENCY AND VOLTAGE (7)**

Turbines and Speed-Governors, Frequency dependence of loads, Droop Control and Power Sharing. Automatic Generation Control. Generation and absorption of reactive power by various components of a Power System. Excitation System Control in synchronous generators, Automatic Voltage Regulators. Shunt Compensators, Static VAR compensators

and STATCOMs. Tap Changing Transformers.Power flow control using embedded dc links, phase shifters.

**UNIT-IV MONITORING AND CONTROL (6)**

Overview of Energy Control Centre Functions: SCADA systems. Phasor Measurement Units and Wide-Area Measurement Systems. State-estimation. System Security Assessment. Normal, Alert, Emergency, Extremis states of a Power System. Contingency Analysis. Preventive Control and Emergency Control.

**UNIT V POWER SYSTEM ECONOMICS AND MANAGEMENT (7)**

Basic Pricing Principles: Generator Cost Curves, Utility Functions, Power Exchanges, Spot Pricing. Electricity Market Models (Vertically Integrated, Purchasing Agency, Whole-sale competition, Retail Competition), Demand Side-management, Transmission and Distributions charges, Ancillary Services. Regulatory framework

**SUGGESTED READINGS**

1. J. Grainger and W. D. Stevenson, “Power System Analysis”, McGraw Hill Education, 1994.
2. O. I. Elgerd, “Electric Energy Systems Theory”, McGraw Hill Education, 1995.
3. A. R. Bergen and V. Vittal, “Power System Analysis”, Pearson Education Inc., 1999.
4. D. P. Kothari and I. J. Nagrath, “Modern Power System Analysis”, McGraw Hill Education, 2003.
5. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, “Electric Power Systems”, Wiley, 2012.

**Semester – VI**

**18BEEE603 MEASUREMENTS AND INSTRUMENTATION 3H-3C**

**(THEORY & LAB)**

**Instruction Hours / week: L:2 T: 0 P: 2** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3 Hours

**Course Objectives**

- To study the units, dimensions and standards.
- To study the different types of measuring instruments.
- To provide adequate knowledge in electrical and electronic measurement techniques and Instruments.
- To make the students to have a clear knowledge of the basic laws governing the operation of the instruments, relevant circuits and their working.
- Introduction to general instrument system, error, calibration etc.
- Emphasis is laid on analog and digital techniques used to measure voltage, current, energy and power, etc.

**Course Outcomes (COs)**

At the end of the course the students will have

1. Learn units, dimensions and standards.
2. Learn basics of different types of measuring instruments to measure different electrical quantites
3. Apply their knowledge to measure electrical quantities using standard analog and digital measuring instruments
4. basic knowledge of measurement systems towards measurements, including error analysis, interpretation, experimental uncertainty, calibration, etc.
5. To apply basic concepts of measurement systems with electrical signals, including signal conditioners (gain, attenuation), indicating and recording devices
6. Measure different electrical parameters using conventional bridges and acquire data through digital measuring instruments and interpret the data.

**UNIT I INTRODUCTION 9**

Functional elements of an instrument – Units and standards of measurements – Static and dynamic characteristics – Sources of Errors in measurement – DC and AC bridges –Wheatstone, Kelvin's double, Maxwell, Anderson, Wien and Schering bridges–Measurement of high resistance – Standards and calibration.

**UNIT II MEASURING INSTRUMENTS 9**

Classification of instruments – working principle of potentiometers – Principle of operation and construction of PMMC, MI, type instruments – Principle types and working of analog and digital voltmeters, ammeters and multimeters – Determination of B–H curve and measurement of iron loss – Instrument transformers – CT and PT – Instruments for measurement of frequency and phase.

**UNIT III MEASUREMENT OF POWER AND ENERGY 9**

Dynamometer type wattmeter – Single and three phase wattmeter's – Induction type instruments – Single and three phase energy meters – calibration of energy meters – direct and phantom loading – Grounding techniques – Megger - Power factor meter- Principle of operation, construction and types of digital frequency meters, Digital Energy meters.

**UNIT IV STORAGE, DISPLAY DEVICES AND TRANSDUCERS 9**

Magnetic measurements – Magnetic disk and tape–recorders – Strip chart recorder – XY recorder. Digital plotters and printers – Cathode ray Oscilloscope– digital CRO and dot matrix display. Classification of transducers – Selection of transducers – Resistive – capacitive and inductive transducers – LVDT – Piezo-electric, optical and digital transducers.

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**UNIT V VIRTUAL INSTRUMENTATION 9**

Concept of VIs and sub VI - Display types – Digital – Analog – Chart and Graphs. Loops - structures - Arrays – Clusters. Local and global variables – String and file I/O. Timers and dialog control.

**SUGGESTED READINGS**

**1.** Doebelin. E.O. Measurement Systems Application and Design Tata McGraw Hill Publishing Company, New Delhi. Tata McGraw Hill 2003.

2. Sawhney. A. K. A Course in Electrical and Electronic Measurements and Instrumentation Dhanpat Rai and Co.,New Delhi. 2011

3. Sanjay Gupta and Joseph John Virtual Instrumentation using LabVIEW Tata McGraw Hill Publishing Company Ltd., 2nd Edition 2010

## ii) MEASUREMENTS AND INSTRUMENTATION LABORATORY

**Course Objectives**

- To deal with measurement of inductance and capacitance.
- To deal with measurement of resistance.
- To deal with calibration of current transformer
- To deal with calibration of single phase energy meter.
- To get the knowledge of two watt meter method to measure 3 phase power and power factor
- To deal with calibration of voltmeter, ammeter and wattmeter.

**Course Outcomes (COs)**

At the end of this course, students will demonstrate the ability to

1. Train the students in the measurement of displacement, resistance, inductance, torque and angle etc.,
2. Give exposure to ac, dc bridges
3. Give knowledge on transient measurement.
4. Understand the procedure and usage of instruments
5. Acquire knowledge of principle of calibration of a measuring instrument and Plotting of calibration curves
6. Acquire hand-on experience on measurement of parameters and verification of Laws of illumination

**LIST OF EXPERIMENTS**

1. Calibration of Pressure and Displacement Transducer.
2. Measurement of inductance & capacitance.
3. Measurement of resistance using wheatstone bridge
4. Calibration of current transformer and Study of instrument transformers.
5. Calibration of single phase energy meter.
6. Conversion of Galvanometer into Voltmeter and Ammeter.
7. Measurement of three phase power and power factor using two wattmeter method.
8. Measurements of resistance using Kelvin's bridge.
9. Calibration of Voltmeter, Ammeter and Wattmeter
10. Study of phantom loading.
11. Study of Smart Energy Meter.

Semester – VI

**18BEEE611 POWER SYSTEMS LABORATORY -II 2H-1C**

**Instruction Hours / week: L:0 T: 0 P: 2** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3 Hours

**Course Objectives**

- To acquire software development skills
- To know usage of standard package necessary for analysis
- To know the simulation of power system required for its planning, operation and control.
- To study economic dispatch in power system
- To study electromagnetic transients and its impact in power system studies
- To study the Fast-Decoupled Methods for load flow analysis to an electrical power network and interpret the results

**Course Outcomes (COs)**

1. Apply load flow analysis to an electrical power network and interpret the results using Gauss-Seidel and Newton Raphson Methods.
2. Apply load flow analysis to an electrical power network and interpret the results using Fast-Decoupled Methods.
3. Explain the transient stability analysis of single and multi machine infinite bus system
4. Examine the electromagnetic transients and its impact in power system studies
5. Evaluate the frequency dynamics, economic dispatch of single and two area power systems.
6. Evaluate the Economic dispatch in power systems

**LIST OF EXPERIMENTS**

1.Load Flow Analysis - I: Solution of Load Flow and related Problems using Gauss-Seidel Method

2.Load Flow Analysis - II: Solution of Load Flow and related Problems using Newton-Raphson and Fast-Decoupled Methods.

3.Load Flow Analysis - III: Solution of Load Flow and related Problems using - II: Fast-Decoupled Methods .

4.Transient and Small Signal Stability Analysis: Single-Machine Infinite Bus System

5.Transient Stability Analysis of Multi-machine Power Systems

6.Electromagnetic Transients in Power Systems.

7.Load – Frequency Dynamics of Single- Area Systems.

8. Load – Frequency Dynamics of Two-Area Systems

9.Economic Dispatch in Power Systems without considering transmission losses.

10.Economic Dispatch in Power Systems with transmission losses.

Semester – VI

**18BEEE612 ELECTRONICS DESIGN LABORATORY 5H-3C**

**Instruction Hours / week: L:1 T: 0 P: 4** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3 Hours

**Course Objectives**

- To understand the design procedure of DC bridge for Resistance measurement.
- To know to design transmitter and voltage regulator.
- To understand the working of Microcontroller based system design.
- To study PCB design
- To study about timer
- To know about the Instrumentation amplifier and Digital Indicator

**Course Outcomes (COs)**

1. Design different process control timer.
2. Design Voltage regulators
3. AM/FM transreceiver.
4. Know the design procedure of Instrumentation amplifier and Digital Indicator.
5. Learn PCB layout design.
6. Learn timer and appliction

**LIST OF EXPERIMENTS**

1. Designing DC bridge for Resistance Measurement (Quarter, Half and Full bridge)
2. Design of process control timer
   Design a sequential timer to switch on & off at least 3 relays in a particular sequence using timer IC.
3. Microcontroller based systems design
   Design of microcontroller based system for simple applications like security systems combination lock etc. using 89c series flash micro controller.
4. Design of DC power supply
5. Frequency Multiplier using PLL.
6. Sequence generator using Digital IC
7. PCB Design for simple circuits using suitable simulation software
8. Study and design of series linear regulators.
9. Design of AM transmitter using 555 timer

**Semester-VII**

**18BEEE701 PROFESSIONAL ETHICS 3H-3C**

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objective**

- To enable the students to create an awareness on Engineering Ethics and Human Values, to instill Moral and Social Values and Loyalty and to appreciate the rights of others.
- To study ethics in society and realize the responsibilities and rights in the society
- To study advanced philosophical knowledge of the profession of recreation and leisure
- To study synthesis of trends and issues as related to current professional practice
- To evaluation of organizational theories and human resource management principles
- To study the ethical practice and ethical management

**Course Outcome**

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

- Apply ethics in society and realize the responsibilities and rights in the society
- Discuss the ethical issues related to engineering
- Advanced philosophical knowledge of the profession of recreation and leisure
- Synthesis of trends and issues as related to current professional practice
- Evaluation of organizational theories and human resource management principles
- Ethical practice and ethical management

**UNIT I HUMAN VALUES**

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

**UNIT II ENGINEERING ETHICS**

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles – Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories

**UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION**

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

**UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS**

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination

**UNIT V GLOBAL ISSUES**

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility

**Suggested Readings**


1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.
   Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.
2. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
3. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009
4. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003
5. Edmund G Seebauer and Robert L Barry, "Fundametals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001
6. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility" Mc Graw Hill education, India Pvt. Ltd.,New Delhi 2013.
7. World Community Service Centre, ' Value Education', Vethathiri publications, Erode, 2011


**web sources**

1. www.onlineethics.org
2. www.nspe.org
3. www.globalethics.org
4. www.ethics.org

Semester – V

**18BEEE5E01 Electrical Machine Design 3H-3C**

**Instruction Hours / week: L:3 T: 0 P: 0** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3 Hours

**Course Objectives**

- To study mmf calculation and thermal rating of various types of electrical machines.
- To design armature and field systems for D.C. machines.
- To design core, yoke, windings and cooling systems of transformers.
- To design stator and rotor of induction machines.
- To design stator and rotor of synchronous machines and study their thermal behaviour.
- To study the simulation of stator and rotor of induction machines.
- To design stator and rotor of synchronous machines and study their thermal behaviour.

**Course Outcomes (COs)**

At the end of this course, students will demonstrate the ability to

1. Understand the construction of electrical machines.
2. Understand the various factors which influence the design: electrical, magnetic and thermal loading of electrical machines
3. Understand the principles of electrical machine design
4. Carry out a basic design of an AC and DC machine.
5. Use software tools to do design calculations.
6. Understand performance characteristics of electrical machines

**UNIT I INTRODUCTION 9**

Major considerations in electrical machine design, electrical engineering materials, space factor, choice of specific electrical and magnetic loadings, thermal considerations, heat flow, temperature rise, rating of machines.

**UNIT II TRANSFORMERS 9**

Sizing of a transformer, main dimensions, kVA output for single- and three-phase transformers, window space factor, overall dimensions, operating characteristics, regulation, no load current, temperature rise in transformers, design of cooling tank, methods for cooling of transformers.

**UNIT III INDUCTION MOTORS 9**

Sizing of an induction motor, main dimensions, length of air gap, rules for selecting rotor slots of squirrel cage machines, design of rotor bars & slots, design of end rings, design of wound rotor, magnetic leakage calculations, leakage reactance of polyphase machines, magnetizing current, short circuit current, circle diagram, operating characteristics.

**UNIT- IV SYNCHRONOUS MACHINES 9**

Sizing of a synchronous machine, main dimensions, design of salient pole machines, short circuit ratio, shape of pole face, armature design, armature parameters, estimation of air gap length, design of rotor, design of damper winding, determination of full load field mmf, design of field winding, design of turbo alternators, rotor design.

**UNIT V COMPUTER AIDED DESIGN (CAD)** **9**

Limitations (assumptions) of traditional designs, need for CAD analysis, synthesis and hybrid methods, design optimization methods, variables, constraints and objective function, problem formulation. Introduction to FEM based machine design. Introduction to complex structures of modern machines-PMSMs, BLDCs, SRM and claw-pole machines.

**SUGGESTED READINGS**

1. A. K. Sawhney, "A Course in Electrical Machine Design", Dhanpat Rai and Sons, 1970.
2. M.G. Say, "Theory & Performance & Design of A.C. Machines", ELBS London.
3. S. K. Sen, "Principles of Electrical Machine Design with computer programmes", Oxford and IBH Publishing, 2006.
4. K. L. Narang, "A Text Book of Electrical Engineering Drawings", SatyaPrakashan, 1969.
5. A. Shanmugasundaram, G. Gangadharan and R. Palani, "Electrical Machine Design Data Book", New Age International, 1979.
6. K. M. V. Murthy, "Computer Aided Design of Electrical Machines", B.S. Publications, 2008.
7. Electrical machines and equipment design exercise examples using Ansoft's Maxwell 2D machine design package.

Semester – V

**18BEEE5E02 INDUSTRIAL AUTOMATION 3H-3C**

**Instruction Hours / week: L:3 T: 0 P: 0** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3 Hours

## Course Objectives

- To study and gain knowledge about various sensors.
- To study and gain knowledge about controllers.
- To study the concept of sensors,
- To study the concept of actuators
- To study the various tuning controllers
- To study the application of SCADA.

## Course Outcomes (COs)

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

1. Understand the concept of sensors,
2. Understand the concept of actuators
3. Analyse the various tuning controllers
4. Analyse the various advanced control techniques used in industrial automation.
5. Understand the application of SCADA.
6. Analyse the SCADA usage in Industries.

**UNIT I SENSORS, ACTUATORS 9**

Sensors, Actuators and Signal conditioning Sensors: Displacement sensors, Force sensors, Ultrasonic sensors, Temperature sensors, Pressure sensors etc Actuators: Dc motors, Servo motors, Stepper motors, Piezoelectric actuators, Pneumatic actuators etc. Signal Conditioning: Filtering, Amplifying, Isolation, ADC, DAC, Sensor protection circuits, Signal transmission and noise suppression, Estimation of errors and calibration.

**UNITII CONTROLLER TUNING 9**

PIcontroller,PDcontroller,PIDcontrollerandtuningmethods:Ziegler-Nicholstuningmethod, Cohen coon tuning method, Implementation of PID controllers (digital and analog).

**UNITIII AUTOMATION 9**

PLC(Programmablelogiccontrollers):Overview,operationandarchitecture,PLCprogramming, Application examples. DCS (Distributed control systems): Overview, Advantages, Functional requirements of Distributed control systems, Communication for distributed control

**UNITIV APPLICATIONS 9**

Application examples SCADA (supervisory control and data acquisition): Introduction to SCADA, SCADA system components, architecture and communication, SCADA applications.

**UNITV ADVANCED CONTROLTECHNIQUES 9**

Feed forward control, Ratio control,Cascade control,Adaptive control,Duplex or split range control, Override control, internal mode control.

**SUGGESTED READINGS**

1. Krishna Kant Computer-Based Industrial Control 2nd edition Prentice Hall of India Ltd 2003.
2.Stephanopoulous Chemical Process Control– Theory and Practice Prentice Hall of India Ltd 2014

Semester – V

**18BEEE5E03 SENSOR AND TRANDUCER 3H-3C**

**Instruction Hours / week: L:3 T: 0 P: 0** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3 Hours

## Course Objectives

- It deals with various types of Sensors & Transducers and their working principle
- It deals with resistive transducers
- It deals with capative transducers
- It deals with inductive transducers
- It deals with some of the miscellaneous transducers
- It deals with characteristics of transducers

**Course Outcomes (COs)**

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

1. understand all types of sensors and transducers.
2. Justify the concept and working principle of different transducers and sensors
3 Justify the transducers that will be utilised in the electrical industries
4. Identify recent developments in transducer domain
5. Discover the knowledge for small technology up gradations in it
6. Analysis the real time application.

**UNIT I INTRODUCTION OF TRANSDUCERS 9**

Transducer – Classification of transducers – Basic requirement of transducers.

**UNIT II CHARACTERISTICS OF TRANSDUCERS 9**

Static characteristics – Dynamic characteristics – Mathematical model of transducer – Zero, first order and second order transducers – Response to impulse, step, ramp and sinusoidal inputs.

**UNIT III RESISTIVE TRANSDUCERS 9**

Potentiometer –Loading effect – Strain gauge – Theory, types, temperature compensation – Applications – Torque measurement – Proving Ring – Load Cell – Resistance thermometer – Thermistors materials – Constructions, Characteristics – Hot wire anemometer.

**UNIT IV INDUCTIVE AND CAPACITIVE TRANSDUCER 9**

Self inductive transducer – Mutual inductive transducers– LVDT Accelerometer – RVDT – Synchros – Microsyn – Capacitive transducer – Variable Area Type – Variable Air Gap type – Variable Permittivity type – Capacitor microphone.

**UNIT V MISCELLEANEOUS TRANSDUCERS 9**

Piezoelectric transducer – Hall Effect transducers – Smart sensors – Fiber optic sensors – Film sensors – MEMS – Nano sensors, Digital transducers.

**TOTAL: 45 HOURS**

**SUGGESTED READINGS**

1. Sawhney A.K, A Course in Electrical and Electronics Measurements and Instrumentation, 18th Edition, Dhanpat Rai & Company Private Limited,2007
2. Renganathan. S, Transducer Engineering, Allied Publishers, Chennai,2003.
3. Doebelin. E.A, Measurement Systems – Applications and Design, Tata McGraw Hill, New York,2000
4. Patranabis. D Sensors and Transducers PHI Learning Pvt. Ltd. 2003
5. John. P, Bentley Principles of Measurement Systems III Edition, Pearson Education 2000

**Semester – VI**

**18BEEE6E01 Digital Control Systems 3H-3C**

**Instruction Hours / week: L:3 T: 0 P: 0** **Marks:** Internal: **40** External: **60** Total: **100**
**End Semester Exam:** 3 Hours

**Course Objectives**

- To study the importance of sample data control system.
- To give adequate knowledge about signal processing in digital control.
- To study the importance of modeling of discrete systems and stability analysis of discrete data system.
- To study the importance of state space representation for discrete data system.
- To introduce the design concept for digital controllers
- To study different application of it

**Course Outcomes (COs)**

At the end of this course, students will demonstrate the ability to

1.Obtain discrete representation of LTI systems.
2.Analyse stability of open loop and closed loop discrete-time systems.
3.Design and analyse digital controllers.
4.Design state feedback and output feedback controllers.
5. Analysis the real time application of digital controllers.
6. Analysis the real time application of State space approach

**UNIT I DISCRETE REPRESENTATION OF CONTINUOUS SYSTEMS (6)**

Basics of Digital Control Systems. Discrete representation of continuous systems. Sample and hold circuit. Mathematical Modelling of sample and hold circuit. Effects of Sampling and Quantization. Choice of sampling frequency. ZOH equivalent.

**UNIT II DISCRETE SYSTEM ANALYSIS (10 )**

Z-Transform and Inverse Z Transform for analyzing discrete time systems. Pulse Transfer function. Pulse transfer function of closed loop systems. Mapping from s-plane to z plane. Solution of Discrete time systems. Time response of discrete time system. Stability analysis by Jury test. Stability analysis using bilinear transformation. Design of digital control system with dead beat response. Practical issues with dead beat response
design.

**UNIT- III STATE SPACE APPROACH FOR DISCRETE TIME SYSTEMS (10)**

State space models of discrete systems, State space analysis. Lyapunov Stability. Controllability, reach-ability, Re constructibility and observability analysis. Effect of pole zero cancellation on the controllability & observability.

**UNIT IV DESIGN OF DIGITAL CONTROL SYSTEM (8)**

Design of Discrete PID Controller, Design of discrete state feedback controller. Design of set point tracker. Design of Discrete Observer for LTI System. Design of Discrete compensator.

**UNIT V DISCRETE OUTPUT FEEDBACK CONTROL (8)**

Design of discrete output feedback control. Fast output sampling (FOS) and periodic output feedback controller design for discrete time systems.

**SUGGESTED READINGS**

1. K. Ogata, "Digital Control Engineering", Prentice Hall, Englewood Cliffs, 1995.
2. M. Gopal, "Digital Control Engineering", Wiley Eastern, 1988.
3. G. F. Franklin, J. D. Powell and M. L. Workman, "Digital Control of Dynamic Systems", Addison-Wesley, 1998.

**Semester – VI**

**18BEEE6E02 Digital Signal Processing 3H-3C**

**Instruction Hours / week: L:3 T: 0 P: 0** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3 Hours

**Course Objectives**

- To introduce discrete Fourier transform and its applications.
- To teach the design of infinite and finite impulse response filters for filtering undesired signals.
- To introduce signal processing concepts in systems having more than one sampling frequency.
- To study the DFT algorithms.
- To study the FFT algorithms
- To study the different types of application of it

**Course Outcomes (COs)**

At the end of this course, students will demonstrate the ability to

1. Represent signals mathematically in continuous and discrete-time, and in the frequency domain.
2. Analyse discrete-time systems using z-transform.
3. Understand the Discrete-Fourier Transform (DFT) and the FFT algorithms.
4. Design digital filters for various applications.
5. Apply digital signal processing for the analysis of real-life signals.
6. Analysis the real time application of it.

**UNIT I DISCRETE-TIME SIGNALS AND SYSTEMS (6)**

Discrete time signals and systems: Sequences; representation of signals on orthogonal basis; Representation of discrete systems using difference equations, Sampling and reconstruction of signals - aliasing; Sampling theorem and Nyquist rate.

**UNIT II Z-TRANSFORM (6)**

z-Transform, Region of Convergence, Analysis of Linear Shift Invariant systems using z transform, Properties of z-transform for causal signals, Interpretation of stability in z-domain, Inverse z-transforms.

**UNIT III : DISCRETE FOURIER TRANSFORM (10)**

Frequency Domain Analysis, Discrete Fourier Transform (DFT), Properties of DFT, Convolution of signals, Fast Fourier Transform Algorithm, Parseval's Identity, Implementation of Discrete Time Systems.

**UNIT- IV DESIGNOF DIGITAL FILTERS (12)**

Design of FIR Digital filters: Window method, Park-McClellan's method. Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations; Low-pass, Band-pass, Band stop and High-pass filters. Effect of finite register length in FIR filter design. Parametric and non-parametric spectral estimation. Introduction to multi-rate signal processing.

**UNIT V APPLICATIONS OF DIGITAL SIGNAL PROCESSING (6 )**

Correlation Functions and Power Spectra, Stationary Processes, Optimal filtering using ARMA Model, Linear Mean-Square Estimation, Wiener Filter.

**SUGGESTED READINGS**

1. S. K. Mitra, “Digital Signal Processing: A computer based approach”, McGraw Hill, 2011.
2. J. G. Proakis and D.G. Manolakis, “Digital Signal Processing: Principles, Algorithms And Applications”, Prentice Hall, 1997.
3. L. R. Rabiner and B. Gold, “Theory and Application of Digital Signal Processing”, Prentice Hall,
1992.
4. J. R. Johnson, “Introduction to Digital Signal Processing”, Prentice Hall, 1992.
5. D. J. DeFatta, J. G. Lucas andW. S. Hodgkiss, “Digital Signal Processing”, John Wiley & Sons, 1988.

**Semester – VI**

| **18BEEE6E03** | **Computer Architecture** | **3H-3C** |
|---|---|---|

**Instruction Hours / week: L:3 T: 0 P: 0** **Marks:** Internal: **40** External: **60** Total: **100**
**End Semester Exam:** 3 Hours

**Course Objectives:**

- To study the various representations of data, register transfer language for micro–operations and organization and design of a digital computer.
- To study the concepts of microprocessors, their principles and practices
- To study the write efficient programs in assembly language of the 8086 family of microprocessors.
- To study a modern computer system and be able to relate it to real examples.
- To study the programs in assembly language for 80286, 80386 and MIPS processors in real and protected modes.
- To learn the embedded applications using ATOM processor.

**Course Outcomes:**

At the end of this course, students will demonstrate the ability to

1. Understand the concepts of microprocessors, their principles and practices.
2. Write efficient programs in assembly language of the 8086 family of microprocessors.
3. Organize a modern computer system and be able to relate it to real examples.
4. Develop the programs in assembly language for 80286, 80386 and MIPS processors in real and protected modes.
5. Implement embedded applications using ATOM processor.

6.Analysis the real time application of it.

**UNIT I: Introduction to computer organization** **(6)**

Architecture and function of general computer system, CISC Vs RISC, Data types, Integer Arithmetic - Multiplication, Division, Fixed and Floating point representation and arithmetic, Control unit operation, Hardware implementation of CPU with Micro instruction, microprogramming, System buses, Multi-bus organization.

**UNIT II: Memory organization** **(6)**

System memory, Cache memory - types and organization, Virtual memory and its implementation, Memory management unit, Magnetic Hard disks, Optical Disks.

**UNIT III: Input – output Organization** **(8)**

Accessing I/O devices, Direct Memory Access and DMA controller, Interrupts and Interrupt

Controllers, Arbitration, Multilevel Bus Architecture, Interface circuits - Parallel and serial port. Features of PCI and PCI Express bus.

**UNIT IV: 16 and 32 microprocessors (8)**

80x86 Architecture, IA – 32 and IA – 64, Programming model, Concurrent operation of EU and BIU, Real mode addressing, Segmentation, Addressing modes of 80x86, Instruction set of 80x86, I/O addressing in 80x86

**UNIT V: Pipelining (8)**

Introduction to pipelining, Instruction level pipelining (ILP), compiler techniques for ILP, Data hazards, Dynamic scheduling, Dependability, Branch cost, Branch Prediction, Influence on instruction set.

## SUGGESTED READINGS


1. B. Brey and C. R. Sarma, **"**The Intel microprocessors**"**, Pearson Education, 2000.
2. J. L. Hennessy and D. A. Patterson, **"**Computer Architecture A Quantitative Approach**"**, Morgan Kauffman, 2011.
3. W. Stallings, **"**Computer organization**"**, PHI, 1987.
4. P. Barry and P. Crowley, **"**Modern Embedded Computing**"**, Morgan Kaufmann, 2012.
5. N. Mathivanan, **"**Microprocessors, PC Hardware and Interfacing**"**, Prentice Hall, 2004

**Semester – VI**

**18BEEE6E04 Electromagnetic Waves 3H-3C**

**Instruction Hours / week: L:3 T: 0 P: 0** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3 Hours

**Course Objectives:**

- To study the transmission lines and estimate voltage and current at any point on transmission line for different load conditions.
- To study the various boundary conditions.
- To study the wave propagation in special cases such as lossy and low loss dielectric media.
- To study field distributions in a rectangular wave-guide.
- To study the radiation by antennas.
- To study the Maxwell's equations and transmission lines..

**Course Outcomes:**

At the end of this course, students will demonstrate the ability to

1.Analyse transmission lines and estimate voltage and current at any point on transmission line for different load conditions.

2.Provide solution to real life plane wave problems for various boundary conditions.

3.Analyse the field equations for the wave propagation in special cases such as lossy and low loss dielectric media.

4. Visualize TE and TM mode patterns of field distributions in a rectangular wave-guide.

5. Understand and analyse radiation by antennas.

6.Analysis the real time application of it.

**UNIT 1 Transmission Lines (6)**

Introduction, Concept of distributed elements, Equations of voltage andcurrent, Standing waves and impedance transformation, Lossless and low-loss transmission lines, Power transfer on a transmission line, Analysis of transmission line in terms of admittances, Transmission line calculations with the help of Smith chart, Applications of transmission line, Impedance matching using transmission lines.

**UNIT II Maxwell's Equations (6)**

Basic quantities of Electromagnetics, Basic laws of Electromagnetics: Gauss's law, Ampere's Circuital law, Faraday's law of Electromagnetic induction. Maxwell's equations, Surface charge and surface current, Boundary conditions at media interface.

**UNIT III: Uniform Plane Wave (7)**

Homogeneous unbound medium, Wave equation for time harmonic fields,Solution of the wave equation, Uniform plane wave, Wave polarization, Wave propagation in conducting medium, Phase velocity of a wave, Power flow and Poynting vector.

**UNIT IV Plane Waves at Media Interface** **(10)**

Plane wave in arbitrary direction, Plane wave at dielectric interface, Reflection and refraction of waves at dielectric interface, Total internal reflection, Wave polarization at media interface, Brewster angle, Fields and power flow at media interface, Lossy media interface, Reflection from conducting boundary.

**UNIT V Waveguides** **(10)**

Parallel plane waveguide: Transverse Electric (TE) mode, transverse Magnetic(TM) mode, Cut-off frequency, Phase velocity and dispersion. Transverse Electromagnetic (TEM) mode, Analysis of waveguide-general approach, Rectangular waveguides.

**SUGGESTED READINGS**

1. R. K. Shevgaonkar, **"**Electromagnetic Waves**"**, Tata McGraw Hill, 2005.
2. M. N.O. Sadiku, "Elements of Electromagnetics**"**, Oxford University Press, 2007.
3. C. A. Balanis, "Advanced Engineering Electromagnetics", John Wiley & Sons, 2012.
4. C. A. Balanis, "Antenna Theory: Analysis and Design**"**, John Wiley & Sons, 2005.

**Semester – VI**

**18BEEE6E05 Computational Electromagnetics 3H-3C**

**Instruction Hours / week: L:3 T: 0 P: 0** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3 Hours

**Course Objectives**

- To study the analytical methods and Finite difference methods
- To study the basic concepts of electromagnetics.
- To study the computational techniques for computing fields.
- To study the techniques to simple real-life problems.
- To learn the computational techniques for various types of problem
- To learn FDM and FEM application

**Course Outcomes:**

At the end of this course, students will demonstrate the ability to

1.Understand the basic concepts of electromagnetics.

2.Understand computational techniques for computing fields.

3.Apply the techniques to simple real-life problems.

4.Analyse and suggest appropriate computational techniques for various types of problem

5.Apply the FDM to simple real-life problems.

6.Apply the FEM to simple real-life problems.

**UNIT I Introduction** **(9)**

Conventional design methodology, Computer aided design aspects – Advantages. Review of basic fundamentals of Electrostatics and Electromagnetics. Development of Helmhotz equation, energy transformer vectors- Poynting and Slepian, magnetic Diffusion-transients and time-harmonic.

**UNIT II Analytical Methods** **(9)**

Analytical methods of solving field equations, method of separation of variables, Roth's method, integral methods- Green's function, method of images.

**UNIT III Finite Difference Method (FDM)** **(8)**

Finite Difference schemes, treatment of irregular boundaries, accuracy and stability of FD solutions, Finite-Difference Time-Domain (FDTD) method- Uniqueness and convergence.

**UNIT IV Finite Element Method (FEM)** **(9)**

Overview of FEM, Variational and Galerkin Methods, shape functions, lower and higher order elements, vector elements, 2D and 3D finite elements, efficient finite element computations.

**UNIT V Special Topics** **(10)**

{Background of experimental methods-electrolytic tank, R-C network solution, Field plotting

(graphical method)}, hybrid methods, coupled circuit - field computations, electromagnetic thermal and electromagnetic - structural coupled computations, solution of equations, method of moments, Poisson's fields.

**Text/Reference Books**

1. P. P. Silvester and R. L. Ferrari "Finite Element for Electrical Engineers", Cambridge University press, 1996.
2. M. N. O. Sadiku, "Numerical Techniques in Electromagnetics", CRC press, 2001.

Semester – VI

**18BEEE6E06 Control Systems Design 3H-3C**

**Instruction Hours / week: L:3 T: 0 P: 0** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3 Hours

**Course Objectives**

- To understand the use of transfer function models for analysis physical systems and introduce the control system components.
- To provide adequate knowledge in the time response of systems and steady state error analysis.
- To accord basic knowledge in obtaining the open loop and closed–loop frequency responses of systems.
- To introduce stability analysis and design of compensators.
- To introduce state variable representation of physical systems
- To study the application of it.

**Course Outcomes (COs)**

At the end of this course, students will demonstrate the ability to

1.Understand various design specifications.

2.Design controllers to satisfy the desired design specifications using simple controller structures (P, PI, PID, compensators).

3.Design controllers using the state-space approach.

4.Understand the stability analysis and design of compensators.

5.Understand the state variable representation of physical systems

6. Analysis the real time application of it

**UNIT I DESIGN SPECIFICATIONS (6 )**

Introduction to design problem and philosophy. Introduction to time domain and frequency domain design specification and its physical relevance. Effect of gain on transient and steady state response. Effect of addition of pole on system performance. Effect of addition of zero on system response.

**UNIT II DESIGN OF CLASSICAL CONTROL SYSTEM IN THE TIME DOMAIN (8)**

Introduction to compensator. Design of Lag, lead lag-lead compensator in time domain. Feedback and Feed forward compensator design. Feedback compensation. Realization of compensators.

**UNIT III : DESIGN OF CLASSICAL CONTROL SYSTEM IN FREQUENCY DOMAIN(8 )**

Compensator design in frequency domain to improve steady state and transient response. Feedback and Feed forward compensator design using bode diagram.

**UNIT- IV DESIGN OF PID CONTROLLERS (6 )**

Design of P, PI, PD and PID controllers in time domain and frequency domain for first, second and third order systems. Control loop with auxiliary feedback – Feed forward control.

**UNIT V CONTROL SYSTEM DESIGN IN STATE SPACE (11)**

Review of state space representation. Concept of controllability & observability, effect of pole zero cancellation on the controllability & observability of the system, pole placement design through state feedback. Ackerman's Formula for feedback gain design. Design of Observer. Reduced order observer. Separation Principle. Various types of non-linearities. Effect of various non-linearities on system performance. Singular points. Phase plot analysis.

**SUGGESTED READINGS**

1. N. Nise, "Control system Engineering", John Wiley, 2000.
2. I. J. Nagrath and M. Gopal, "Control system engineering", Wiley, 2000.
3. K. Ogata, "Modern Control Engineering", Prentice Hall, 2010.
4. B. C. Kuo, "Automatic Control system", Prentice Hall, 1995.
5. J. J. D'Azzo and C. H. Houpis, "Linear control system analysis and design (conventional and modern)", McGraw Hill, 1995.
6. R. T. Stefani and G. H. Hostetter, "Design of feedback Control Systems", Saunders College Pub, 1994.

Semester – VI

**18BEEE6E07 Industrial Electrical Systems 3H-3C**

**Instruction Hours / week: L:3 T: 0 P: 0** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3 Hours

**Course Objectives**

- To study the Electrical System components and Illumination Sytems
- To acquire knowledge of the electrical wiring systems for residential, commercial and industrial consumers, representing the systems with standard symbols and drawings, SLD.
- To study about various components of industrial electrical systems.
- To study the proper size of various electrical system components.
- To learn the industrial applications
- To study the technical reason behind every practical operations of the sysems

**Course Outcomes (COs)**

At the end of this course, students will demonstrate the ability to

1.Reproduce the electrical wiring systems for residential, commercial and industrial consumers, representing the systems with standard symbols and drawings, SLD.

2.Reproduce various components of industrial electrical systems.

3.Recognize and select the proper size of various electrical system components.

4.Summarize the concepts in various industrial applications

5.Discover the technical reason behind every practical operations of the sysems

6. Analysis the real time application of it

**UNIT I: Electrical System Components (8)**

LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices

**UNIT II: Residential and Commercial Electrical Systems (8)**

Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, earthing system calculations, requirements of commercial installation,

deciding lighting scheme and number of lamps, earthing of commercial installation, selection and sizing of components.

**UNIT III: Illumination Systems (6)**

Understanding various terms regarding light, lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, energy saving in illumination systems, design of a lighting scheme for a residential and commercial premises, flood lighting.

**UNIT IV: Industrial Electrical Systems I (8)**

HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components.

**UNIT V: Industrial Electrical Systems II (6)**

DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and Battery Banks, Selection of UPS and Battery Banks.

**SUGGESTED READINGS**

1. S. L. Uppal and G. C. Garg, “Electrical Wiring, Estimating & Costing”, Khanna publishers, 2008.
2. K. B. Raina, “Electrical Design, Estimating & Costing”, New age International, 2007.
3.. S. Singh and R. D. Singh, “Electrical estimating and costing”, Dhanpat Rai and Co., 1997.
4.. Web site for IS Standards.
5. H. Joshi, “Residential Commercial and Industrial Systems”, McGraw Hill Education, 2008.

**Semester – VII**

**18BEEE6E08 Electrical Drives 3H-3C**

**Instruction Hours / week: L:3 T: 0 P: 0** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3 Hours

**Course Objectives**

- To study and understand the operation of electric drives controlled from a power electronic converter and to introduce the design concepts of controllers.
- To understand the stable steady–state operation and transient dynamics of a motor–load system.
- To study and analyze the operation of the converter/chopper fed dc drive and to solve simple problems.
- To study and understand the operation of both classical and modern induction motor drives.
- To understand the differences between synchronous motor drive and induction motor drive and to learn the basics of permanent magnet synchronous motor drives.
- To analyze and design the current and speed controllers for a closed loop solid–state d.c motor drives.

**Course Outcomes (COs)**

At the end of this course, students will demonstrate the ability to

1. Understand the characteristics of dc motors and induction motors.
2. Understand the principles of speed-control of dc motors and induction motors.
3. Understand the power electronic converters used for dc motor and induction motor speed control.
4. Acquire detailed knowledge of DC Shunt and Series motor operation using Generalized machine theory
5. Acquire knowledge on how DC Drives may pollute the power supply and how to mitigate such pollution
6. Acquire detailed knowledge on AC-DC Converters and DC-DC Converters and their modeling for steady-sate and transient

**UNIT I DC MOTOR CHARACTERISTICS (5)**

Review of emf and torque equations of DC machine, review of torque-speed characteristics of separately excited dc motor, change in torque-speed curve with armature voltage, example load torque-speed characteristics, operating point, armature voltage control for varying motor speed, flux weakening for high speed operation.

**UNIT II CHOPPER FED DC DRIVE (11)**

Review of dc chopper and duty ratio control, chopper fed dc motor for speed control, steady state operation of a chopper fed drive, armature current waveform and ripple, calculation of losses in dc motor and chopper, efficiency of dc drive, smooth starting. Review of motoring and generating modes operation of a separately excited dc machine, four quadrant operation of dc machine; single-quadrant, two-quadrant and four-quadrant choppers; steady-state operation of multi-quadrant chopper fed dc drive, regenerative braking.

**UNIT- III CLOSED-LOOP CONTROL OF DC DRIVE (6)**

Control structure of DC drive, inner current loop and outer speed loop, dynamic model of dc motor – dynamic equations and transfer functions, modeling of chopper as gain with switching delay, plant transfer function, for controller design, current controller specification and design, speed controller specification and design.

**UNIT V INDUCTION MOTOR CHARACTERISTICS (12)**

Review of induction motor equivalent circuit and torque-speed characteristic, variation of torque-speed curve with (i) applied voltage, (ii) applied frequency and (iii) applied voltage and frequency, typical torque-speed curves of fan and pump loads, operating point, constant flux operation, flux weakening operation. Impact of rotor resistance of the induction motor torque-speed curve, operation of slip-ring induction motor with external rotor resistance, starting torque, power electronic based rotor side control of slip ring motor, slip power recovery.

**UNIT VI SCALAR CONTROL OR CONSTANT V/F CONTROL OF INDUCTION MOTOR(6)**

Review of three-phase voltage source inverter, generation of three-phase PWM signals, sinusoidal modulation, space vector theory, conventional space vector modulation; constant V/f control of induction motor, steady-state performance analysis based on equivalent circuit, speed drop with loading, slip regulation.

**SUGGESTED READINGS**

1. G. K. Dubey, “Power Semiconductor Controlled Drives”, Prentice Hall, 1989.
2. R. Krishnan, “Electric Motor Drives: Modeling, Analysis and Control”, Prentice Hall, 2001.
3. G. K. Dubey, “Fundamentals of Electrical Drives”, CRC Press, 2002.
4. W. Leonhard, “Control of Electric Drives”, Springer Science & Business Media, 2001.

**Semester – VII**

**18BEEE6E09 Line Commutated and Active Rectifiers 3H-3C**

**Instruction Hours / week: L:3 T: 0 P: 0** **Marks:** Internal: **40** External: **60** Total: **100**
**End Semester Exam:** 3 Hours

**Course Objectives**
**Students ill learn**

1. controlled rectifier circuits.
2. the operation of line-commutated rectifiers – 6 pulse and multi-pulse configurations.
3. the operation of PWM rectifiers – operation in rectification and regeneration modes and lagging, leading and unity power factor mode.
4. the real time application of it
5. knowlege of rectifier usage in industrial VFD system
6. knowledge of advanced converter system

**Course Outcomes**
At the end of this course, students will demonstrate the ability to
1.Analyse controlled rectifier circuits.
2. Understand the operation of line-commutated rectifiers – 6 pulse and multi-pulse configurations.
3. Understand the operation of PWM rectifiers – operation in rectification and regeneration modes and lagging, leading and unity power factor mode.
4.Analysis the real time application of it
5. Students will get knowlege of rectifier usage in industrial VFD system
6.Will getting knowledge of advanced converter system

**UNIT I : Diode rectifiers with passive filtering (9)**
Half-wave diode rectifier with RL and RC loads; 1-phase full-wave diode rectifier with L, C and LC filter; 3-phase diode rectifier with L, C and LC filter; continuous and discontinuous conduction, input current waveshape, effect of source inductance; commutation overlap.
**UNIT II : Thyristor rectifiers with passive filtering (9)**
Half-wave thyristor rectifier with RL and RC loads; 1-phase thyristor rectifier with L and LC filter; 3-phase thyristor rectifier with L and LC filter; continuous and discontinuous conduction, input current waveshape.
**UNIT III : Multi-Pulse converter (9)**
Review of transformer phase shifting, generation of 6-phase ac voltage from 3-phase ac, 6-pulse converter and 12-pulse converters with inductive loads, steady state analysis,

commutation overlap, notches during commutation.

**UNIT IV : Single-phase ac-dc single-switch boost converter (9)**

Review of dc-dc boost converter, power circuit of single-switch ac-dc converter, steady state analysis, unity power factor operation, closed-loop control structure.

**UNIT V : Ac-dc bidirectional boost converter (9)**

Review of 1-phase inverter and 3-phase inverter, power circuits of 1-phase and 3-phase ac-dc boost converter, steady state analysis, operation at leading, lagging and unity power factors. Rectification and regenerating modes. Phasor diagrams, closed-loop control structure..

**SUGGESTED READINGS:**

1. G. De, “Principles of Thyristorised Converters”, Oxford & IBH Publishing Co, 1988.
2. J.G. Kassakian, M. F. Schlecht and G. C. Verghese, “Principles of Power Electronics”, AddisonWesley, 1991.
3. L. Umanand, “Power Electronics: Essentials and Applications”, Wiley India, 2009.
4. N. Mohan and T. M. Undeland, “Power Electronics: Converters, Applications and Design”, John Wiley & Sons, 2007.
5. R. W. Erickson and D. Maksimovic, “Fundamentals of Power Electronics”, Springer Science & Business Media, 2001.

**Semester – V**

**18BEEE6E10** **High Voltage Engineering** **3H-3C**

**Instruction Hours / week: L:3 T: 0 P: 0** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3 Hours

**Course Objectives**

- To understand the various types of over voltages in power system and Protection methods.
- To study about generation of over voltages in laboratories.
- To know about measurement of over voltages.
- To study about the nature of Breakdown mechanism in solid, liquid and gaseous dielectrics -discussion on commercial insulates.
- To study about testing of power apparatus and insulation coordination
- To study the AC and DC high voltage and current using CVT

**Course Outcomes (COs)**

At the end of the course, the student will demonstrate

1. Identify the causes of over voltages and its effects and estimate the reflection and refractions of travelling waves in transmission lines
2. Discuss the various types of breakdown mechanisms and analyze the breakdown mechanisms in solid, liquid, gases and composite dielectrics
3. Explain the generation and design of different types of Generating circuits for high voltage and currents of AC, DC and impulse
4. Measure AC and DC high voltage and current using high resistance with series ammeter, dividers, peak voltmeter and generating voltmeters
5. Discuss the testing methodologies related to various high voltage equipment with reference to national and international standards
6. Estimate the AC and DC high voltage and current using CVT, electrostatic voltmeters, sphere gaps, high current shunts and digital techniques in high voltage measurement

**UNIT I BREAKDOWN IN GASES (15)**

Ionization processes and de-ionization processes, Types of Discharge, Gases as insulating materials, Breakdown in Uniform gap, non-uniform gaps, Townsend's theory, Streamer mechanism, Corona discharge. Breakdown in pure and commercial liquids, Solid dielectrics and composite dielectrics, intrinsic breakdown, electromechanical breakdown and thermal breakdown, Partial discharge, applications of insulating materials.

**UNIT II GENERATION OF HIGH VOLTAGES (7)**

Generation of high voltages, generation of high D. C. and A.C. voltages, generation of impulse voltages, generation of impulse currents, tripping and control of impulse generators.

**UNIT- III MEASUREMENTS OF HIGH VOLTAGES AND CURRENTS (7)**

Peak voltage, impulse voltage and high direct current measurement method, cathode ray oscillographs for impulse voltage and current measurement, measurement of dielectric constant and loss factor, partial discharge measurements.

**UNIT IV LIGHTNING AND SWITCHING OVER-VOLTAGES (7)**

Charge formation in clouds, Stepped leader, Dart leader, Lightning Surges. Switching overvoltages, Protection against over-voltages, Surge diverters, Surge modifiers.

**UNIT V HIGH VOLTAGE TESTING OF ELECTRICAL APPARATUS AND HIGH VOLTAGE LABORATORIES (7)**

Various standards for HV Testing of electrical apparatus, IS, IEC standards, Testing of insulators and bushings, testing of isolators and circuit breakers, testing of cables, power transformers and some high voltage equipment, High voltage laboratory layout, indoor and outdoor laboratories, testing facility requirements, safety precautions in H. V. Labs.

**SUGGESTED READINGS**

1. M. S. Naidu and V. Kamaraju, “High Voltage Engineering”, McGraw Hill Education, 2013.
2. C. L. Wadhwa, “High Voltage Engineering”, New Age International Publishers, 2007.
3. D. V. Razevig (Translated by Dr. M. P. Chourasia), “High Voltage Engineering Fundamentals”, Khanna Publishers, 1993.
4. E. Kuffel, W. S. Zaengl and J. Kuffel, “High Voltage Engineering Fundamentals”, Newnes Publication, 2000.
5. R. Arora and W. Mosch “High Voltage and Electrical Insulation Engineering”, John Wiley & Sons, 2011.
6. Various IS standards for HV Laboratory Techniques and Testing

**Semester – VI**

**18BEEE6E11 Electrical Energy Conservation And Auditing 3H-3C**

**Instruction Hours / week: L:3 T: 0 P: 0** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3 Hours

**Course Objectives**

- To gain the knowledge about energy management.
- To understand the basic concepts in economic analysis in energy management.
- To understand the basic principles of energy audit.
- To study the instruments used for auditing
- To study the eligibilty and criteria for energy manager
- To study the eligibilty and criteria for energy auditor

**Course Outcomes (COs)**

At the end of this course, students will demonstrate the ability to

1.Understand the current energy scenario and importance of energy conservation.
2. Understand the concepts of energy management.
3. Understand the methods of improving energy efficiency in different electrical systems.
4. Understand the concepts of different energy efficient devices.
5.Analysis the real time issues in industries.
6.Become Certified Enery Manager and Energy Auditor.

**UNIT 1: Energy Scenario (6)**

Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy conservation and its importance, restructuring of the energy supply sector, energy strategy for the future, air pollution, climate change. Energy Conservation Act-2001 and its features.

**UNIT 2: Basics of Energy and its various forms (7)**

Electricity tariff, load management and maximum demand control, power factor improvement, selection & location of capacitors, Thermal Basics-fuels, thermal energy contents of fuel, temperature & pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity & heat transfer, units and conversion.

**UNIT 3: Energy Management & Audit (6)**

Definition, energy audit, need, types of energy audit. Energy management (audit) approach understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel

& energy substitution, energy audit instruments. Material and Energy balance: Facility as an energy system, methods for preparing process flow, material and energy balance diagrams.

**UNIT 4: Energy Efficiency in Electrical Systems (7)**

Electrical system: Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit, selection and location of capacitors, performance assessment of PF capacitors, distribution and transformer losses. Electric motors: Types, losses in induction motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy saving opportunities with energy efficient motors.

**UNIT 5: Energy Efficiency in Industrial Systems (8)**

Compressed Air System: Types of air compressors, compressor efficiency, efficient compressor operation, Compressed air system components, capacity assessment, leakage test, factors affecting the performance and savings opportunities in HVAC, Fans and blowers: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Pumps and Pumping System: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Cooling Tower: Types and performance evaluation, efficient system operation, flow control strategies and energy saving opportunities, assessment of cooling towers.

**SUGGESTED READINGS**

1. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects (available online)
2. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-3, Electrical Utilities (available online)
3. S. C. Tripathy, "Utilization of Electrical Energy and Conservation", McGraw Hill, 1991.
4. Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org)

Semester – VII

**18BEEE7E01** **Wind and Solar Energy Systems** **3H-3C**

**Instruction Hours / week: L:3 T: 0 P: 0** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3 Hours

**Course Objectives**

- Understanding basic characteristics of renewable sources of energy and technologies for their utilization.
- Awareness about renewable Energy Sources and technologies.
- Adequate inputs on a variety of issues in harnessing renewable Energy.
- Recognize current and possible future role of renewable energy sources.
- To learn the power electronic interfaces for wind and solar generation.
- To study the issues related to the grid-integration of solar and wind energy systems.

**Course Outcomes (COs)**

1. At the end of this course, students will demonstrate the ability to
   Able to perform an initial design of a renewable energy system.
2. Understand the energy scenario and the consequent growth of the power generation from renewable energy sources.
3. Understand the basic physics of wind and solar power generation.
4. Understand the power electronic interfaces for wind and solar generation.
5. Understand the issues related to the grid-integration of solar and wind energy systems.
6. Able to analyze how changes in functionality in a component will affect the other components of the system.

**UNIT I PHYSICS OF WIND POWER (5)**

History of wind power, Indian and Global statistics, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions.

**UNIT II WIND GENERATOR TOPOLOGIES (12)**

Review of modern wind turbine technologies, Fixed and Variable speed wind turbines, Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent Magnet Synchronous Generators, Power electronics converters. Generator-Converter configurations, Converter Control.

**UNIT III THE SOLAR RESOURCE AND SOLAR THERMAL POWER GENERATION (3)**

Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability, Technologies, Parabolic trough, central receivers, parabolic dish, Fresnel, solar pond,elementary analysis.

**UNIT- IV SOLAR PHOTOVOLTAIC (8)**

Technologies-Amorphous, monocrystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms. Converter Control.

**UNIT V NETWORK INTEGRATION ISSUES (8)**

Overview of grid code technical requirements. Fault ride-through for wind farms - real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behavior during grid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and wind systems.

**SUGGESTED READINGS**

1. T. Ackermann, "Wind Power in Power Systems", John Wiley and Sons Ltd., 2005.
2. G. M. Masters, "Renewable and Efficient Electric Power Systems", John Wiley and Sons, 2004.
3. S. P. Sukhatme, "Solar Energy: Principles of Thermal Collection and Storage", McGraw Hill, 1984.
4. H. Siegfried and R. Waddington, "Grid integration of wind energy conversion systems" John Wiley and Sons Ltd., 2006.
5. G. N. Tiwari and M. K. Ghosal, "Renewable Energy Applications", Narosa Publications, 2004.
6. J. A. Duffie and W. A. Beckman, "Solar Engineering of Thermal Processes", John Wiley & Sons, 1991.

**Semester – VI**

**18BEEE7E02** **Electrical and Hybrid Vehicles** **3H-3C**

**Instruction Hours / week: L:3 T: 0 P: 0** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3 Hours

**Course Objectives**

- To study the basic concepts of electric hybrid vehicles.
- To study about energy storage system for hybrid vehicle.
- To study about energy management strategies
- To study the different strategies related to energy storage systems.
- To study the different strategies related to energy management systems.
- To study the concept of different Motor drive.

**Course Outcomes (COs)**

At the end of this course, students will demonstrate the ability to

1.Understand the models to describe hybrid vehicles and their performance.

2. Understand the concept of Electric Trains.

3. Understand the different possible ways of energy storage.

4. Understand the different strategies related to energy storage systems.

5. Understand the different strategies related to energy management systems.

6. Understand the concept of different Motor drive.

**UNIT I INTRODUCTION (10)**

Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance. Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid

drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

**UNIT II ELECTRIC TRAINS (5)**

Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.

**UNIT III ELECTRIC PROPULSION UNIT (5)**

Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

**UNIT IV ENERGY STORAGE (10)**

Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems

**UNIT- V ENERGY MANAGEMENT STRATEGIES (9)**

Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies. Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

**SUGGESTED READINGS**

1. C. Mi, M. A. Masrur and D. W. Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons, 2011.
2. S. Onori, L. Serrao and G. Rizzoni, "Hybrid Electric Vehicles: Energy Management Strategies", Springer, 2015.
3. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2004.
4. T. Denton, "Electric and Hybrid Vehicles", Routledge, 2016.

Semester – VII

**18BEEE7E03** **Power System Protection** **3H-3C**

**Instruction Hours / week: L:3 T: 0 P: 0** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3 Hours

**Course Objectives**

- To understand the current interruption in Power System and study the various switchgears.
- Discussion on various earthing practices, usage of symmetrical components to estimate fault current and fault MVA.
- Study of Relays, protection scheme, and solid state relays.
- To understand the method of circuit breaking, various arc theories, Arcing phenomena capacitive and inductive breaking, Types of circuit breakers.
- To expose the students to the various faults in power system and learn the various methods of protection scheme
- To study the protection schemes, and the use of wide-area measurements.

**Course Outcomes (COs)**

At the end of this course, students will demonstrate the ability to

1. Understand the different components of a protection system.
2. Evaluate fault current due to different types of fault in a network.
3. Understand the protection schemes for different power system components.
4. Understand the basic principles of digital protection.
5. Understand system protection schemes, and the use of wide-area measurements.
6. Analysis the Real time application of it.

**UNIT I INTRODUCTION AND COMPONENTS OF A PROTECTION STEM (12)**

Principles of Power System Protection, Relays, Instrument transformers, Circuit Breakers. Review of Fault Analysis, Sequence Networks. Introduction to Overcurrent Protection and overcurrent relay co-ordination.

**UNIT II EQUIPMENT PROTECTION SCHEMES (8)**

Directional, Distance, Differential protection. Transformer and Generator protection. Bus bar Protection, Bus Bar arrangement schemes.

**UNIT- III DIGITAL PROTECTION (8)**

Computer-aided protection, Fourier analysis and estimation of Phasors from DFT. Sampling, aliasing issues.

**UNIT IV MODELING AND SIMULATION OF PROTECTION SCHEMES (8)**

CT/PT modeling and standards, Simulation of transients using Electro-Magnetic Transients (EMT) programs. Relay Testing.

**UNIT V SYSTEM PROTECTION (4)**

Effect of Power Swings on Distance Relaying. System Protection Schemes. Under-frequency, under-voltage and df/dt relays, Out-of-step protection, Synchro-phasors, Phasor Measurement Units and Wide-Area Measurement Systems (WAMS). Application of WAMS for improving protection systems.

**SUGGESTED READINGS**

1. J. L. Blackburn, "Protective Relaying: Principles and Applications", Marcel Dekker, New York, 1987.
2. Y. G.Paithankar and S. R. Bhide, "Fundamentals of power system protection", Prentice Hall, India, 2010.
3. A. G. Phadke and J. S. Thorp, "Computer Relaying for Power Systems", John Wiley & Sons, 1988.
4. A. G. Phadke and J. S. Thorp, "Synchronized Phasor Measurements and their Applications", Springer, 2008.
5. D. Reimert, "Protective Relaying for Power Generation Systems", Taylor and Francis, 2006.

Semester – VII

**18BEEE7E04** **HVDC Transmission Systems** **3H-3C**

**Instruction Hours / week: L:3 T: 0 P: 0** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3 Hours

**Course Objectives**

- To understand the different types HVDC systems
- To Study the control strategies used in HVDC transmission system.
- To Study the improvement of power system stability using an HVDC system.
- To Study and Analysis the components of HVDC system.
- To Study and comparative Analyse the DC and AC Transmission
- To Study the stability control of different system

**Course Outcomes (COs)**

At the end of this course, students will demonstrate the ability to

1.Understand the advantages of dc transmission over ac transmission.

2.Understand the operation of Line Commutated Converters and Voltage Source Converters.

3.Understand the control strategies used in HVDC transmission system.

4.Understand the improvement of power system stability using an HVDC system.

5.Analysis the components of HVDC system.

6.Analysis the Real time application of it.

**UNIT 1:DC Transmission Technology (9)**

Comparison of AC and dc Transmission (Economics, Technical Performance and Reliability). Application of DC Transmission. Types of HVDC Systems. Components of a HVDC system. Line Commutated Converter and Voltage Source Converter based systems.

**UNIT 2: Analysis of Line Commutated and Voltage Source Converters (10)**

Line Commutated Converters (LCCs): Six pulse converter, Analysis neglecting commutation overlap, harmonics, Twelve Pulse Converters. Inverter Operation. Effect of Commutation Overlap. Expressions for average dc voltage, AC current and reactive power absorbed by the converters. Effect of Commutation Failure, Misfire and Current Extinction in LCC links. Voltage Source Converters (VSCs): Two and Three-level VSCs. PWM schemes: Selective Harmonic Elimination, Sinusoidal Pulse Width Modulation. Analysis of a six pulse converter. Equations in the rotating frame. Real and Reactive power control using a VSC.

**UNIT 3:Control of HVdc Converters: (10)**

Principles of Link Control in a LCC HVdc system. Control Hierarchy, Firing Angle Controls – Phase-Locked Loop, Current and Extinction Angle Control, Starting and Stopping of a Link. Higher level Controllers Power control, Frequency Control, Stability Controllers. Reactive Power Control. Principles of Link Control in a VSC HVdc system: Power flow and dc Voltage Control. Reactive Power Control/AC voltage regulation.

**UNIT 4:Components of HVdc systems: (8)**

Smoothing Reactors, Reactive Power Sources and Filters in LCC HVdc systems DC line: Corona Effects. Insulators, Transient Over-voltages. dc line faults in LCC systems. dc line faults in VSC systems. dc breakers. Monopolar Operation. Ground Electrodes.

**UNIT 5:Stability Enhancement using HVdc Control (9)**

Basic Concepts: Power System Angular, Voltage and Frequency Stability. Power Modulation: basic principles – synchronous and asynchronous links. Voltage Stability Problem in AC/dc systems.

## SUGGESTED READING

1. K. R. Padiyar, “HVDC Power Transmission Systems”, New Age International Publishers, 2011.
2. J. Arrillaga, “High Voltage Direct Current Transmission”, Peter Peregrinus Ltd., 1983.
3. E. W. Kimbark, “Direct Current Transmission”, Vol.1, Wiley-Interscience, 1971.

**Semester – VI**

**18BEEE7E05** **Power Quality and FACTS** **3H-3C**

**Instruction Hours / week: L:3 T: 0 P: 0** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3 Hours

**Course Objectives**

- To understand the concept of power and power factor in single phase and three phase systems supplying non linear loads
- To understand the conventional compensation techniques used for power factor correction and load voltage regulation.
- To understand the active compensation techniques used for power factor correction.
- To understand the active compensation techniques used for load voltage regulation.
- To study the basic concepts of power quality.
- To study the concept of Harmonics

**Course Outcomes (COs)**

At the end of this course, students will demonstrate the ability to

1.Understand the characteristics of ac transmission

2.Understand the effect of shunt and series reactive compensation.

3.Understand the working principles of FACTS devices and their operating characteristics.

4.Understand the basic concepts of power quality.

5.Understand the concept of Harmonics

6.Understand the working principles of devices to improve power quality.

**UNIT I TRANSMISSION LINES AND SERIES/SHUNT REACTIVE POWER COMPENSATION (4)**

Basics of AC Transmission. Analysis of uncompensated AC transmission lines. Passive Reactive Power Compensation. Shunt and series compensation at the mid-point of an AC line. Comparison of Series and Shunt Compensation.

**UNIT II THYRISTOR-BASED FLEXIBLE AC TRANSMISSION CONTROLLERS (FACTS) (6)**

Description and Characteristics of Thyristor-based FACTS devices: Static VAR Compensator (SVC), Thyristor Controlled Series Capacitor (TCSC), Thyristor Controlled Braking Resistor and Single Pole Single Throw (SPST) Switch. Configurations/Modes of Operation, Harmonics and control of SVC and TCSC. Fault Current Limiter.

**UNIT III : VOLTAGE SOURCE CONVERTER BASED (FACTS) CONTROLLERS (8)**

Voltage Source Converters (VSC): Six Pulse VSC, Multi-pulse and Multi-level Converters, Pulse-Width Modulation for VSCs. Selective Harmonic Elimination, Sinusoidal PWM and

Space Vector Modulation. STATCOM: Principle of Operation, Reactive Power Control: Type I and Type II controllers, Static Synchronous Series Compensator (SSSC) and Unified Power Flow Controller (UPFC): Principle of Operation and Control. Working principle of Interphase Power Flow Controller. Other Devices: GTO Controlled Series Compensator. Fault Current Limiter.

**UNIT- IV APPLICATION OF FACTS AND POWER QUALITY PROBLEMS IN DISTRIBUTION SYSTEMS (8)**

Application of FACTS devices for power-flow control and stability improvement. Simulation example of power swing damping in a single-machine infinite bus system using a TCSC. Simulation example of voltage regulation of transmission mid-point voltage using a STATCOM.

Power Quality problems in distribution systems: Transient and Steady state variations in voltage and frequency. Unbalance, Sags, Swells, Interruptions, Wave-form Distortions: harmonics, noise, notching, dc-offsets, fluctuations. Flicker and its measurement. Tolerance of Equipment: CBEMA curve.

**UNIT VI DSTATCOM (8)**

Reactive Power Compensation, Harmonics and Unbalance mitigation in Distribution Systems using DSTATCOM and Shunt Active Filters. Synchronous Reference Frame Extraction of Reference Currents. Current Control Techniques in for DSTATCOM.

**SUGGESTED READINGS**

1. N. G. Hingorani and L. Gyugyi, “Understanding FACTS: Concepts and Technology of FACTS Systems”, Wiley-IEEE Press, 1999.
2. K. R. Padiyar, “FACTS Controllers in Power Transmission and Distribution”, New Age International (P) Ltd. 2007.
3. T. J. E. Miller, “Reactive Power Control in Electric Systems”, John Wiley and Sons, New York, 1983.
4. R. C. Dugan, “Electrical Power Systems Quality”, McGraw Hill Education, 2012.
5. G. T. Heydt, “Electric Power Quality”, Stars in a Circle Publications, 1991

Semester – VII

**18BEEE7E06 POWER SYSTEM DYNAMICS AND CONTROL 3H-3C**

**Instruction Hours / week: L:3 T: 0 P: 0** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3 Hours

Course Objectives

- To impart knowledge on dynamic modeling of a synchronous machine in detail
- To describe the modeling of excitation and speed governing system in detail.
- To understand the fundamental concepts of stability of dynamic systems and its classification.
- To understand and enhance small signal stability problem of power systems.Model different power system components for the study of stability
- To Study the methods to improve stability.
- To Study the real time difficulties in machine analysis

**Course Outcomes:**

At the end of this course, students will demonstrate the ability to

1. Understand the problem of power system stability and its impact on the system.
2. Analyse linear dynamical systems and use of numerical integration methods.
3. Model different power system components for the study of stability.
   Understand the methods to improve stability.
4. Understand real time difficulties in machine analysis
5. To get known about modelling system and its control

**UNIT 1: Introduction to Power System Operations (3)**

Introduction to power system stability. Power System Operations and Control. Stability problems in Power System. Impact on Power System Operations and control.

**UNIT 2 : Analysis of Linear Dynamical System and Numerical Methods (5)**

Analysis of dynamical System, Concept of Equilibrium, Small and Large Disturbance Stability. Modal Analysis of Linear System. Analysisusing Numerical Integration Techniques. Issues in Modeling: Slow and Fast Transients, Stiff System.

**UNIT 3 : Modeling of Synchronous Machines and Associated Controllers (12)**

Modeling of synchronous machine: Physical Characteristics. Rotor position dependent model. D-Q Transformation. Model with Standard Parameters. Steady State Analysis of Synchronous Machine. Short Circuit Transient Analysis of a Synchronous Machine. Synchronization of Synchronous Machine to an Infinite Bus. Modeling of Excitation and Prime Mover Systems. Physical Characteristics and Models. Excitation System Control. Automatic Voltage Regulator. Prime Mover Control Systems. Speed Governors.

**UNIT 4 : Modeling of other Power System Components (10)**

Modeling of Transmission Lines and Loads. Transmission Line Physical Characteristics. Transmission Line Modeling. Load Models - induction machine model. Frequency and Voltage Dependence of Loads. Other Subsystems – HVDC and FACTS controllers, Wind Energy Systems.

**UNIT 5 : Stability Analysis (11)**

Angular stability analysis in Single Machine Infinite Bus System. Angular Stability in multimachine systems – Intra-plant, Local and Inter-area modes. Frequency Stability: Centre of Inertia Motion. Load Sharing: Governordroop. Single Machine Load Bus System: Voltage Stability. Introduction to Torsional Oscillations and the SSR phenomenon. Stability Analysis Tools:Transient Stability Programs, Small Signal Analysis Programs.

## SUGGESTED READINGS

1. K.R. Padiyar, “Power System Dynamics, Stability and Control”, B. S. Publications, 2002.
2. P. Kundur, “Power System Stability and Control”, McGraw Hill, 1995.
3. P. Sauer and M. A. Pai, “Power System Dynamics and Stability”, Prentice Hall, 1997.

**B.E. Electrical and Electronics Engineering** **2019-2020**

**Semester – VIII**

**18BEEE8E01** **ADVANCED ELECTRIC DRIVES** **3H-3C**

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**Instruction Hours / week: L:3 T: 0 P: 0** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3 Hours

## Course Objectives

- To study and understand the operation of electric drives controlled from a power electronic converter and to introduce the design concepts of controllers.
- To understand the stable steady–state operation and transient dynamics of a motor–load system.
- To study and analyze the operation of the converter/chopper fed dc drive and to solve simple problems.
- To Study the vector control strategies for ac motor drives
- To Study the implementation of the control strategies using digital signal processors.
- To study the Voltage and frequency control in real time applications

## Course Outcomes:

At the end of this course, students will demonstrate the ability to

1.Understand the operation of power electronic converters and their control strategies.

2.Understand the vector control strategies for ac motor drives

3.Understand the implementation of the control strategies using digital signal processors.

4.To know the importance of reluctance and PM motors inj industrial applications

6. To understand the V/F control in real time application

**UNIT 1: Power Converters for AC drives** **(10)**

PWM control of inverter, selected harmonic elimination, space vector modulation, current control of VSI, three level inverter, Different topologies, SVM for 3 level inverter, Diode rectifier with boost chopper, PWM converter as line side rectifier, current fed inverters with self-commutated devices. Control of CSI, H bridge as a 4-Q drive.

**UNIT 2: Induction motor drives** **(10)**

Different transformations and reference frame theory, modeling of induction machines, voltage fed inverter control-v/f control, vector control, direct torque and flux control(DTC).

**UNIT 3: Synchronous motor drives** **(6)**

Modeling of synchronous machines, open loop v/f control, vector control, direct torque control, CSI fed synchronous motor drives.

**UNIT 4: Permanent magnet motor drives (6)**

Introduction to various PM motors, BLDC and PMSM drive configuration, comparison, block diagrams, Speed and torque control in BLDC and PMSM.

**UNIT 5: Switched reluctance motor drives (6)**

Evolution of switched reluctance motors, various topologies for SRM drives, comparison, Closed loop speed and torque control of SRM..

**SUGGESTED READINGS**

1. B. K. Bose, "Modern Power Electronics and AC Drives", Pearson Education, Asia, 2003.
2. P. C. Krause, O. Wasynczuk and S. D. Sudhoff, "Analysis of Electric Machinery and Drive Systems", John Wiley & Sons, 2013.
3. H. A. Taliyat and S. G. Campbell, "DSP based Electromechanical Motion Control", CRC press, 2003.
4. R. Krishnan, "Permanent Magnet Synchronous and Brushless DC motor Drives", CRC Press, 2009.

Semester – VIII

**18BEEE8E02 POWER SYSTEM STABILITY 3H-3C**

**Instruction Hours / week: L:3 T: 0 P: 0** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3 Hours

## Course Objectives

- To study the stability studies and Equal area criterion
- To study about excitation systems.
- To study the control and stability
- To study about control of different excitation systems.
- To study about network analyzers
- To study about digital computer systems.

## Course Outcomes:

At the end of this course, students will demonstrate the ability to

1.To understand concept of stability and transient stability.

2.To analyse the Equal area criterion and factors affecting stability.

3. To understand concept of excitation systems.

4. To understand concept of steady state stability

5. To understand the network analyzers and digital system

6. To Understand the different controls in excitation systems

## UNIT-I INTRODUCTION

Concept and importance of stability in power system operation and design. Steady state, transient and dynamic stability. The swing equation of machines connected to infinite bus bar and machines connected together

## UNIT -II STABILITY STUDIES

Swing curves-Solution by point by point and Euler's method. Qualitative treatment of stability studies on Network analyzers and digital computers..

## UNIT -III EQUAL AREA CRITERION

Equal area criterion, calculation of critical clearing angle by equal area criterion of various fault conditions. Effect of reclosure. Factors affecting transient stability and its improvement.

## UNIT-IV EXCITATION SYSTEMS

Types of excitation systems, AVR, calculation of exciter response by graphical integration and step-by-step methods. Effect of speed governing system inertia and damping on steady state and transient stability.

## UNIT-V STEADY STATE STABILITY

Significance of steady state stability, power limit of transmission systems. Clarke's diagram of two machine systems with and without losses. Steady stability of one machine connected to an infinite bus bar.

## SUGGESTED READINDS

1.K.A. Gangadhar,Analysis and stability of Electrical power system,Khanna Publishers 2001.

2.E.W.Kimbark,Power System Stability, Vol-I and II, Wiley Eastern Ltd,2002.

3. Olle.I.Elgerd,Electric Energy Systems Theory-An Introduction Tata McGraw-Hill Pub.co.Ltd., New Delhi 2003

Semester – VIII

**18BEEE8E03 POWER GENERATION SYSTEMS 3H-3C**

**Instruction Hours / week: L:3 T: 0 P: 0** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3 Hours

## Course Objectives

- To learn the economics connected with power generation.
- To understand the measurements of various parameter in power plant and their control.
- To study about Powerplant instrumentation
- To acquire knowledge of renewable power system
- To study about technologies of distributed system
- To study layout and working of thermal, nuclear and hydropower plants.

**Course Outcomes:**

1.At the end of the course the student will gain knowledge about economics of power Generation

2. The student also gain knowledge about distributed generation, boiler turbine monitoring system.

3. To get knowledge in Powerplant instrumentation

4. Students acquire knowledge of renewable power system

5. Gather knowledge in layout and working of thermal, nuclear and hydropower plants.

6. Acquire knowledge in cost and tariff of energy

**UNIT I ECONOMICS OF GENERATION 9**

Load and load duration curve–Load, demand and diversity factors–Plant capacity and plant use factors–choice of type of generation–choice of size and number of unit–cost of energy generated – Tariffs.

**UNIT II THERMAL, NUCLEARAND HYDROPOWER PLANTS 9**

Location, Layout and working of steam, diesel and gas power plants-Principles of nuclear power generation, Types of nuclear power plants and their comparison, Layout and working of nuclear power plants, Advantages and disadvantages of nuclear energy-Layout and working, Types of hydroelectric power plants, Advantages of hydro generation, Environmental issues.

**UNIT III POWERPLANT INSTRUMENTATION** **9**

Importanceofinstrumentationinpowerplants,UP&Idiagramofboiler-Measurementsofnon Electrical parameters, flow of feed water, air, steam, radiation detector, smoke density measurement-analyzers, flue gas oxygen analyzer, chromatography, PH meter, pollution monitoring instruments.

**UNIT IV BOILER, TURBINE-MONITORINGAND CONTROL** **9**

Combustion control - furnace draft control-drum level control- de-aerator control- boiler interlocks-speed, vibration, temperature monitoring control of turbine lubrication and cooling system of turbine.

**UNITV DISTRIBUTED GENERATION AND NON CONVENTIONAL PLANTS 9**

Introduction to the concept of distributed generation –basics on distributed generation Technologies-Effect on system operation. Basic concepts, Principle of working and layout of MHD, Solar, Wind, Tidal, Biomass and Geothermal Power Generation Systems.

**SUGGESTED READINGS**

1. Nagpal.G.R Power plant engineering Khanna Publishers, New Delhi 2001
2. Wadhwa, C.L Generation,Distribution and Utilization of Electric Energy New Age International
LTd 2011.
3. Gupta B.R Generation of Electrical Energy Eurasia Publishing House (p) Ltd, New Delhi

Semester – VIII

**18BEEE8E04 VIRTUAL INSTRUMENTATION 3H-3C**

**Instruction Hours / week: L:3 T: 0 P: 0** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3 Hours

**Course Objectives**

- To introduce concepts of Lab view software.
- To study graphical programming, interfacing instruments and its protocols.
- To introduce data acquisition methods.
- To introduce signal processing and network automation tools.
- To study about data cards in instrumentation
- To study the interface bus and signals

**Course Outcomes:**

At the end of the course the student will be able

1. To understand the concepts of virtual instrumentation.
2. To gather knowledge in software of instrumentation
3. To acquire the knowledge about display types
4. Get experience about data cards in instrumentation
5. Gain knowledge of interface bus and signals
6. Gain Knowledge of automated control in instrumentation

**UNIT I REVIEW OF DIGITAL INSTRUMENTATION 9**

Representation of analog signals in the digital domain – Review of quantization in amplitude and time axes, sample and hold, sampling theorem, ADC and DAC.

**UNIT II GRAPHICAL PROGRAMMING AND LABVIEW 9**

Concepts of graphical programming – LABVIEW software – Concept of VIs and sub VI - Display types – Digital – Analog – Chart and Graphs. Loops - structures - Arrays – Clusters. Local and global variables – String and file I/O. Timers and dialog controls.

**UNIT III INSTRUMENT INTERFACES AND PROTOCOLS 9**

RS232, RS 422, RS 485 and USB standards - IEEE 488 standard – Introduction to bus protocols of MOD bus and CAN bus. Electronic standards for signals – noise and EMI effects. Signal conditioning chassis and extension modules. Image acquisition cards.

**UNIT IV PC BASED DATA ACQUISITION 9**

Concept of PC based data acquisition – Typical on board DAQ card – Resolution and sampling frequency - analog inputs and outputs – Single-ended and differential inputs

–DAQ cards terminal boxes - Use of timer-counter and analog outputs on the universal DAQ card.

**UNIT V SIGNAL PROCESSING AND NETWORK BASED AUTOMATION 9**

Mathematical tools for statistical calculation – Signal processing tools- Windowing and filtering
tools –Control system tools – PID controller – CRO – function generator –illustration and case study – Web publishing tool –configuring VI server.

**SUGGESTED READINGS**

1.Sanjeev Gupta Virtual Instrumentation using LabVIEW' TMH 2004.

2. Jovitha Jerome Virtual Instrumentation using LabVIEW Prentice Hall 2010.

3.Gary W.Johnson,Richard Jennings Lab-view Graphical Programming Tata McGraw Hill Professional Publishing, IV Edition 2006.

## OPEN ELECTIVES
## AUTOMOBILE ENGINEERING

| B.E Electrical and Electronics Engineering | | 2019-2020 |
|---|---|---|
| **18BEAEOE01** | **AUTOMOBILE ENGINEERING** | **3H-3C** |

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objectives**

- To impart the knowledge on constructional details and principle of operation of various automobile components.
- To learn the function and working of various components in transmission and drive lines.
- To study the concept and working of steering and suspension systems in an automobile.
- To give the knowledge on wheels, tyres and brakes of automobiles.
- To provide the information on current and future trends in automobiles.
- To study the ignition of engine system

**Course Outcomes**

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

- Demonstrate the operating principles and constructional details of various automobile components.
- Explain the function and working of components in transmission and drive lines.
- Identify and explain the types of steering system and suspension system.
- Classify and describe the types of wheels, tyres and brakes of automobiles.
- Discuss the current and future trends in the automobiles.
- Gather the knowledge of the ignition of engine system

**UNIT I ENGINE AND AUXILIARY SYSTEMS**

Classification of engines – construction and working of four-stroke spark ignition (SI) engine and compression ignition (CI) engine – construction and working of two-stroke SI and CI engine – firing order – carburettor – fuel injection systems – battery – dynamo – alternator – starting motor – lighting system – ignition system.

**UNIT II TRANSMISSION SYSTEMS**

Requirements of transmission system – flywheel – clutch – types of clutch – construction of single and multi-plate clutches – need, types and construction of transmission gear box – universal joint – propeller shaft – need, types and construction of differential – four wheel drive.

**UNIT III STEERING AND SUSPENSION SYSTEMS**

Principle of steering – steering linkages – types of steering gear box –power steering – suspension systems – need and types – independent suspension – coil spring, leaf spring, torsion bar and air suspension – shock absorbers.

**UNIT IV WHEELS AND BRAKES**

Wheels and tyres – construction – types and specifications – tyre wear and causes – brakes – need – braking distance – types – mechanical, hydraulic and pneumatic brakes – power brake – parking brake – redundant braking system.

**UNIT V CURRENT AND FUTURE TRENDS**

Anti-lock Braking System (ABS) – brake assist – Electronic Brakeforce Distribution (EBD) – airbags – automatic high-beam control – backup cameras – defogger – electric vehicles – hybrid vehicles – autonomous vehicles – vehicle-to-vehicle communication – vehicle tracking – alternative fuels.

**Suggested Readings:**


1. Kirpal Singh, Automobile Engineering Volume 1, Standard Publishers, New Delhi, 2018.
2. Sethi H M, Automobile Technology, Tata McGraw-Hill, New Delhi, 2003.
3. William H Crouse and Donald L Anglin, Automotive Mechanics, Tata McGraw-Hill, New Delhi, 2006.
4. Srinivasan S, Automotive Mechanics, Tata McGraw-Hill, New Delhi, 2003.
5. Ganesan V, Internal Combustion Engines, McGraw-Hill Education, New Delhi, 2012.

**18BEAEOE02 TWO AND THREE WHEELER TECHNOLOGY 3H-3C**

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objectives**

- To impart the technical knowledge on construction and working of power train and drive train of two and three wheeler vehicles.
- To familiarize with the maintenance procedures of engine and subsystems of two and three wheelers.
- To study the types of transmission, steering and suspension systems.
- To study the types of wheels, tyres and brakes for two and three wheelers.
- To study the cranking system in IC engines
- To study anti braking system of engines

**Course Outcomes**

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

- Construct the frames of two and three wheelers of different layouts.
- Demonstrate the constructional details and principle of operation of various engine components.
- Identify and explain the types of transmission, steering and suspension systems.
- Classify and describe the types of wheels, tyres and brakes for two and three wheelers.
- Explain the servicing of two and three wheelers.
- Get knowledge of practical things in cranking system

**UNIT I INTRODUCTION**

History of two and three wheelers – classification and layouts of two wheelers – classification and layouts of three wheelers – main frame for two wheelers and types – main frame for three wheelers and types.

**UNIT II INTERNAL COMBUSTION ENGINES**

Classification of engines – selection criteria of engine for two and three wheelers – design considerations for two and three wheeler engines – construction and working of two-stroke and four-stroke engines – fuel feed system – lubricating system – cooling system – scavenging system – cranking system – kick start and auto-start mechanisms.

**UNIT III TRANSMISSION, STEERING AND SUSPENSION SYSTEMS**

Clutch – single plate, multiple plate and centrifugal clutches – primary reduction – gear box – gear shifting mechanisms – automatic transmission – final drive and differential for three wheelers – steering geometry – steering column construction – steering system for three wheelers – front and rear suspension systems – spring and shock absorber assembly.

**UNIT IV WHEELS, TYRES AND BRAKES**

Spoked wheels, pressed steel wheels and alloy wheel – tyre construction – tyre with tube and tubeless tyre – theory of brake action – drum and disc brakes – brake links layout for front and rear wheels – mechanical and hydraulic brake control systems – anti-lock braking system.

**UNIT V TWO AND THREE WHEELERS CASE STUDY**

Case study of mopeds, scooters, motor cycles, sports bikes, auto rickshaws, pickup vans, delivery vans and trailers – servicing – factors affecting fuel economy and emission.

**Suggested Readings**


1. Dhruv U Panchal, Two and Three Wheeler Technology, PHI Learning, New Delhi, 2015.
2. Ramalingam K K, Two Wheelers and Three Wheelers: Theory, Operation and Maintenance, Scitech Publications, Chennai, 2017.
3. Irving P E, Motorcycle Engineering, Veloce Enterprises, USA, 2017.
4. Dennis Bailey and Keith Gates, Bike Repair and Maintenance for Dummies, John Wiley & Sons, USA, 2009.

**18BEAEOE03 VEHICLE MAINTENANCE 3H-3C**

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objectives**

- To understand the need for vehicle maintenance and its importance.
- To familiarize the maintenance procedure for various components of an automobile.
- To study the servicing of transmission and driveline components.
- To study the procedure for steering, suspension, wheel and brake maintenance.
- To study the fault diagnosis in the electrical and air conditioner systems.
- To study the various services of brakings

**Course Outcomes**

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

- Describe and differentiate the types of maintenance.
- List the procedure for dismantling, servicing and assembling of engine components.
- Demonstrate the servicing of transmission and driveline components.
- Discuss the procedure for steering, suspension, wheel and brake maintenance.
- Explain the fault diagnosis in the electrical and air conditioner systems.
- To acquire the knowledge of tune-up of vehicle system

**UNIT I MAINTENANCE OF RECORDS AND SCHEDULES**

Need for maintenance – preventive and breakdown maintenance – requirements of maintenance – preparation of check lists – inspection schedule – maintenance of records, log sheets and other forms – safety precautions in maintenance – workshop layout, tools and equipment.

**UNIT II ENGINE AND ENGINE SUBSYSTEM MAINTENANCE**

General engine service – dismantling of engine components – engine repair – service of basic engine parts, cooling and lubricating system, fuel system, intake and exhaust system – engine tune-up.

**UNIT III TRANSMISSION AND DRIVELINE MAINTENANCE**

General checks, adjustment and service of clutch – dismantling, identifying, checking and reassembling transmission, transaxle – road testing – removing and replacing propeller shaft – servicing of cross and yoke joint, and constant velocity joint – rear axle service points – removing axle shaft and bearings – servicing differential assemblies – fault diagnosis.

**UNIT IV STEERING, SUSPENSION, WHEEL AND BRAKE MAINTENANCE**

Inspection, maintenance and service of steering linkage, steering column, rack and pinion steering, recirculating ball steering, worm type steering, power steering system – inspection, maintenance and service of MacPherson strut, coil spring, leaf spring, shock absorbers – wheel alignment and balance – removing and fitting of tyres – tyre wear and tyre rotation – inspection, maintenance and service of hydraulic brake, drum brake, disc brake, parking brake – bleeding of brakes.

**UNIT V ELECTRICAL AND AIR CONDITIONER MAINTENANCE**

Maintenance of batteries, starting system, charging system and body electrical – fault diagnosis using scan tools – maintenance of air conditioning parts like compressor, condenser, expansion valve, evaporator – replacement of hoses – leak detection – air conditioner charging – fault diagnosis – vehicle body repair like panel beating, tinkering, soldering, polishing, painting.

**Suggested Readings**


1. Tim Gilles, Automotive Service: Inspection, Maintenance, Repair, Cengage Learning, USA, 2015.
2. Philip Knott and Adam Roylance, An Introductory Guide to Motor Vehicle Maintenance: Light Vehicles, EMS Publishing, UK, 2010.
3. James D Halderman and Curt Ward, Advanced Engine Performance Diagnosis, Pearson, USA, 2016.
4. Ed May and Les Simpson, Automotive Mechanics Volume 1, McGraw-Hill Australia, 2006.
5. James E Duffy, Modern Automotive Technology, Goodheart-Willcox, USA, 2017.
6. Service manuals of various OEMs.

**18BEAEOE04 MODERN VEHICLE TECHNOLOGY 3H-3C**

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objectives**

- To impart the knowledge on trends in vehicle power plants.
- To learn about the various advanced driver assistance systems.
- To study the working of advanced suspension and braking systems in an automobile.
- To give the information about motor vehicle emission and noise pollution control.
- To provide the knowledge of vehicle telematics.
- To study about pedestrian detections

**Course Outcomes**

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

- Distinguish and describe the various modern vehicle power plant systems.
- List and explain the various driver assistant mechanisms.
- Identify and explain the working of advanced suspension and braking systems.
- Apply the knowledge of motor vehicle emission and noise pollution control.
- Describe the vehicle telematics and its applications.
- Getting knowledge of safety of vehicles securities

**UNIT I TRENDS IN POWER PLANTS**

Hybrid vehicles – stratified charged / learn burn engines – hydrogen engines – battery vehicles – electric propulsion with cables – magnetic track vehicles.

**UNIT II DRIVER ASSISTANCE SYSTEMS**

Adaptive cruise control – intelligent speed adaptation – lane departure warning systems – traction control systems – driver drowsiness detection system – collision avoidance systems – hill descent control – anti spin regulation – parking assistance systems – night-vision systems – pedestrian detection.

**UNIT III SUSPENSION, BRAKES AND SAFETY**

Interconnected air and liquid suspensions – hydrolastic suspension system – hydra gas suspension – closed loop suspension – indirect floating calliper disc brake – self energising disc brake – anti-skid braking system – retarders – regenerative braking – auto emergency braking – crumple zone – safety cage – airbags – seat belts – head rests.

**UNIT IV EMISSION AND NOISE POLLUTION CONTROL**

Engine emissions – types of catalytic converters – open loop and closed loop operation to the oxidizing catalytic converter – evaporative emission – internal and external noise – identification of noise sources – noise control techniques – adaptive noise control.

**UNIT V VEHICLE TELEMATICS**

Building blocks of vehicle telematics system – Global Positioning System (GPS) and Geographic Information System (GIS) for vehicle tracking – automotive navigation system – road recognition system – wireless vehicle safety communications – Usage Based Insurance (UBI).

**Suggested Readings**


1. Ljubo Vlacic, Michael Parent and Fumio Harashima, Intelligent Vehicle Technologies, Butterworth-Heinemann, UK, 2001.
2. Ronald K Jurgen, Navigation and Intelligent Transportation Systems, SAE International, USA, 1998.
3. Heinz Heisler, Advanced Vehicle Technology, Butterworth-Heinemann, UK, 2002.
4. James E Duffy, Modern Automotive Technology, Goodheart-Willcox, USA, 2017.
5. William B Ribbens, Understanding Automotive Electronics, Butterworth-Heinemann, UK, 2017.
6. Bosch Automotive Handbook, Robert Bosch, Germany, 2018.

| 18BEAEOE05 | FLEET MANAGEMENT | 3H-3C |
|---|---|---|

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objectives**

- To impart the knowledge on personnel management, selection process, training methods and motor vehicle act.
- To plan the vehicle routes, scheduling of vehicles and fare structure.
- To study the motor vehicle act in terms of registration and describe the various vehicles and conduct the test of competence to drive.
- To study the buildup of fare structure and analyze the methods of fare collection.
- Analyze the vehicle parts, supply management and data processing.
- To design the vehicle maintenance systems.

**Course Outcomes**

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

- Apply the knowledge of personnel management and analyze the selection process and training methods.
- Apply the motor vehicle act in terms of registration and describe the various vehicles and conduct the test of competence to drive.
- Construct a fare structure and analyze the methods of fare collection.
- Analyze the vehicle parts, supply management and data processing.
- Demonstrate an electronically controlled vehicle maintenance system and analyze the work scheduling.
- Gaining knowledge in test of competence

**UNIT I INTRODUCTION**

Personnel management – objectives and functions of personnel management – psychology, sociology and their relevance to an organization – selection process: job description, employment tests, interviewing, introduction to training objectives, methods of training, training procedure and psychological tests.

**UNIT II MOTOR VEHICLE ACT**

Schedules and sections of the motor vehicle act – traffic signs, fitness certificate, registration requirements, permit, insurance and constructional regulations – description of vehicle: goods carrier, tankers, tippers, delivery vans, recovery vans, power wagons and fire fighting vehicles – spread over, running time, test of competence to drive.

**UNIT III SCHEDULING AND FARE STRUCTURE**

Route planning – scheduling of transport vehicles – preparation of timetable – preparation of vehicle and crew schedule – principal features of operating costs for transport vehicles – fare structure and method of drawing up of a fare table – methods of fare collection.

**UNIT IV VEHICLE PARTS, SUPPLY MANAGEMENT AND BUDGET**

Cost of inventory – balancing inventory cost against downtime – parts control – bin tag systems – time management – time record keeping – budget activity and capital expenditures – classification of vehicle expenses – fleet management and data processing – data processing systems – computer controlling of fleet activity.

**UNIT V MAINTENANCE**

Scheduled and unscheduled maintenance – preventive maintenance – evaluation of Preventive Maintenance Inspection (PMI) programme – work scheduling – overtime – breakdown analysis – control of repair backlogs – cost of options – electronically controlled vehicle maintenance system.

**Suggested Readings**


1. Robert P Currie, Michelle B Currie and George M Keen, Fleet Management, Wandering Brothers Publishing, USA, 2006.
2. John Dolce, Fleet Management, McGraw-Hill, 1984.
3. SCC Editorial, Motor Vehicles Act, 1988, Eastern Book Company, New Delhi, 2019.
4. Rex W Faulks, Bus and Coach Operation, Butterworth-Heinemann, UK, 1987.
5. John E Dolce, Analytical Fleet Maintenance Management, SAE International, USA, 2009.

## BIOMEDICAL ENGINEERING

**B.E Electrical and Electronics Engineering** **2019-2020**

**18BEBMEOE01** **ROBOTICS IN MEDICINE** **3H-3C**

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objectives**

The goal of this course is for students

- To understand the basics of Robotics, Kinematics.
- To understand the basics of Inverse Kinematics.
- To explore various kinematic motion planning solutions for various Robotic configurations.
- To study the trajectory planning for robot.
- To understand the task level programming
- To explore various applications of Robots in Medicine

**Course Outcome**

Upon completion of this course, students will be able to:

- Explain various kinds robotics techniques, vision, planning and applications.
- Outline the basic concept of robotics
- Identify and discuss the Robot Vision
- Describe about manipulators and kinematics.
- Demonstrate Task level programming
- Discuss the applications of robotic systems in medical field.

**UNIT I INTRODUCTION**

Introduction Automation and Robots, Classification, Application, Specification, Notations, Direct Kinematics Dot and cross products, Coordinate frames, Rotations, Homogeneous coordinates Link coordination arm equation – Five-axis robot, Four-axis robot, Six-axis robot

**UNIT II KINEMATICS**

Inverse Kinematics – General properties of solutions tool configuration, Five axis robots, Three-Four axis, Six axis Robot, Workspace analysis and trajectory planning work envelope and examples, workspace fixtures, Pick and place operations, Continuous path motion, Interpolated motion, Straight-line motion.

**UNIT III ROBOT VISION**

Robot Vision Image representation, Template matching, Polyhedral objects, Shane analysis, Segmentation – Thresholding, region labeling, Shrink operators, Swell operators, Euler numbers, Perspective transformation, Structured illumination, Camera calibration.

**UNIT IV PLANNING**

Task Planning Task level programming, Uncertainty, Configuration, Space, Gross motion, Planning, Grasp Planning, Fine-motion planning, Simulation of planar motion, Source and Goal scenes, Task Planner simulation.

**UNIT V APPLICATIONS**

Applications in Biomedical Engineering – Bio Engineering Biologically Inspired Robots, Neural Engineering, Application in Rehabilitation – Interactive Therapy, Bionic Arm, Clinical and Surgical – Gynecology, Orthopedics, Neurosurgery

**Suggested Readings**


1. Robert Schilling Fundamentals of Robotics-Analysis and control Prentice Hall 2003
2. J.J.Craig Introduction to Robotics Pearson Education 2005
3. Staugaard, Andrew C Robotics and Artificial Intelligence: An Introduction to Applied Machine Learning Prentice Hall Of India 1987
4. Grover, Wiess, Nagel, Oderey Industrial Robotics: Technology, Programming and Applications McGraw Hill 1986.
5. Wolfram Stadler Analytical Robotics and Mechatronics McGraw Hill,1995
6. Saeed B. Niku, Introduction to Robotics: Analysis, Systems, Applications Prentice Hall 2001
7. K. S. Fu, R. C. Gonzales and C. S. G. Lee Robotics McGraw Hill 2008

**18BEBMEOE02 VIRTUAL REALITY AND AUGMENTED REALITY 3H-3C**

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objectives**

The goal of this course is for students:

- To introduce the relevance of this course to the existing technology through demonstrations, case studies and applications with a futuristic vision along with socio-economic impact and issues
- To understand virtual reality, augmented reality and using them to build Biomedical engineering applications
- To study the importance of virtual reality is getting optimized results
- To study the importance of VR reality and safety issues
- To study about the devices for trackers and interfaces
- To know the intricacies of these platform to develop PDA applications with better optimality.

**Course Outcomes**

Upon completion of this course, students will be able to:

- Applications of virtual reality are military and robotics.
- Importance of virtual reality is getting optimized results
- To know about importance of VR reality and safety issues
- To know the application in games, movies etc
- Gather knowledge practically about the devices for trackers and interfaces
- Acquire practical knowledge about the VR on the web and mobile

**UNIT I INTRODUCTION**

The three I‘s of virtual reality-commercial VR technology and the five classic components of a VR system - Input Devices: (Trackers, Navigation, and Gesture Interfaces): Three-dimensional position trackers, navigation and manipulation-interfaces and gesture interfaces-Output Devices: Graphics displays-sound displays & haptic feedback..

**UNIT II VR DEVELOPMENT PROCESS**

Geometric modeling - kinematics modeling- physical modeling - behaviour modeling - model Management.

**UNIT III CONTENT CREATION CONSIDERATIONS FOR VR**

Methodology and terminology-user performance studies-VR health and safety issues-Usability of virtual reality system- cyber sickness -side effects of exposures to virtual reality environment

**UNIT IV VR ON THE WEB & VR ON THE MOBILE**

JS-pros and cons-building blocks (WebVR, WebGL, Three.js, device orientation events)-frameworks (A-frame, React VR)-Google VR for Android-Scripts, mobile device configuration, building to android-cameras and interaction-teleporting-spatial audio-Assessing human parameters-device development and drivers-Design Haptics

**UNIT V APPLICATIONS**

Medical applications-military applications-robotics applications- Advanced Real time Tracking other applications- games, movies, simulations, therapy.

**Suggested Readings**


1. C. Burdea & Philippe Coiffet Virtual Reality Technology Second Edition, Gregory, John Wiley & Sons, Inc 2008
2. Jason Jerald The VR Book: Human-Centred Design for Virtual Reality. Association for Computing Machinery and Morgan & Claypool New York, NY, US
3. Dieter Schmalstieg & Tobias Hollerer Augmented Reality: Principles and Practice (Usability)Pearson Education (US), Addison-Wesley Educational Publishers Inc, New Jersey, United States 2016
4. Steve Aukstakalnis, Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR (Usability) Addison-Wesley Professional 1 edition, 2016
5. Robert Scoble & Shel Israel The Fourth Transformation: How Augmented Reality & Artificial Intelligence Will Change Everything, Patrick Brewster Press 2016
6. Tony Parisi, Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web, and Mobile O'Reilly Media; 1 edition 2015
7. Tony Parisi Programming 3D Applications with HTML5 and WebGL: 3D Animation and Visualization for Web Pages O'Reilly Media; 1 edition 2014
8. Jos Dirksen Learning Three.js: The JavaScript 3D Library for WebGL Packt Publishing - ebooks Account; 2nd Revised ed. Edition 2015

**18BEBMEOE03 ARTIFICIAL ORGANS AND IMPLANTS 3H-3C**

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objectives**

The goal of this course is for students:

- To discuss the overview of artificial organs &transplants
- To extend the principles of implant design with a case study
- To explain the implant design parameters and solution in use
- To simplify about various blood interfacing implants
- To know the biocompatibility of artificial organs
- To learn about the implantable medical devices

**Course Outcomes**

Upon completion of this course, students will be able to:

- Explain the implant design parameters and solution inuse
- Analyze about various blood interfacing implants
- Evaluate response of biomaterials in living system
- Perceive knowledge about artificial organs &transplants
- Demonstrate different types of soft tissue replacement and hard tissuere placement
- Assess biocompatibility of artificial organs

**UNIT I ARTIFICIAL ORGANS & TRANSPLANTS**

ARTIFICIAL ORGANS:-Introduction, outlook for organ replacements, design consideration, evaluation process. TRANSPLANTS:-Overview, Immunological considerations, Blood transfusions, individual organs – kidney, liver, heart and lung, bone marrow, cornea.

**UNIT II PRINCIPLES OF IMPLANT DESIGN**

Principles of implant design, Clinical problems requiring implants for solution, Permanent versus absorbable devices, the missing organ and its replacement, Tissue engineering, scaffolds, cells and regulators criteria for materials selection, Case study of organ regeneration.

**UNIT III IMPLANT DESIGN PARAMETERS AND ITS SOLUTION**

Biocompatibility, local and systemic effects of implants, Design specifications for tissue bonding and modulus matching, Degradation of devices, natural and synthetic polymers, corrosion, wear and tear, Implants for Bone, Devices for nerve regeneration.

**UNIT IV BLOOD INTERFACING IMPLANTS**

Neural and neuromuscular implants, heart valve implants, heart and lung assist devices, artificial heart, cardiac pacemakers, artificial kidney- dialysis membrane and artificial blood.

**UNIT V IMPLANTABLE MEDICAL DEVICES AND ORGANS**

Gastrointestinal system, Dentistry, Maxillofacial and craniofacial replacement, Soft tissue repair, replacement and augmentation, recent advancement and future directions.

**Suggested Readings**


1. Kopff W.J Artificial Organs John Wiley and sons, New York, 1st edition 1976
2. Park J.B., Biomaterials Science and Engineering Plenum Press 1984
3. J D Bronzino Biomedical Engineering handbook Volume II CRC Press / IEEE Press 2000
4. R S Khandpur Handbook of Biomedical Instrumentation Tata McGraw Hill 2003
5. Joon B Park Biomaterials – An Introduction Plenum press, New York 1992
6. Yannas, I. V Tissue and Organ Regeneration in Adults New York, NY: Springer 2001
7. Yadin David, Wolf W. von Maltzahn, Michael R. Neuman, Joseph.D, Bronzino Clinical Engineering CRC Press, 1st edition 2010
8. Myer Kutz Standard Handbook of Biomedical Engineering & Design McGraw- Hill 2003

## BIO TECHNOLOGY

**B.E Electrical and Electronics Engineering** **2019-2020**

| **18BTBTOE01** | **BIOREACTOR DESIGN** | **3H-3C** |
|---|---|---|

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objectives**

- To impart basic knowledge in bioprocess Engineering
- To design the bioreactors for various operations.
- To understand the principle and working of heat transfer equipments.
- To extend the knowledge in principle of heat transfer inside a bioreactor
- To construct the equipments used in mass transfer operations.
- To learn the equipments used in separation process.

**Course Outcomes**

- Summarize the basic concepts in bioprocess Engineering.
- Ability to design the bioreactors for various operations.
- Ability to develop the heat transfer equipments for Bioprocess Engineering.
- Ability to construct the equipments used in mass transfer operations.
- To acquire the knowledge of regulatory constraints in bioprocess
- Categorize the equipments used in separation process.

**UNIT I INRODUCTION TO BIOPROCESS ENGINEERING**

Introduction – Biotechnology and Bioprocess Engineering- Biologists and Engineers Differ in their approach to research-How Biologists and Engineers work Together- Bioprocesses: Regulatory constraints.

**UNIT II REACTOR DESIGN**

Design of Airlift fermentor, Bubble column reactor and Continuous stirred tank reactor.

**UNIT III HEAT TRANSFER EQUIPMENTS**

Design of Shell and tube Heat exchanger, Double pipe heat exchanger, long tube vertical evaporator and forced circulation evaporator.

**UNIT IV MASS TRANSFER EQUIPMENTS**

Design of Bollmann extractor, fractionating column, packed tower and spray tray absorber

**UNIT V SEPARATION EQUIPMENTS**

Design of plate and frame filter press, leaf filter, rotary drum filter, disc bowl centrifuge, rotary drum drier and Swenson –walker crystallizer.

**Suggested Readings**


1. James Edwin Bailey, David F. Ollis (2015) Biochemical Engineering Fundamentals, Second Edition. McGraw-Hill Education (India) private limited.
2. Don W. Green, Robert H.Perry (2008). Chemical Engineer Hand book. The McGraw-Hill Companies, Inc.
3. Pauline. M. Doran (2015). Bioprocess Engineering Principles Second Edition . Academic Press.

**18BTBTOE02 FOOD PROCESSING AND PRESERVATION 3H-3C**

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objectives**

- To learn the scope and importance of food processing.
- To impart basic knowledge in different food processing methods carried out in the food tech companies.
- To extend the brief knowledge in food conservation operations.
- To study the methods of food preservation by cooling.
- To familiarize the students on the concepts of preservation methods for fruits.
- To create deeper understanding on preservation methods for vegetables.

**Course Outcomes**

- Describe the scope and importance of food processing.
- Outline the various processing methods for foods.
- Extend the knowledge in food conservation operations.
- Describe the methods of food preservation by cooling.
- Summarize the preservation methods for fruits.
- Demonstrate the preservation methods for vegetables.

**UNIT I SCOPE AND IMPORTANCE OF FOOD PROCESSING**

Properties of food - Physical, thermal, mechanical, sensory. Raw material Preparation - Cleaning, sorting, grading, peeling.

**UNIT II PROCESSING METHODS**

Heating- Blanching and Pasteurization. Freezing- Dehydration- canning-additives- fermentation- extrusion cooking- hydrostatic pressure cooking- dielectric heating- micro wave processing and aseptic processing – Infra red radiation processing-Concepts and equipment used.

**UNIT III FOOD CONVERSION OPERATIONS**

Size reduction – Fibrous foods, dry foods and liquid theory and foods – equipments - membrane separation- filtration- equipment and application.

**UNIT IV FOOD PRESERVATION BY COOLING**

Refrigeration, Freezing-Theory, freezing time calculation, methods freezing of freezing equipments, freeze drying, freeze concentration, thawing, effect of low temperature on food. Water activity, methods to control water activity.

## UNIT V PRESERVATION METHODS FOR FRUITS AND VEGETABLES

Pre processing operations - preservation by reduction of water content: drying / dehydration and concentration – chemical preservation – preservation of vegetables by acidification, preservation with sugar - Heat preservation– Food irradiation- Combined preservation techniques.

**Suggested Readings**


1. R. Paul Singh, Dennis R.Heldman (2014).Introduction to food engineering. Academic press.
2. P.Fellows.( 2017). Food processing technology principles and practice, Fourth Edition. Wood head publishing Ltd.
3. Mircea Enachescu Dauthy. (1995). Food and vegetable processing.FAO agricultural services bulletin.
4. M.A. Rao, Syed S.H.Rizvi, Ashim K. Datta. (2014). Engineering properties of foods. CRC press.
5. B. Sivasankar. (2002). Food processing and preservation.PHI learning Pvt.Ltd.

| 18BTBTOE03 | BASIC BIOINFORMATICS | 3H-3C |
|---|---|---|

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objectives**

- To understand the available tools and databases for performing research in bioinformatics.
- To expose students to sequence alignment tool in bioinformatics.
- To construct the phylogenetic trees for evolution.
- To get familiar with the 3D structure of protein and classification.
- To acquire basic knowledge in protein secondary structure prediction.
- To extend the brief knowledge in Micro array data analysis.

**Course Outcomes**

- Summarize the basic concepts and importance of Bioinformatics in various sectors.
- Demonstrate the sequence alignment tool in bioinformatics.
- Construct the phylogenetic trees for evolution.
- Analyze the three dimensional protein structure and classification using various tools.
- Illustrate the protein secondary structure prediction by comparative modeling.
- Extend the knowledge in micro array technology and applications of bioinformatics in various sectors.

**UNIT I OVERVIEW OF BIOINFORMATICS**

The scope of bioinformatics; bioinformatics & the internet; useful bioinformatics sites. Data acquisition: sequencing DNA, RNA & proteins; determination of protein structure; gene & protein expression data; protein interaction data. Databases – contents, structure & annotation: file formats; annotated sequence databases; miscellaneous databases.

**UNIT II RETRIEVAL OF BIOLOGICAL DATA**

Data retrieval with Entrez & DBGET/ Link DB; data retrieval with SRS (sequence retrieval system).Searching sequence databases by sequence similarity criteria: sequence similarity searches; amino acid substitution matrices; database searches, FASTA & BLAST; sequence filters; iterative database searches & PSI-BLAST. Multiple-sequence alignment, gene & protein families: multiple-sequence alignment & family relationships; protein families & pattern databases; protein domain families.

**UNIT III PHYLOGENETICS**

Phylogenetics, cladistics & ontology; building phylogenetic trees; evolution of macromolecular sequences. Sequence annotation: principles of genome annotation; annotation tools & resources.

**UNIT IV STRUCTURAL BIOINFORMATICS**

Conceptual models of protein structure; the relationship of protein three-dimensional structure to protein function; the evolution of protein structure & function; obtaining, viewing & analyzing structural data; structural alignment; classification of proteins of known three-dimensional structure: CATH & SCOP; introduction to protein structure prediction; structure prediction by comparative modeling; secondary structure prediction; advanced protein structure prediction & prediction strategies.

**UNIT V MICROARRAY DATA ANALYSIS**

Microarray data, analysis methods; microarray data, tools & resources; sequence sampling & SAGE. Bioinformatics in pharmaceutical industry: informatics & drug discovery; pharma informatics resources. Basic principles of computing in bioinformatics: running computer software; computer operating systems; software downloading & installation; database management.

**Suggested Readings**


1. Dan E krane Michael L Rayme. (2004). Fundamental concepts of Bioinformatics. Pearson Education.
2. Andreas D Baxevanis B.F. Franchis Ouellette. (2004). Bioinformatics: A practical guide to the analysis of genes and proteins. Wiley-Interscience.
3. David W. Mount. (2004). Sequence and Genome Analysis. Cold Spring Harbor Laboratory.
4. Jonathan Pevsner.(2015). Bioinformatics and functional genomics. wiley-Liss.
5. Michael J Koernberg. (2016).Microarray Data Analysis: Methods and applications. Humana Press

**18BTBTOE04 FUNDAMENTALS OF NANO BIOTECHNOLOGY 3H-3C**

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objectives**

- To impart the skills in the field of nano biotechnology and its applications.
- To acquire knowledge in the nano particles and its significance in various fields.
- To extend the knowledge in types and application of nano particles in sensors.
- To define the concepts of biomaterials through molecular self assembly.
- To equip students with clinical applications of nano devices.
- To describe deeper understanding of the socio-economic issues in nanobiotechnology.

**Course Outcomes**

- Develop skills in the field of nano biotechnology and its applications.
- Summarize the nanoparticles and its significance in various fields.
- Extend the knowledge in types and application of nano particles in sensors.
- Define the concepts of biomaterials through molecular self assembly.
- Outline the clinical applications of nano devices.
- Describe the socio-economic issues in nanobiotechnology.

**UNIT I INTRODUCTION**

Introduction, Scope and Overview, Length scales , Importance of Nanoscale and Technology, History of Nanotechnology, Future of Nanotechnology: Nano Technology Revolution, Silicon based Technology, Benefits and challenges in Molecular manufacturing: The Molecular assembler concept, Controversies and confusions, Understanding advanced capabilities, Nanotechnology in Different, Fields: Nanobiotechnology, Materials, Medicine, Dental care.

**UNIT II NANO PARTICLES**

Introduction, Types of Nanoparticles, Techniques to Synthesize Nanoparticles, Characterization of Nanoparticles, Applications, Toxic effects of Nanomaterials, Significance of Nanoparticles Nano fabrications- MEMS/NEMS, Atomic Force Microscopy, Self assembled monolayers/ Dip- pen Nanolithography, Soft Lithography, PDMS Molding, Nano Particles, Nano wires and Nanotubes.

**UNIT III MEDICAL NANOTECHNOLOGY**

Nano medicine, Nano biosensor and Nano fluidics. Nanocrystals in biological detection, Electrochemical DNA sensors and Integrated Nanoliter systems. Nano-Biodevices and Systems. Fabrication of Novel Biomaterials through molecular self assembly- Small scale systems for in vivo drug delivery- Future nanomachine.

**UNIT IV NANOBIOTECHNOLOGY**

Clinical applications of nanodevices. Artificial neurons. Real-time nano sensors- Applications in cancer biology. Nanomedicine. Synthetic retinyl chips based on bacteriorhodopsins. High throughput DNA sequencing with nan carbontubules. Nanosurgical devices.

**UNIT V ETHICAL ISSUES IN NANOTECHNOLOGY**

Introduction, Socioeconomic Challenges, Ethical Issues in Nanotechnology: With Especial Reference to Nanomedicine, Nanomedicine Applied in Nonmedical Contexts, Social Issues Relating to Nanomedicine. Social and Ethical Issues, Economic Impacts, Other Issues, Nanotechnology and Future Socio-economic challenges.

**Suggested Readings**


1. Niemeyer, C.M. and Mirkin, C.A (2005). Nanobiotechnology: Concepts, Applications and Perspectives. Wiley-VCH.
2. Goodsell, D.S. (2004). Bionanotechnology. John Wiley and Sons, Inc.
3. Shoseyov, O.and Levy, I (2008).Nanobiotechnology: Bioinspired Devices and Materials of the Future. Humana Press.
4. Bhushan, B.(2017). Springer Handbook of Nanotechnology. Springer-Verlag Berlin Heidelberg.
5. FreitasJr R.A (2006) Nanomedicine. Landes Biosciences.
6. Kohler, M. and Fritzsche, W. (2008). Nanotechnology – An Introduction to Nanostructuring Techniques. Wiley-VCH.

## CHEMICAL ENGINEERING

**B.E Electrical and Electronics Engineering** **2019-2020**

**18BTCEOE01 ENERGY MANAGEMENT IN CHEMICAL INDUSTRIES 3H-3C**

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objectives**

- Teaching the basic concepts and fundamental aspects of industrial and domestic thermal systems' design.
- To study the relationship between energy systems and society
- To study optimization techniques for conservation of energy in chemical industries
- To study about environment population and its technology
- To study about commercial generation of power requirement
- Prepare the students for the positions of energy management in energy intensive industries

**Course Outcomes**

After completion of the course, students are able to

- Plan to optimize energy using systems and procedures to meet energy demand
- Describe the movement of substances in the entire globe
- Examine the relationship between energy systems and society
- Use optimization techniques for conservation of energy in chemical industries
- To acquire knowledge about environment population and its technology
- Evaluate the production rate and analyze the cost from economic balance for energy consumption.

**UNIT I PLANNING FOR ENERGY NEEDS**

Forecasting techniques; energy demand; magnitude and pattern; input and output analysis; energy modeling and optimal mix of energy sources.

**UNIT II ENERGY AND ENVIRONMENT**

Energy; various forms; energy storage; structural properties of environment; bio-geo-chemical cycles; society, environment population and technology.

**UNIT III ENERGY AND SOCIETY**

Energy and evolution; growth and change; patterns of consumption in developing and advanced countries; commercial generation of power requirements and benefit.

## UNIT IV MANAGEMENT OF ENERGY CONSERVATION IN CHEMICAL INDUSTRIES

Chemical industries; classification; conservation in unit operations such as separation; cooling tower; drying; conservation applied to refineries, petrochemical, fertilisers, cement, pulp and paper, food and chlor-alkali industries; conservation using optimization techniques.

## UNIT V ECONOMIC BALANCE IN ENERGY CONSUMPTION

Cost analysis; capacity; production rate; system rate; system cost analysis; corporate models; production analysis and production using fuel inventories; input-output analysis; economics; tariffs

**Suggested Readings**


1. Jerrold H Kertz, Energy Conservation and Utilization, Allyn and BacurInc, 1976.
2. Gemand M Gramlay, Energy, Macmillion publishing Co, Newyork, 1975
3. Krentz J. H., Energy Conservation and Utilization, Allyn and Bacur Inc., 1976.
4. Gramlay G. M., Energy, Macmillan Publishing Co., New York, 1975.
5. Rused C. K., Elements of Energy Conservation, McGraw-Hill Book Co., 1985

**B.E Electrical and Electronics Engineering** **2019-2020**

**18BTCEOE02** **FERTILIZER TECHNOLOGY** **3H-3C**

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objective**

- To enable the students to learn the fertilizer manufacturing including new or modified fertilizer products and new techniques
- To study the various processes and develop the flow chart for the manufacture of phosphatic fertilizers.
- To study the manufacturing of potassic fertilizer and analyze the unit operations involved in the process.
- To study the quality and pollution standards permissible in fertilizer industry.
- To study about availability of fertilizer demand in India
- To study about importance of micro nutrients

**Course Outcomes**

After completion of the course, students are able to

- Illustrate chemical, organic fertilizers and nutrients
- Develop the flow chart for manufacture of nitrogenous fertilizers
- Analyze the various processes and develop the flow chart for the manufacture of phosphatic fertilizers.
- Develop the flow chart for the manufacture of potassic fertilizer and analyze the unit operations involved in the process.
- Illustrate the quality and pollution standards permissible in fertilizer industry.
- Gain knowledge about practical fertilizer generation in India

**UNIT I INTRODUCTION**

Chemical Fertilizers and Organic Manures - Types of chemical Fertilizers. Secondary nutrients, micro nutrients.

**UNIT II NITROGEN FERTILIZERS**

Nitrogenous Fertilizers - Methods of production of Ammonia and Urea. Nitric acid, Ammonium sulphate, Ammonium Nitrate, Calcium Ammonium Nitrate, Ammonium Chloride - Their methods of production, characteristics, storage and handling specifications.

**UNIT III PHOSPHATIC FERTILIZERS**

Raw materials, phosphate rock, Sulphur pyrites -Process for the production of Sulphuric and Phosphoric acids. Ground phosphate rock, bone meal. Single Super Phosphate, Triple Super phosphate -Methods of production, characteristics and specifications.

**UNIT IV POTASSIC FERTILIZERS**

Potassium chloride, Potassium sulphate, Potassium schoenite - Methods of production, specification, characteristics. Complex Fertilizers, NPK Fertilizers, Mono ammonium phosphate, Diammonium phosphate, Nitro phosphate Methods of production.

**UNIT V FERTILIZERS IMPACTS AND STANDARDS**

Fluid fertilizers. Controlled Release of fertilizers. Solid, Liquid and Gaseous pollution from ammonia urea and NPK fertilizer industries and standards laid down for them. Fertilizer production in India.

**Suggested Readings**


1. GopalaRao M., Marshall Sittig, Dryden's Outlines of Chemical Technology, Third Edition, WEP East-West Press, New Delhi, 2010.
2. George T. Austin., Shreve's Chemical Process Industries, Fifth Edition, McGraw Hill Professional, 2012
3. Advances in Fertilizer Technology, The Fertilizer Association of India, New Delhi,1972.
4. Sauchelli V., Manual on Fertilizer Manufacture, Industry Publication Inc, New Jersy, 1963.
5. CHEMTECH - II - (Chapter on Fertilizers by Chari, K.S.), Chemical Engineering Education Development Centre, I.I.T.,Madras, 1977.
6. Menon M.G., Fertilizer Industry - Introductory Survey, Higginbothams, Madras, 1973

**18BTCEOE03 INDUSTRIAL WASTEWATER TREATMENT 3H-3C**

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objectives**

- To introduce students to the principles of wastewater and solid waste treatment and management.
- The students will learn the fundamental concepts in water and wastewater treatment technologies, hazardous solid waste disposal and management issues related to sludge treatment and disposal.
- To study the contaminants from the effluent for treatability.
- To study the biomass yield and substrate utilization rate for biological treatment process and design of activated sludge process.
- To study the importance of neutralisation and oxidation
- To study the flow sheet for the waste water treatment from dairy, sugar, pulp and paper, textile and pharmaceutical industries

**Course Outcomes**

After completion of the course, students are able to

- Examine the constituents of waste water and its effects.
- Separate the contaminants from the effluent for treatability.
- Determine the biomass yield and substrate utilization rate for biological treatment process and design of activated sludge process.
- Develop a flow sheet for the waste water treatment from dairy, sugar, pulp and paper, textile and pharmaceutical industries.
- Develop process flow diagram for water reuse and sludge disposal.
- To acquire knowledge of notification and de-nitrification

**UNIT I INTRODUCTION TO WASTE WATER ENGINEERING**

Waste Water Engineering - Overview, inorganic non-metallic constituents and metallic constituents, physical and biological Characteristics.

**UNIT II OPERATIONS AND UNIT PROCESS**

Screening, Flow Equalization, Mixing, Flocculation, Grit removal, Sedimentation, Coagulation, Precipitation, Oxidation and Neutralization

**UNIT III FUNDAMENTALS OF BIOLOGICAL TREATMENT**

Introduction, Microbial growth kinetics, types of biological process for wastewater treatment - aerobic and anaerobic oxidation, Biological Nitrification and De-nitrification, biological phosphorous removal, activated sludge process (with design
Considerations), trickling filters and lagoons.

**UNIT IV WASTE WATER TREATMENT IN SPECIFIC INDUSTRIES**

Dairy, Sugar, Pulp and Paper, Textile and Pharmaceutical Industries.

**UNIT V WATER REUSE**

Wastewater reclamation technologies and reuse, Solid processing flow diagrams, sludge and scum pumping, grinding, screening, degritting, blending, anaerobic digestion, composting, conditioning, dewatering and incineration.

**Suggested Readings**


1. Metcalf Eddy, Wastewater Engineering -Treatment and Reuse, Fourth Edition, Tata McGraw Hill, New Delhi, 2002.
2. Mark J. Hammer, Water and Wastewater Technology, Seventh Edition, Prentice Hall of India Pvt Limited, New Delhi, 2012.
3. James M. Montgomery, Water Treatment Principles and Design, First Edition, A Wiley Interscience publication, New York,1985

**18BTCEOE04 SOLID AND HAZARDOUS WASTE MANAGEMENT 3H-3C**

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objectives**

- To provide an understanding of solid and hazardous waste engineering principles and management issues
- To study the source reduction, recycling and reuse techniques of solid waste.
- To study the collection systems and method of transfer of solid waste.
- To study the processing techniques for solid and hazardous waste.
- Select the suitable methods for disposal of solid and hazardous waste.
- This course is designed to provide students with the necessary background and knowledge pertaining to the engineering design of solid and hazardous waste facilities

**Course Outcomes**

- After successful completion of the course, student will be able to
- Outline the salient features of solid waste management and handling.
- Deduce the source reduction, recycling and reuse techniques of solid waste.
- Analyze the collection systems and method of transfer of solid waste.
- Describe the processing techniques for solid and hazardous waste.
- Select the suitable methods for disposal of solid and hazardous waste.
- Interpret the legislation for management, handling and disposal of solid and hazardous waste.

**UNIT I CHARACTERISTICS AND SOURCE REDUCTION OF SOLID WASTE**

Definition, sources, and types of solid waste - Composition, physical, chemical and biological properties of solid wastes - Percapita generation rates - Sampling and characterization of solid waste - Source reduction of wastes -Waste exchange – Recycling and reuses - Salient features of Indian legislations on management and handling of municipal solid wastes.

**UNIT II COLLECTION AND TRANSPORT OF SOLID WASTE**

Estimation of solid waste and factors affecting generation rates - On-site handling, storage, and processing- Collection services: municipal and commercial - Industrial services - Collection systems: Hauled-container system (HCS) and stationary container system (SCS) - Vehicle and labour assessment - Assessment of collection route - Transfer and transport - Transfer station location- Means and methods of transfer.

**UNIT III PROCESSING AND DISPOSAL OF SOLID WASTE**

Objective of processing - material separation and processing technologies- biological, chemical and thermal conversion technologies- disposal in Landfills: site selection methods and operations,

leachate and gas generations and movement and control of gas and leachate techniques - Composting: aerobic and anaerobic - Resource and energy recovery schemes.

**UNIT IV HAZARDOUS WASTE CHARACTERIZATION AND MANAGEMENT**

Definitions and Identifications of hazardous waste - Origin and characterization of hazardous solid waste- Typical hazardous wastes in MSW - Hazardous waste management: minimization, collection, storage, handling, transport, and disposal - design of hazardous waste landfills - TCLP tests - National and International legislation for hazardous waste management – Atomic Energy Regulatory Board -International Atomic Energy Agency - Department of Atomic Energy - Nuclear Power Corporation - Nuclear power plants in India.

**UNIT V NUCLEAR WASTE AND e-WASTE**

Sources - classification - effects of nuclear waste- initial treatment of nuclear waste verification, ion exchange, synroc – long term management - above ground disposal, geological disposal, ocean dumping, transmutation, space disposal - reuse of waste - nuclear safety and waste regulation - case study on nuclear disaster - source of e-waste - material composition of e-waste - recycling and recovery - integrated approaches to e-waste recycling - socio economic factors - treatment option - disposal option - e-waste legislation.

**Suggested Readings**


1. Tchobanoglous, G. et al., "Integrated Solid Waste Management", McGraw-Hill Publication., New York, 1993.
2. Ronald E. Hester, Roy M. Harrison "Electronic Waste Management", Royal Society of Chemistry, 2009.
3. Charles, A.W., "Hazardous Waste Management", McGraw-Hill Publication, 2002

## CIVIL ENGINEERING

**B.E Electrical and Electronics Engineering** **2019-2020**

**18BECEOE01** **HOUSING PLAN AND MANAGEMENT** **3H-3C**

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objectives**

- To examine the role and tasks of basic housing policies and building bye laws
- Understand the process of integrated service delivery in the context of economic, social, environmental and institutional factors
- Analyze the Innovative construction methods and Materials
- Analyze city management strategies and strengthen the urban governance through a problem solving approach
- To know the Importance of basic housing policies and building bye laws
- To use Housing Programmes and Schemes

**Course Outcomes**

The students will be able to

- Know the Importance of basic housing policies and building bye laws
- Use Housing Programmes and Schemes
- Plan and Design of Housing projects
- Examine Innovative construction methods and Materials
- Know Housing finance and loan approval procedures
- Understand Construction as well as managing techniques

**UNIT I INTRODUCTION TO HOUSING**

Definition of Basic Terms – House, Home, Household, Apartments, Multi storeyed Buildings, Special Buildings, Objectives and Strategies of National Housing Policies, Principle of Sustainable Housing, Housing Laws at State level, Bye-laws at Urban and Rural Local Bodies – levels - Development Control Regulations, Institutions for Housing at National, State and Local levels

**UNIT II HOUSING PROGRAMMES**

Basic Concepts, Contents and Standards for Housing Programmes - Sites and Services, Neighborhoods, Open Development Plots, Apartments, Rental Housing, Co-operative Housing, Slum Housing Programmes, Role of Public, Private and Non-Government Organizations.

**UNIT III PLANNING AND DESIGN OF HOUSING PROJECTS**

Formulation of Housing Projects – Site Analysis, Layout Design, Design of Housing Units (Design Problems)

**UNIT IV CONSTRUCTION TECHNIQUES AND COST-EFFECTIVE MATERIALS**

New Constructions Techniques – Cost Effective Modern Construction Materials, Building Centers – Concept, Functions and Performance Evaluation

**UNIT V HOUSING FINANCE AND PROJECT APPRAISAL**

Appraisal of Housing Projects – Housing Finance, Cost Recovery – Cash Flow Analysis, Subsidy and Cross Subsidy, Pricing o f Housing Units, Rents, Recovery Pattern (Problems).

**Suggested Readings**


1. Meera Mehta and Dinesh Mehta, Metropolitan Housing Markets, Sage Publications Pvt. Ltd., New Delhi, 2002.
2. Francis Cherunilam and Odeyar D Heggade, Housing in India, Himalaya Publishing House,
   Bombay, 2001.
3. Development Control Rules for Chennai Metropolitan Area, CMA, Chennai, 2002.
4. UNCHS, National Experiences with Shelter Delivery for the Poorest Groups, UNCHS (Habitat), Nairobi, 2000.

**18BECEOE02 BUILDING SERVICES 3H-3C**

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objectives**

- Defining and identifying of eng. services systems in buildings.
- The role of eng. services systems in providing comfort and facilitating life of users of the building.
- The basic principles of asset management in a building & facilities maintenance environment
- Importance of Fire safety and its installation techniques
- To Know the principle of Refrigeration and application
- To Understand Electrical system and its selection criteria

**Course Outcome**

The students will be able to

- Machineries involved in building construction
- Understand Electrical system and its selection criteria
- Use the Principles of illumination & design
- Know the principle of Refrigeration and application
- Importance of Fire safety and its installation techniques
- Know the principle behind the installation of building services and to ensure safety in buildings

**UNIT I MACHINERIES**

Hot Water Boilers – Lifts and Escalators – Special features required for physically handicapped and elderly – Conveyors – Vibrators – Concrete mixers – DC/AC motors – Generators – Laboratory services – Gas, water, air and electricity

**UNIT II ELECTRICAL SYSTEMS IN BUILDINGS**

Basics of electricity – Single / Three phase supply – Protective devices in electrical installations – Earthing for safety – Types of earthing – ISI specifications – Types of wires, wiring systems and their choice – Planning electrical wiring for building – Main and distribution boards – Transformers and switch gears – Layout of substations

**UNIT III PRINCIPLES OF ILLUMINATION & DESIGN**

Visual tasks – Factors affecting visual tasks – Modern theory of light and colour – Synthesis of light – Additive and subtractive synthesis of colour – Luminous flux – Candela – Solid angle illumination – Utilization factor – Depreciation factor – MSCP – MHCP –Classification of lighting – Artificial light sources – Spectral energy distribution – Luminous efficiency – Colour temperature – Colour rendering. Design of modern lighting – Lighting for stores, offices, schools, hospitals and house lighting. Elementary idea of special features required and minimum level of illumination required for physically handicapped and elderly in building types.

**UNIT IV REFRIGERATION PRINCIPLES & APPLICATIONS**

Thermodynamics – Heat – Temperature, measurement transfer – Change of state – Sensible heat – Latent heat of fusion, evaporation, sublimation – saturation temperature – Super heated vapour – Sub cooled liquid – Pressure temperature relationship for liquids – Refrigerants – Vapour compression cycle – Compressors – Evaporators – Refrigerant control devices – Electric motors – Starters – Air handling units – Cooling towers – Window type and packaged air-conditioners – Chilled water plant – Fan coil systems – Water piping – Cooling load – Air conditioning systems for different types of buildings – Protection against fire to be caused by A.C. Systems

**UNIT V FIRE SAFETY INSTALLATION**

Causes of fire in buildings – Safety regulations – NBC – Planning considerations in buildings like non-combustible materials, construction, staircases and lift lobbies, fire escapes and A.C. systems. Special features required for physically handicapped and elderly in building types – Heat and smoke detectors – Fire alarm system, snorkel ladder – Fire lighting pump and water storage – Dry and wet risers – Automatic sprinklers

**Suggested Readings**


1. E.R.Ambrose, “Heat Pumps and Electric Heating”, John and Wiley and Sons, Inc., New York, 2002.
2. Handbook for Building Engineers in Metric systems, NBC, New Delhi, 2005.
3. Philips Lighting in Architectural Design, McGraw-Hill, New York, 2000.
4. A.F.C. Sherratt, “Air-conditioning and Energy Conservation”, The Architectural Press, London, 2005.
5. National Building Code.

**18BECEOE03 REPAIR AND REHABILITATION OF STRUCTURES 3H-3C**

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objectives**

- To learn various distress and damages to concrete and masonry structures
- To know the influence of corrosion in durability of structures
- To understand the importance of maintenance of structures
- To study the various types and properties of repair materials
- To learn various techniques involved in demolition of structures
- To Assessing damage of structures and various repair techniques

**Course Outcomes**

By the end of this course students will have the capability/knowledge of

- Various distress and damages to concrete and masonry structures
- Durability of structures and corrosion mechanism
- The importance of maintenance of structures, types and properties of repair materials etc
- Assessing damage of structures and various repair techniques
- Modern technique and equipment being adopted for the demolition of structures
- Influence of corrosion in durability of structures

**UNIT I INTRODUCTION**

Quality assurance for concrete construction as built concrete properties strength, permeability, thermal properties and cracking. Effects due to climate, temperature, chemicals, wear and erosion, Design and construction errors.

**UNIT II DURABILITY OF STRUCTURES**

Corrosion mechanism – diagnosis- causes and effects - cover thickness and cracking, measurements for corrosion - methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coatings, cathodic protection.

**UNIT III MAINTENANCE AND REPAIR STRATEGIES**

Definitions: Maintenance, repair and rehabilitation, Facets of Maintenance importance of Maintenance Preventive measures on various aspects Inspection, Assessment procedure for evaluating a damaged structure causes of deterioration - testing techniques.

**UNIT IV MATERIALS FOR REPAIR**

Special concretes and mortar, concrete chemicals, special elements for accelerated strength gain, Expansive cement, polymer concrete, sulphur infiltrated concrete, Ferro cement, Fibre reinforced concrete. eliminators and polymers coating for rebars during repair foamed concrete, mortar and dry pack, vacuum concrete.

**UNIT V TECHNIQUES FOR REPAIR AND REPAIR OF STRUCTURES**

Non-destructive Testing Techniques, Corrosion protection techniques , Gunite and Shotcrete Epoxy injection, Mortar repair for cracks, shoring and underpinning. Repairs to overcome low member strength, Deflection, Cracking, Chemical disruption, weathering wear, fire, leakage, marine exposure Engineered demolition techniques for dilapidated structures - case studies

**Suggested Readings**


1. Repair of Concrete Structures R.T.Allen and S.C.Edwards Blakie and Sons, UK, 2011
2. Rehabilitation of concrete structures Dr.B.Vidivelli Standard publishers, Chennai.2011


**Websites**

1. Http://Www.Icivilengineer.Com
2. http://www.engineeringcivil.com/
3. http://www.aboutcivil.com/
4. http://www.engineersdaily.com
5. http://www.asce.org/
6. http://www.cif.org/
7. http://icevirtuallibrary.com/
8. http://www.ice.org.uk/
9. http://www.engineering-software.com/ce/

**18BECEOE04 COMPUTER-AIDED CIVIL ENGINEERING DRAWING 3H-3C**

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objectives**

- Develop Parametric design and the conventions of formal engineering drawing
- Produce and interpret 2D & 3D drawings
- Communicate a design idea/concept graphically/ visually
- Examine a design critically and with understanding of CAD - The student learn to interpret drawings,
- To produce designs using a combination of 2D and 3D software.
- Get a Detailed study of an engineering artifact

**Course Outcome**

The students will be able to

- Develop Parametric design and the conventions of formal engineering drawing
- Produce and interpret 2D & 3D drawings
- Communicate a design idea/concept graphically/ visually
- Examine a design critically and with understanding of CAD - The student learn to interpret drawings, and to produce designs using a combination of 2D and 3D software.
- Get a Detailed study of an engineering artifact
- Planning and designing of structures

**UNIT I INTRODUCTION**

Introduction to concept of drawings, Interpretation of typical drawings, Planning drawings to show information concisely and comprehensively; optimal layout of drawings and Scales; Introduction to computer aided drawing, co- ordinate systems, reference planes. Commands: Initial settings, Drawing aids, Drawing basic entities, Modify commands, Layers, Text and Dimensioning, Blocks. Drawing presentation norms and standards.

**UNIT II SYMBOLS AND SIGN CONVENTIONS**

Materials, Architectural, Structural, Electrical and Plumbing symbols. Rebar drawings and structural steel fabrication and connections drawing symbols, welding symbols; dimensioning standards

**UNIT III MASONRY BONDS**

English Bond and Flemish Bond – Corner wall and Cross walls - One brick wall and one and half brick wall

**UNIT IV BUILDING DRAWING**

Terms, Elements of planning building drawing, Methods of making line drawing and detailed drawing. Site plan, floor plan, elevation and section drawing of small residential buildings. Foundation plan. Roof drainage plans. Depicting joinery, standard fittings & fixtures, finishes. Use of Notes to improve clarity

**UNIT V PICTORIAL VIEW**

Principles of isometrics and perspective drawing. Perspective view of building.

**List of Drawing Experiments:**

1. Buildings with load bearing walls including details of doors and windows.
2. Single storey RCC building
3. Multistorey RCC building

**Suggested Readings**


1. Subhash C Sharma & Gurucharan Singh (2005), " Civil Engineering Drawing", Standard Publishers
2. Ajeet Singh (2002), " Working with AUTOCAD 2000 with updates on AUTOCAD 200I", Tata- Mc Graw-Hill Company Limited, New Delhi
3. Sham Tickoo Swapna D (2009), "AUTOCAD for Engineers and Designers", Pearson Education,
4. Venugopal (2007), "Engineering Drawing and Graphics + AUTOCAD", New Age International Pvt. Ltd.,

**COMPUTER SCIENCE AND ENGINEERING**

**B.E Electrical and Electronics Engineering** **2019-2020**

| **18BECSOE01** | **INTERNET PROGRAMMING** | **3H-3C** |
|---|---|---|

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objectives**

- To study concepts of Internet, IP addresses and protocols
- To explain the concept of web page development through HTML
- To introduce the PERL and explore its current strengths and Weaknesses
- To write working Java code to demonstrate the use of applets for client side programming
- To study Internet telephony and various multimedia applications
- To Elaborate on the principles of web page development

**COURSE OUTCOMES:**

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

- Learn the advanced concepts& techniques of Internet and Java.
- Analyze the requirements for and create and implement the principles of web page development
- Understand the concepts of PERL
- Implement client side programming using java applets
- Generate internet telephony based upon advanced concepts
- Develop applications on internet programming based on java applets and scripts

**UNIT I INTRODUCTION**

Introduction - Network of Networks, Intranet, Extranet and Internet. World Wide Web- Domain and Sub domain, Address Resolution, DNS, Telnet, FTP, HTTP. TCP/IP- Features, Segment, Three-Way Handshaking, Flow Control, Error Control, Congestion control, IP Datagram, IPv4 and IPv6. IP Subnetting and addressing- Classful and Classless Addressing, Subnetting

**UNIT II HTML**

Introduction, Editors, Elements, Attributes, Heading, Paragraph. Formatting, Link, Head, Table, List, Block, Layout, CSS. Form, Iframe, Colors, Colorname, Colorvalue. Image Maps- map, area, attributes of image area- Extensible Markup Language (XML)- Introduction, Tree, Syntax, Elements, Attributes, Validation, Viewing. XHTML in brief. CGI Scripts- Introduction- Environment Variable, GET and POST Methods.

**UNIT III PERL**

Introduction, Variable, Condition, Loop, Array, Implementing data structure, Hash, String, Regular Expression, File handling, I/O handling- JavaScript- Basics, Statements, comments,

variable, comparison, condition, switch, loop, break. Object – string, array, Boolean, reg-ex. Function, Errors, Validation. Cookies- Definition of cookies, Create and Store a cookie with example. Java Applets-Container Class, Components, Applet Life Cycle, Update method, Applications.

**UNIT IV CLIENT-SERVER PROGRAMMING**

Client-Server programming In Java - Java Socket, Java RMI. Threats - Malicious code-viruses, Trojan horses, worms; eavesdropping, spoofing, modification, denial of service attacks- Network security techniques- Password and Authentication- VPN, IP Security, security in electronic transaction, Secure Socket Layer (SSL), Secure Shell (SSH). Firewall- Introduction, Packet filtering, Stateful, Application layer, Proxy.

**UNIT V INTERNET TELEPHONY**

Introduction, VoIP- Multimedia Applications- Multimedia over IP: RSVP, RTP, RTCP and RTSP- Streaming media, Codec and Plugins, IPTV- Search Engine and Web Crawler- Definition, Meta data, Web Crawler, Indexing, Page rank, overview of SEO.

**Suggested Readings**


1. Paul Deitel, Harvey Deitel and Abby Deitel, “Internet and World Wide Web-How to Program”, 5th Edition, 2011.
2. Web Technology: A Developer's Perspective, N.P. Gopalan and J. Akilandeswari, PHI Learning, Delhi, 2013.
3. Rahul Banerjee, Internetworking Technologies, An Engineering Perspective, PHI Learning, Delhi, 2011.
4. Robert W. Sebesta, “Programming the World Wide Web”, Pearson Education, 2016

| 18BECSOE02 | MULTIMEDIA AND ANIMATION | 3H-3C |
|---|---|---|

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objectives**

- To impart the fundamental concepts of Computer Animation and Multimedia
- To study the graphic techniques and algorithms using flash
- Explain various concepts available in 3D animation
- Explain various devices available for animation
- To study the multimedia concepts and various I/O technologies for concept development
- To understand the three-dimensional graphics and their transformations

**COURSE OUTCOMES**

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

- Develop their creativity using animation and multimedia
- Understand the concepts of Flash and able to develop animation using it
- Understand about various latest interactive 3D animation concepts
- Know the various devices and software available in motion capture
- Understand the concept development process
- Develop an interactive multimedia presentation by using multimedia devices and identify theoretical and practical aspects in designing multimedia applications surrounding the emergence of multimedia technology.

**UNIT I INTRODUCTION**

What is mean by Animation – Why we need Animation – History of Animation– Uses of Animation
– Types of Animation – Principles of Animation – Some Techniques of Animation – Animation on the WEB – 3D Animation – Special Effects -Creating Animation.

**UNIT II CREATING ANIMATION IN FLASH**

Introduction to Flash Animation – Introduction to Flash – Working with the Timeline and Frame-based Animation - Working with the Timeline and Tween-based Animation – Understanding Layers - Action script.

**UNIT III 3D ANIMATION & ITS CONCEPTS**

Types of 3D Animation – Skeleton & Kinetic 3D Animation – Texturing & Lighting of 3D Animation – 3D Camera Tracking – Applications & Software of 3D Animation.

**UNIT IV MOTION CAPTION**

Formats – Methods – Usages – Expression – Motion Capture Software's – Script Animation Usage
– Different Language of Script Animation Among the Software.

**UNIT V CONCEPT DEVELOPMENT**

Story Developing – Audio & Video – Color Model – Device Independent Color Model – Gamma and Gamma Correction - Production Budgets- 3D Animated Movies.

**Suggested Readings**


1. Computer Graphics, Multimedia and Animation-Malay K. Pakhira,PHI Learning PVT Ltd,2010
2. Principles of Multimedia – Ranjan Parekh, 2007, TMH. (Unit I, Unit V)
3. Multimedia Technologies – Ashok Banerji, Ananda Mohan Ghosh – McGraw Hill Publication.
4. Encyclopedia of Multimedia and Animations-Pankaj Dhaka, Anmol Publications-2011

**18BECSOE03 PC HARDWARE AND TROUBLE SHOOTING 3H-3C**

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objectives**

- To study the basic parts of computer in detail
- Introduce various peripheral devices available for computer and its detailed working concepts
- Overview of various interfaces and other hardware overview
- Assemble/setup and upgrade personal computer systems and discuss about power supplies and the skills to trouble-shoot various power-related problems.
- To study basic concepts and methods in troubleshooting
- To study the installation/connection and maintenance of computer and its associated peripherals.

**COURSE OUTCOME:**

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

- Identify the main components for the PC, familiarize themselves with PC memories such as RAM and ROM devices and so on.
- Identify various peripheral devices available and its working
- Understand various concepts of hardware and its interface and control
- Perform basic installation of PC. Importance of maintenance is understood
- Understand Various faults and failures are identified and troubleshooting in detail
- Understand overall PC hardware, interfacing, maintenance and troubleshooting

**UNIT I INTRODUCTION**

Introduction - Computer Organization – Number Systems and Codes – Memory – ALU – CU – Instruction prefetch – Interrupts – I/O Techniques – Device Controllers – Error Detection Techniques– Microprocessor – Personal Computer Concepts – Advanced System Concepts – Microcomputer Concepts – OS – Multitasking and Multiprogramming – Virtual Memory – Cache Memory – Modern PC and User.

**UNIT II PERIPHERAL DEVICES**

Introduction – Keyboard – CRT Display Monitor – Printer – Magnetic Storage Devices – FDD – HDD – Special Types of Disk Drives – Mouse and Trackball – Modem – Fax-Modem – CD ROM Drive – Scanner – Digital Camera – DVD – Special Peripherals.

**UNIT III PC Hardware Overview**

Introduction – Hardware BIOS DOS Interaction – The PC family – PC hardware – Inside the System Box – Motherboard Logic – Memory Space – Peripheral Interfaces and Controllers – Keyboard Interface – CRT Display interface – FDC – HDC.

**UNIT IV INSTALLATION AND PREVENTIVE MAINTENANCE**

Introduction – system configuration – pre installation planning – Installation practice – routine checks – PC Assembling and integration – BIOS setup – Engineering versions and compatibility – preventive maintenance – DOS – Virus – Data Recovery.

**UNIT V TROUBLESHOOTING**

Introduction – computer faults – Nature of faults – Types of faults – Diagnostic programs and tools – Microprocessor and Firmware – Programmable LSI's – Bus Faults – Faults Elimination process – Systematic Troubleshooting – Symptoms observation and analysis – fault diagnosis – fault rectification – Troubleshooting levels – FDD, HDD, CD ROM Problems.

**Suggested Readings**


1. B. Govindarajalu, "IBM PC Clones Hardware, Troubleshooting and Maintenance", 2/E, TMH, 2002.
2. Peter Abel, Niyaz Nizamuddin, "IMB PC Assembly Language and Programming", Pearson Education, 2007
3. Scott Mueller, "Repairing PC's", PHI, 1992

| 18BECSOE04 | JAVA PROGRAMMING | 3H-3C |
|---|---|---|

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objective**

- To understand Object Oriented Programming concepts and basic characteristics of Java
- To know the principles of packages, inheritance and interfaces
- To define exceptions and use I/O streams
- To develop a java application with threads, generics classes and swings
- To explain the need for generic programming
- To design and build simple Graphical User Interfaces

**COURSE OUTCOMES:**

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

- Develop Java programs using OOP principles
- Develop Java programs with the concepts inheritance and interfaces
- Build Java applications using exceptions and I/O streams
- Develop Java applications with threads and generics classes and swings
- Understand various aspects for motivation of generic programming
- Develop various interactive Java programs using OOP concepts of Java

**UNIT I INTRODUCTION TO JAVA**

Object oriented programming concepts – objects – classes – methods and messages –abstraction and encapsulation – inheritance – abstract classes – polymorphism.- Objects and classes in Java – defining classes – methods - access specifiers – static members –constructors – finalize method

**UNIT II PACKAGES**

Arrays – Strings - Packages – Java-Doc comments –- Inheritance – class hierarchy –polymorphism – dynamic binding – final keyword – abstract classes

**UNIT III I/O STREAMS**

The Object class – Reflection – interfaces – object cloning – inner classes – proxies - I/O Streams - Graphics programming – Frame – Components – working with 2D shapes.

**UNIT IV EXCEPTION HANDLING**

Basics of event handling – event handlers – adapter classes – actions – mouse events – AWT event hierarchy – introduction to Swing – Model-View-Controller design pattern –buttons – layout management – Swing Components – exception handling – exception hierarchy – throwing and catching exceptions.

**UNIT V MOTIVATION FOR GENERIC PROGRAMMING**

Motivation for generic programming – generic classes – generic methods – generic code and virtual

machine – inheritance and generics – reflection and generics - Multi-threaded programming – interrupting threads – thread states – thread properties – thread synchronization – Executors – synchronizers.

**Suggested Readings**


1. Cay S. Horstmann and Gary Cornell Core Java: Volume I – Fundamentals Sun Microsystems Press 2008
2. K. Arnold and J. Gosling The JAVA programming language Third edition, Pearson Education, 2009
3. Timothy Budd Understanding Object-oriented programming with Java Updated Edition, Pearson Education 2002
4. C. Thomas Wu An introduction to Object-oriented programming with Java Fourth Edition, Tata McGraw-Hill Publishing company Ltd., 2008


**Websites**

1. http://elvis.rowan.edu/~kay/cpp/vc6_tutorial/
2. http://www.winprog.org/tutorial/msvc.html
3. http://www.tutorialized.com/tutorials/Visual-C/1
4. http://www.freeprogrammingresources.com/visualcpp.html

| 18BECSOE05 | MACHINE LEARNING | 3H-3C |
|---|---|---|

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

## COURSE OBJECTIVES

- To introduce the basic concepts and techniques of Machine Learning, supervised and unsupervised learning techniques
- To have a complete understanding of linear models and tree models in machine learning
- To study the various probability based learning techniques
- To learn Dimensionality Reduction Techniques.
- To understand Evolutionary Models and Graphical models of machine learning algorithms
- To discuss the overall concepts of various models in Machine learning

## COURSE OUTCOMES

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

- Distinguish between, supervised, unsupervised and semi-supervised learning
- Apply the appropriate machine learning strategy for any given problem based on linear and tree model
- Suggest probability learning algorithms for any given problem
- Understand various dimensionality reduction techniques
- Design systems that uses the appropriate graph models of machine learning
- Modify existing machine learning algorithms to improve classification accuracy / efficiency

## UNIT I INTRODUCTION

Foundations: Linear Algebra-Probability-Vectorization

Learning – Types of Machine Learning – Supervised Learning – Preliminaries-Testing Machine Learning Algorithms-Data into Probabilities – Basic Statistics-The Brain and the Neuron – Design a Learning System – Perspectives and Issues in Machine Learning – Concept Learning Task – Concept Learning as Search – Finding a Maximally Specific Hypothesis – Version Spaces and the Candidate Elimination Algorithm – Linear Discriminants – Perceptron – Linear Separability – Linear Regression-Logistic Regression

## UNIT II LINEAR MODELS AND TREE

Multi-layer Perceptron – Going Forwards – Going Backwards: Back Propagation Error – Multi- layer Perceptron in Practice – Examples of using the MLP – Overview – Deriving Back-Propagation – Radial Basis Functions and Splines – Concepts – RBF Networks – Curse of Dimensionality – Interpolations and Basis Functions – Support Vector Machines-Introduction to Deep Learning.

## UNIT III - PROBABILISTIC MODELS

Decision Trees – Constructing Decision Trees – Classification and Regression Trees –Feature Selection-Ensemble Learning – Boosting – Bagging – Different ways to Combine Classifiers – Probability and Learning –Gaussian Mixture Models – Nearest Neighbor Methods – Unsupervised Learning – K-Means and K-Medoids Algorithms – Vector Quantization – Self Organizing Feature

Map-

**Case Study 1** **:** Analysis of Feature Selection Algorithms for Real World Problems

**Case Study 2** **:** Evaluation of Neural Network Model, Decision Trees and Support Vector Machines for Real World Problems

**Case Study 3** **:** Evaluation of Clustering Algorithms such as K-Means and K-Medoids for Real World Problems

**Case Study 4:** Modify Supervised & Unsupervised Learning algorithms to improve the learning performance.

**UNIT IV -DIMENSIONALITY REDUCTION, EVOLUTIONARY MODELS**

Dimensionality Reduction – Linear Discriminant Analysis – Principal Component Analysis – Factor Analysis – Independent Component Analysis – Locally Linear Embedding – Isomap – Least Squares Optimization – Evolutionary Learning – Genetic algorithms – Genetic Offspring: - Genetic Operators – Using Genetic Algorithms – Reinforcement Learning – Overview – Getting Lost Example – Markov Decision Process

**UNIT V - GRAPHICAL MODELS**

Markov Chain Monte Carlo Methods – Sampling – Proposal Distribution – Markov Chain Monte Carlo – Graphical Models – Bayesian Networks – Markov Random Fields – Hidden Markov Models – Tracking Methods

**Case Study 5** **:** Working with Dimensionality Reduction Algorithms for Real World Problems

**Case Study 6** **:** Demonstrating the use of Evolutionary Algorithms to improve the efficiency of the algorithm / to optimization problem for Real World scenarios

**Case Study 7** **:** Working with Markov Models and Bayesian Networks to forecast future for Real World scenarios

**Suggested Readings**


1. Stephen Marsland, ―Machine Learning – An Algorithmic Perspective, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
2. Jason Bell, ―Machine learning – Hands on for Developers and Technical Professionals, First Edition, Wiley, 2014
3. Michael Bowles, Machine Learning in Python-Essential Techniques for Predictive Analysis, Wiley Publication, 2015.
4. Ethem Alpaydin, ―Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series), Third Edition, MIT Press, 2014
5. Peter Flach, ―Machine Learning: The Art and Science of Algorithms that Make Sense of Data, First Edition, Cambridge University Press, 2012.
6. Tom M Mitchell, ―Machine Learning, First Edition, McGraw Hill Education, 2013

**Websites**

1. 1) http://nptel.ac.in/courses/106106139/
2. 2)https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-867-machine-learning-fall-2006/
3. 3) https://www.kdnuggets.com/2015/11/seven-steps-machine-learning-python.html
4. 4) https://www.dataquest.io/blog/machine-learning-python/
5. 5)https://www.analyticsvidhya.com/blog/2016/10/16-new-must-watch-tutorials-courses-on-machine-learning/

**18BEECOE01 Real Time Embedded Systems 3H-3C**

**Instruction Hours/week: L: 3 T: 1 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objectives**

- To introduce students to the embedded systems, its hardware and software.
- To introduce devices and buses used for embedded networking.
- To study about task management
- To learn about semaphore management and message passing
- To study about memory management
- To imparts knowledge on

**Course Outcomes**

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

- Understand overview of embedded systems architecture
- Acquire knowledge on embedded system, its hardware and software.
- Gain knowledge on overview of Operating system
- Discuss about task Management
- Gain knowledge about semaphore management and message passing.
- Gain knowledge about memory management.

**UNIT-I INTRODUCTION TO EMBEDDED SYSTEM**

Introduction- Embedded systems description, definition, design considerations & requirements-Overview of Embedded System Architecture (CISC and RISC)-Categories of Embedded Systems-embedded processor selection & tradeoffs- Embedded design life cycle -Product specifications-hardware / software partitioning- iterations and implementation- hardware software integration – product testing techniques–ARM7.

**UNIT-II OPERATING SYSTEM OVERVIEW**

Introduction–Advantage and Disadvantage of Using RTOS–Multitasking–Tasks-Real Time Kernels – Scheduler- Non-Preemptive Kernels – Preemptive Kernels – Reentrancy- Reentrant Functions– Round Robin Scheduling- Task Priorities- Static Priorities– Mutual Exclusion– Deadlock– Inter task Communication–Message Mailboxes–Message Queues- Interrupts- Task Management–Memory Management-Time Management–Clock Ticks.

**UNIT-III TASK MANAGEMENT**

Introduction-µ C/OS-II Features-Goals ofµ C/OS-II-Hardware and Software Architecture–Kernel Structures: Tasks–Task States–Task Scheduling–Idle Task–Statistics Task–Interrupts Under µC/OS-II – Clock Tick-µ C/OS- II Initialization. Task Management: Creating Tasks–Task Stacks–Stack Checking–Task'sPriority–SuspendingTask– esumingTask.TimeManagement: Delaying a Task–Resuming a

Delayed Task–System Time. Event Control Blocks-Placing a Task in the ECB Wait List–Removing a Task from an ECB wait List.

**UNIT-IV SEMAPHORE MANAGEMENT AND MESSAGE PASSING**

Semaphore Management: Semaphore Management Overview– Signaling a Semaphore. Message Mailbox Management: Creating a Mailbox –Deleting Mailbox–Waiting for a Message box–Sending Message to a Mailbox- Status of Mailbox. Message Queue Management: Creating Message Queue–Deleting a Message Queue–Waiting for a Message Queue–Sending Message to a Queue– Flushing a Queue.

**UNIT-V MEMORY MANAGEMENT**

Memory Management: Memory Control Blocks–Creating Partition-Obtaining a Memory Block–Returning a Memory Block. Getting Started withμ C/OS-II–Installingμ C/OS-II–Portingμ C/OS-II: Development Tools–Directories and Files– Testing a Port -IAR Workbench withμ C/OS-II-μ C/OS- II Porting on a 8051CPU– Implementation of Multitasking- Implementation of Scheduling and Rescheduling –Analyze the Multichannel ADC with help ofμ C/OS-II.

**SUGGESTED READINGS**


1. Floyd JeanJ. Labrosse Micro C/OS–II The Real Time Kernel CMPBOOKS 2009
2. David Seal ARM Architecture Reference Manual.Addison-Wesley 2008
3. Steve Furbe, ARM System-on-Chip Architecture, Addison-Wesley Professional, California 2000.
4. K.V.K.K.Prasad Embedded Real-Time Systems: Concepts, Design & Programming Dream Tech Press 2005.
5. Sriram V Iyer, Pankaj Gupta Embedded Real Time Systems Programming Tata Mc Graw Hill 2004

**18BEECOE02 Consumer Electronics 3H-3C**

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objectives**

- To study about various speakers and microphone
- To learn the fundamental of television systems and standards
- To learn the process of audio recording and reproduction
- To study various telephone networks
- To discuss about the working of home appliances
- To familiarize with TV services like ISDN.

**Course Outcomes**

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

- Understand working of various type of loud speakers
- Acquire knowledge on various types of picture tubes
- Demonstrate the working of various optical recording systems
- Distinguish various standards for color TV system
- Acquire knowledge on various telecommunication networks
- Demonstrate the working of various home appliances

**UNIT-I LOUDSPEAKERS AND MICROPHONES**

Dynamic Loudspeaker, Electrostatic loudspeaker, Permanent Magnet Loudspeaker, Woofers and Tweeters – Microphone Characteristics, Carbon Microphones, Dynamic Microphones and Wireless Microphones.

**UNIT-II TELEVISION STANDARDS AND SYSTEMS**

Components of a TV system–interlacing–composite video signal. Colour TV– Luminance and Chrominance signal; Monochrome and Colour Picture Tubes- Color TV systems– NTSC, PAL, SECAM-Components of a Remote Control.

**UNIT-III OPTICAL RECORDING AND REPRODUCTION**

Audio Disc– Processing of the Audio signal–readout from the Disc –Reconstruction of the audio signal– Video Disc–Video disc formats- recording systems–Playback Systems.

**UNIT-IV TELECOMMUNICATION SYSTEMS**

Telephone services-telephone networks–switching system principles–PAPX switching–Circuit, packet and message switching, LAN, MAN and WAN, Integrated Services Digital Network. Wireless Local Loop. VHF/UHF radio systems, Limited range Cordless Phones; cellular modems.

**UNIT-V HOME APPLIANCES**

Basic principle and block diagram of microwave oven; washing machine hardware and software; Components of air conditioning and refrigeration systems.

**SUGGESTED READINGS**


1. S.P. Bali Consumer Electronics Pearson Education 2007
2. J.S.Chitode Consumer Electronics Technical Publications 2007
3. Philip Hoff, Philip Herbert Hoff Consumer Electronics for Engineers Cambridge University Press 1998

**18BEECOE03 Neural Networks and its Applications 3H-3C**

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objectives**

- To introduce the basic concepts of neural networks and its applications in various domain
- To educate how to use Soft Computing to solve real-world problems
- To have a solid understanding of Basic Neural Network.
- To provide students with a sound and comprehensive understanding of artificial neural networks and machine learning.
- To gain exposure in the field of neural networks and relate the human neural system into the digital world
- To provide knowledge of computation and dynamical systems using neural networks

**Course Outcomes**

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

- Understand the basic concepts of neural networks and its applications in various domains
- Gain knowledge about learning process in Neural Networks
- Apply perception concept in design
- Design using ART phenomena
- Gain knowledge on SOM concepts
- Ability to develop the use of Soft Computing to solve real-world problems

**UNIT-I INTRODUCTION TO NEURAL NETWORKS**

Introduction-biological neurons and their artificial models-learning, adaptation and neural network's learning rules-types of neural networks-single layer, multiple layer-feed forward, feedback networks

**UNIT-II LEARNING PROCESS**

Error– correction learning– memory based learning- hebbian learning-competitive learning-Boltzmann learning-supervised and unsupervised learning-adaptation-statistical learning theory.

**UNIT-III PERCEPTION**

Single layer Perception-Adaptive filtering-unconstrained Optimization-Least-mean square algorithm- Leaning Curve-Annealing Technique-perception convergence Theorem-Relationship between perception and Baye's Classifier-Back propagation algorithm

**UNIT-IV ATTRACT OR NEURAL NETWORK AND ART**

Hopfield model-BAM model -BAM Stability-Adaptive BAM -Lyapunov function-effect of gain-Hopfield Design-Application to TSP problem-ART-layer 1-layer 2-orienting subsystem- ART algorithm-ARTMAP.

**UNIT-V SELF ORGANIZATION**

Self-organizing map-SOM Algorithm-properties of the feature map-LVQ-Hierarchical Vector Quantization. Applications of self-organizing maps: The Neural Phonetic Type Writer Learning Ballistic Arm Movements.

**SUGGESTED READINGS**


1. SimonHaykin Neural Networks and Learning Machines 3rd Edition Pearson/Prentice Hall 2009
2. SatishKumar Neural Networks: A Classroom Approach TMH 2008
3. Rajasekaran.S, Vijayalakshmi Pai.G.A Neural Networks, Fuzzy Logic and Genetic Algorithms, Synthesis and Applications PHI, New Delhi 2003.
4. LaureneFausett Fundamentals of Neural Networks: Architectures, Algorithms, and Applications Pearson/Prentice Hall 1994
5. Wasserman P.D Neural Computing Theory & Practice Van Nortrand Reinhold 1989.
6. Freeman J.A, S kapura D.M Neural networks, algorithms, applications, and programming techniques AdditionWesley 2005.

**18BEECOE04 Fuzzy Logic and its Applications 3H-3C**

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objectives**

- To introduce the basic concepts of Fuzzy logic and its applications in various domain
- To educate how to use Fuzzy computation to solve real-world problems
- To have a solid understanding of Basic fuzzy models.
- Provide an understanding of the basic mathematical elements of the theory of fuzzy sets.
- To learn about applications on Fuzzy based systems
- To familiarize with fuzzy fiction and de fuzzy fiction procedures

**Course Outcomes**

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

- Understand the basic concepts of Fuzzy logic and its applications in various domain
- Gain knowledge on theory of Reasoning
- Develop fuzzy controllers
- Understand concepts of adaptive fuzzy control
- Ability to develop how to use Fuzzy computation to solve real- world problems
- Design fuzzy based model for any application

**UNIT-I BASICS OF FUZZY LOGIC**

Fuzzy sets, Properties of fuzzy sets, operation in fuzzy sets, fuzzy relations, the extension principle

**UNIT-II THEORY OF APPROXIMATE REASONING**

Linguistic variables, Fuzzy proportions, Fuzzy if-then statements, inference rules, compositional rule of inference-fuzzy models

**UNIT-III FUZZY KNOWLEDGE BASED CONTROLLERS**

Basic concept structure of FKBC, choice of membership functions, scaling factors, rules, fuzzy fiction and de fuzzy fiction procedures–Design of Fuzzy Logic Controller

**UNIT-IV ADAPTIVE FUZZY CONTROL**

Process performance monitoring, adaption mechanisms, membership functions, tuning using gradient descent and performance criteria. Set organizing controller model based controller.

**UNIT-V FUZZY BASED SYSTEMS**

Simple applications of FKBC-washing machines-traffic regulations-lift control-fuzzy in medical Applications-Introduction to ANFIS.

**SUGGESTED READINGS**


1. D .Diankar ,H. Hellendoom and M .Rein frank An Introduction to Fuzzy Control Narosa Publishers India 1996
2. G.J. KlirandT.A. Folger Fuzzy Sets Uncertainty and Information PHI IEEE 1995
3. Timothy J. Ross Fuzzy Logic with Engineering Applications McGraw Hill1997
4. George. J Klir and Bo Yuan Fuzzy Sets and Fuzzy Logic Prentice Hall, USA 1995

**18BEECOE05 Principles of Modern Communication System 3H-3C**

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objectives**

- To provide students with an overview of communication systems
- To provide an overview on mobile communication
- To make students to have a better understanding on satellite and radar communication
- To understand the basic communication techniques which in turn are used as the building blocks of the larger and more complex communication systems.
- To acquire the basic engineering understanding to the modern communication systems and; the relevant theory and technique.
- Design simple systems for landing and navigation.

**Course Outcomes**

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

- Understand past, present and future trends in mobile communication.
- Gain knowledge about mobile cellular communication
- Understand various standards in use for wireless communication and its application.
- Demonstrate some basic application of GPS.
- Gain knowledge about RADAR working and its applications
- Demonstrate how a simple radar system works and its applications.

**UNIT I THE EVOLUTION OF ELECTRONIC COMMUNICATION**

From smoke signals to smart phones - History of communications: Theoretical Foundations, Development & Applications - Frequencies for communication - Frequency regulations - Overview of communication transmitter and receiver.

**UNIT II MOBILE CELLULAR COMMUNICATIONS**

Evolution to cellular networks – Cellular systems generations and standards: 1G, 2G, 3G, 4G - Cellular network components - Components of a mobile phone - setting up a call process - Making a call process - Receiving a call process - Spectrum allocation: Policies and strategies, Role of TRAI.

**UNIT III WIRELESS COMMUNICATION**

Introduction - Bluetooth - Infrared communication - IEEE Wireless LANs (Wi-Fi) - IEEE 802.16 (WiMaX) - Future mobile and wireless networks: Introduction to 5G- device to device communication- IoT.

**UNIT IV SATELLITE COMMUNICATION**

History of Satellite communication, Basics of Satellites, Types of Satellites, Capacity Allocation - Launch Vehicles and Orbits: Introduction to launching vehicles, Important Orbits, working of rocket, Three Pioneers of Rocketry - Basics of Global Positioning System (GPS) - Applications of GPS.

**UNIT V RADAR & NAVIGATION**

Introduction, Radar Block diagram and Operation, Radar Frequencies, Applications of Radar. Navigation Systems: Introduction & methods of navigation, Instrument Landing System, Microwave landing system- Modern Navigation systems.

**SUGGESTED READINGS**


1. S.Haykin, ―Communication Systems, 4/e, John Wiley 2007
2. B.P.Lathi, ―Modern Digital and Analog Communication Systems, 3/e, Oxford University Press,2007
3. Rappaport Theodore S - Wireless Communications: Principles and Practice, 2/E, Pearson Education India, 2010
4. Vijay. K. Garg, ―Wireless Communication and Networking, Morgan Kaufmann Publishers, 2007.
5. T.Pratt, C. Bostian and J.Allnutt; ―Satellite Communications, John Wiley and Sons, Second Edition., 2003
6. M. I .Skolnik ―Introduction to Radar Systems, Tata McGraw Hill 2006.
7. Myron Kyton and W.R.Fried ―Avionics Navigation Systems, John Wiley & Sons 1997.

## FOOD TECHNOLOGY

**B.E Electrical and Electronics Engineering** **2019-2020**

| **18BTFTOE01** | **PROCESSING OF FOOD MATERIALS** | **3H-3C** |
|---|---|---|

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objectives**

- Explain the milling, extraction and manufacture of tremendous products from cereals, pulses and oil seeds
- Summarize the production and processing methods of fruits and vegetables
- Discuss the chemical composition, processing, production, spoilage and quality of milk and milk products
- Outline the overall processes involved in the production of meat, poultry and fish products
- Review the production and processing methods of plantation and spice products
- To learn more about pasta products and its technologies

**Course Outcomes**

- Discuss the various processing technologies involved in cereal, pulses and oilseed technology
- Demonstrate the major operations applied in fruits and vegetable processing
- Illustrate the techniques involved in the processing of dairy products
- Infer the production of different types of milk
- List the overall processing of meat, poultry and fish processing
- Outline the processing of spices and plantation products

**UNIT I CEREAL, PULSES AND OIL SEEDS TECHNOLOGY**

Rice milling, Pulse milling, Wheat milling - Oil extraction - Methods of manufacture of Bread - different processes of manufacture - types of breads - buns, biscuits, cakes and cookies -Pasta products -Tortilla - Method of manufacture.

**UNIT II FRUITS AND VEGETABLE PROCESSING**

Production of Fruits and vegetables in India, Cause for heavy losses, preservation treatments - Basics of Canning, Minimal processing and Hurdle technology as applied to Vegetable and Fruit processing, Processing of fruit juices, Dehydration, Aseptic processing.

**UNIT III DAIRY PROCESSING**

Basic dairy terminology, composition, General tests at reception, Dairy Processing - Method of manufacture of Standardized, toned and double toned milk, milk powder - Equipments - Pasteurizers, homogenizers and pumps - Method of manufacture of dairy products - Icecream, Cheese, Paneer, Yoghurt - Pasteurization and microorganisms involved in spoilage of milk.

**UNIT IV MEAT, POULTRY AND FISH PROCESSING**

Meat composition from different sources, Definitions and measurements, Carcass Processing, Meat Products, Processing of Poultry Products, Fish and other Marine Products Processing .

**UNIT V PLANTATION PRODUCT TECHNOLOGY**

Processing of Tea, Coffee and Cocoa - Outline of the methods of manufacture of - green tea, black tea, instant tea, Instant coffee, Cocoa and Chocolate. Outline of the methods of processing of Pepper, cardamom, ginger, vanilla and turmeric

**Suggested Readings**


1. Srivastava R.P. and Kumar S. Fruit and Vegetable Preservation: Principles and Practices. International Book Distributing Co. Lucknow. 3rd Edition. 2010.
2. Chakraverty A., Mujumdar A.S., Raghavan G.S.V and Ramaswamy H.S. Handbook of Post-harvest Technology: Marcel Dekker Press. USA. 1st Edition. 2003.
3. Sukumar De. Outlines of Dairy Technology. Oxford University Press. New Delhi. 23rd impression. 2016.

**18BTFTOE02 NUTRITION AND DIETETICS 3H-3C**

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course objectives**

- Explain the basic concepts of food and nutrition
- Define the overall classification, function, and source of carbohydrates, lipids and proteins
- Discuss the overall aspects of vitamins
- To study the various attributes of fat and water soluble vitamins
- Outline the role of health and nutritional importance of micro and macro minerals
- Summarize the recent trends in nutrition

**Course outcomes**

- Discuss the basics in the area of nutritional assessment in health and disease
- Categorize the recommended dietary allowances for different age groups
- Express the classifications, functions and sources of carbohydrates, lipids and proteins
- List the various attributes of fat and water soluble vitamins
- Report the role, bioavailability, sources and deficiency diseases of macro and micro minerals
- Recognize the diets and concepts of foods suggested for nutrional, chronic and acute disorders

**UNIT I HUMAN NUTRITION**

Historical perspective of nutrient requirements – Assessment of nutritional status - recommended dietary allowances of macronutrients for all age groups - Assessment of protein quality – Malnutrition and related disorders – Balanced Diet. Factors influencing dietary intake: Food habits, food fads and fallacies, their influence on health and wellbeing.

**UNIT II BIOMOLECULES** Carbohydrates-

Definition, classification, Functions, Sources of Carbohydrates, Deficiency. Lipids – Definition, classification, function, sources, Refined & Hydrogenated fats process. Proteins – Definitions, Classification, Function, Amino Acids, Sources of Proteins.

**UNIT III VITAMINS**

Physiological role, bio-availability, requirements, sources and deficiency of Fat Soluble Vitamins: Vitamin A, Vitamin D, E & K. Water soluble vitamins: Vitamin C, Thiamine, Riboflavin, Niacin, Pantothenic acid, Biotin, Folic acid, Vitamin B12, VitaminB6.

**UNIT IV MINERALS**

Physiological role, bio-availability, requirements, sources and deficiency of Macro minerals: Calcium, Phosphorus Magnesium, Sodium, Potassium chloride. Micro minerals: Iron, Zinc, copper, selenium, chromium, iodine, manganese, Molybdenum and fluoride.

## UNIT V RECENT TRENDS IN NUTRITION

Principles of dietary management in gout, rheumatism, AIDS/HIV - Cancer-risk factors, symptoms, dietary management, role of food in prevention of Cancer. Role of functional foods, health foods and novel foods, organically grown foods, recent concepts in human nutrition like nutrigenomics, nutraceuticals etc.

**Suggested Readings**


1. Gordon M. Wardlaw. Perspectives in Nutrition. WCB McGraw-Hill Publishers, Boston, 9th Edition. 2013.
2. Shubhangini A. Joshi. Nutrition and Dietetics. Tata Mc Grow- Hill publishing Company Ltd, New Delhi. 4th Edition. 2016.
3. Srilakshmi. B. Nutrition Science. New Age International Pvt. Ltd, Publishers. 6th Edition. 2017.
4. Ronald Ross Watson. Functional foods and Nutraceuticals in Cancer Prevention. Ed. Wiley – Blackwell. 2003.
5. Sunetra Roday. Food Science and Nutrition. Oxford Higher Education/Oxford University Press. 3rd edition 2018.

**18BTFTOE03 READY TO EAT FOODS 3H-3C**

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objectives**

- Outline the current status of snack food Industry
- Describe the production, processing and marketing trends of potato and tortilla chips
- Outline the overall processing of popcorn
- To study the production, processing and manufacturing of fruit based snacks
- Explain the production and processing of fruits involved in snack food preparation
- Summarize the sensory analysis methods and packaging techniques of snack foods

**Course Outcomes**

- Review the overall aspects of snack food industry
- Develop ready to eat foods from potato and maize flour
- Demonstrate the various unit operations involved in the production of potato and tortilla chips
- Illustrate the overall aspects of popcorn production
- List the production, processing and manufacturing of fruit based snacks
- Recognize the sensory analysis and packaging methods of snack foods

**UNIT I SNACK FOOD INDUSTRY**

Introduction-History-Past innovations- Outline of snack food industry- Nutrition-Total Quality Management of Technology-Domestic Snack Food Market-Global Market-Snack Food Association Future Considerations

**UNIT II POTATO AND TORTILLA CHIPS PROCESSING**

Potato Production- Potato snack Ingredients- Potato Analysis and Composition-Potato chip manufacturing process-Unit Operations-Other value added products from Potato.

Tortilla chips - Raw Materials- Processing steps-Equipment involved-Reconstitution of Dry Maize Flour-Unit operations.

**UNIT III POPCORN PROCESSING**

Introduction- Raw popcorn selection and preparation-Popping Methods-Home preparation of Popcorn-Equipments-Industrial manufacturing process- Flavorings and Applicators-Popcorn

Packaging- Relative Nutrition- Marketing.

**UNIT IV FRUIT BASED SNACKS**

Introduction-production and processing of fruit crops – fruit purees – fruit powders – canned fruit snacks – alcoholic preservation of fruit snacks – fruit candies – fruit bars – exotic fruits.

**UNIT V SENSORY EVALUATION AND PACKAGING**

Introduction- Analytical methods-Sensory methods- Sensory Aspect of Processing- Quality properties of Snack Foods and Packaging Materials-Automated Bag- Pouch Packaging- Cartoning Case Packing- Current Issues in Snack Foods Packaging

**Suggested Reading**


1. Lusas, E. W and Rooney, L. W. Snack Foods Processing. CRC Press,1st Edition 2001.
2. Panda, H. The Complete Technology Book on Snack Foods, National Institute of Industrial Research, Delhi. 2nd Edition 2013.
3. Sergio O Serna-Saldivar, Industrial Manufacture of Snack Foods, Kennedys Books Ltd. 2008.

**18BTFTOE04 AGRICULTURAL WASTE AND BYPRODUCTS UTILIZATION 3H-3C**

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objectives**

- Categorize the types of agricultural wastes
- Outline the production and utilization of biomass
- Explain the various parameters considered to be important in the designing of biogas units
- Review the various methods employed in the production of alcohol from the byproducts of agricultural wastes
- To study the gaisifier maintenance
- Summarize the overall aspects involved in the production of paperboards and particleboards from agricultural wastes

**Course Outcomes**

- List and group the types of agricultural wastes
- Develop a number of value added products from agriculture wastes
- Discuss the techniques and production involved in the utilization of biomass
- Assess the various parameters considered to be important in the designing of biogas units
- Illustrate the various methods employed in the production of alcohol from the byproducts of agricultural wastes
- Choose the appropriate materials to produce paperboards and particle boards from agricultural wastes

**UNIT I TYPES OF AGRICULTURAL WASTES**

Introduction and Background Agricultural Waste, Crop Waste, Agricultural Residues (annual crops), Technical terms, rice by-products utilization-rice bran and germ, rice bran oil, economic products from agriculture waste/by-products.

**UNIT II BIOMASS PRODUCTION AND UTILIZATION**

Biomass Gasifier, Technology used for the utilization of agricultural wastes: Biomass Gasifier, Nimbkar Agricultural Research Institute (NARI) Gasifier, Rice-Husk Based Gasifier, Heat and Steam from Sugarcane Leaf and Bagasse.

**UNITIII BIOGAS DESIGN AND PRODUCTION**

Biogas: Definition, composition, history of biogas, Production of biogas; types of biogas plant (floating drum type and fixed dome type) and their components (inlet, outlet, stirrer, slanting pipe, digester, gas holder and gas outer pipe), Selection and Design of biogas plant.

**UNIT IV PRODUCTION OF ALCOHOL FROM WASTE MATERIALS**

Production of Alcohol from waste materials: Introduction, Production methods, Cellulolysis (biological approach): Pretreatment, Cellulolytic processes (Chemical and Enzymatic hydrolysis), Microbial fermentation, Gasification process (thermochemical approach).

**UNIT V PRODUCTION OF PAPERBOARDS AND PARTICLEBOARDS FROM AGRICULTURAL WASTE**

Production and testing of Paperboards and Particleboards from Agricultural Waste: Introduction, History, Terminology and classification, Raw materials, Production steps- Pulping, Classifications of pulp, Bleaching, Plies, Coating, Grades.

**Suggested Readings**


1. K M Sahay and K K Singh. Unit Operations of Agricultural Processing. Vikas Publishing House Pvt Ltd, Noida, Uttar Pradesh. 2nd Edition 2013.
2. Beggs C. Energy Management and Conservation. Elsevier Pulication. 2nd Edition 2009.
3. Chaturvedi P. 2009. Energy Management: Challenges for the Next Millennium. Concept Publishing Co. 1st Edition 2000.
4. Fardo SW, Patrick DR, Richardson RE and Fardo BW. Energy Conservation Guidebook. The Fairmont Press. 3rd Edition 2014.
5. Wulfinghoff DR. Energy Efficiency Manual. Energy Institute Press. 2000.

**B.E Electrical and Electronics Engineering** **2019-2020**

**18BEMEOE01 COMPUTER AIDED DESIGN 3H-3C**

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objective**

- To apply basic concepts to develop construction (drawing) techniques.
- To ability to manipulate drawings through editing and plotting techniques.
- To understand geometric construction and Produce template drawings.
- To understand and demonstrate dimensioning concepts and techniques.
- To understand Section and Auxiliary Views.
- To become familiar with Solid Modelling concepts and techniques.

**Course Outcomes**

- Apply basic concepts to develop construction (drawing) techniques.
- Ability to manipulate drawings through editing and plotting techniques.
- Understand geometric construction and Produce template drawings.
- Understand and demonstrate dimensioning concepts and techniques
- Understand Section and Auxiliary Views
- Become familiar with Solid Modelling concepts and techniques.

**UNIT I OVERVIEW OF CAD SYSTEMS**

Conventional and computer aided design processes-advantages and disadvantages. Subsystems of CAD-CAD hardware and software, analytical and graphics packages, CAD workstations. Networking of CAD systems.

**UNIT II INTERACTIVE COMPUTER GRAPHICS AND GRAPHICS TRANSFORMATIONS**

Generative, cognitive and image processing graphics. Static and dynamic data graphics. Transport of graphics data. Graphic standards. Generation of graphic primitives - display transformation in Two- and Three – Dimensional graphics concepts, Graphical input technique, Geometric transformations, Visual Realism, Computer animation, customizing graphics software.

**UNIT III GEOMETRIC MODELING**

Wireframe, surface, NURBS and solid modeling-applications and advantages. Creating primitive solids, sweeping solids, Boolean operations. Extracting entities from a solid. Filleting of edges of solids. Boundary representation (B-rep) Constructive Solid Geometry (CSG) and Analytical Solid Modeling(ASM)

**UNIT IV PARAMETRIC DESIGN AND OBJECT REPRESENTATION**

Types of co-ordinate systems. Parametric design - definition and advantages. Parametric representation of analytic and synthetic curves. Parametric representation of surfaces and solids - manipulations.

**UNIT V PRODUCT DESIGN AND DEVELOPMENT**

Automated 2D drafting - basics, mechanical assembly - bill of materials generation. Mass property calculations.

**Suggested Readings**


1. Vera B Anand, Computer Graphics and Geometric Modeling for Engineers,1st edition, John Wiley & Sons, New York, 2000
2. Radhakrishnan P and Subramanyan S, CAD/CAM/CIM, 2nd edition, New Age International Pvt. Ltd, 2008
3. Ibrahim Zeid, CAD/CAM Theory and Practice,2nd edition, McGraw Hill Inc., New York, 2009
4. Barry Hawhes, The CAD/CAM Process,1st edition, Pitman Publishing, London, 2007(digital)
5. William M Newman and Robert Sproul, Principles of Interactive Computer Graphics,1st edition, McGraw Hill Inc., New York, 2001
6. Sadhu Singh, Computer-Aided Design and Manufacturing,1st edition, Khanna Publishers, New Delhi, 1998

**18BEMEOE02 INDUSTRIAL SAFETY AND ENVIRONMENT 3H-3C**

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objective**

- To recognize and evaluate occupational safety and health hazards in the workplace.
- To determine appropriate hazard controls following the hierarchy of controls.
- To analyze the effects of workplace exposures, injuries and illnesses, fatalities.
- To prevent incidents using the hierarchy of controls, effective safety and health management systems and task-oriented training.
- To teach student the concept of Industrial Safety & provide useful practical knowledge for workplace safety.
- To prevent or mitigate harm or damage to people, property, or the environment.

**Course Outcome**

- Recognize and evaluate occupational safety and health hazards in the workplace.
- Determine appropriate hazard controls following the hierarchy of controls.
- Analyze the effects of workplace exposures, injuries and illnesses, fatalities.
- Prevent incidents using the hierarchy of controls, effective safety and health management systems and task-oriented training.
- Understand the concept of Industrial Safety & provide useful practical knowledge for workplace safety.
- Prevent or mitigate harm or damage to people, property, o rthe environment.

**UNIT I CONCEPTS**

Evolution of modern safety concept- Safety policy - Safety Organization - line and staff functions for safety- Safety Committee- budgeting for safety.

**UNIT II TECHNIQUES**

Incident Recall Technique (IRT), disaster control, Job Safety Analysis (JSA), safety survey, safety inspection, safety sampling, Safety Audit.

**UNIT III ACCIDENT INVESTIGATION AND REPORTING**

Concept of an accident, reportable and non reportable accidents, unsafe act and condition – principles of accident prevention, Supervisory role- Role of safety committee – Accident causation models - Cost of accident. Overall accident investigation process - Response to accidents, India reporting requirement, Planning document, Planning matrix, Investigators Kit, functions of investigator, four types of evidences, Records of accidents, accident reports

**UNIT IV SAFETY PERFORMANCE MONITORING**

Reactive and proactive monitoring techniques - Permanent total disabilities, permanent partial disabilities, temporary total disabilities -Calculation of accident indices, frequency rate, severity rate, frequency severity incidence, incident rate, accident rate, safety "t" score, safety activity rate – problems.

## UNIT V SAFETY EDUCATION AND TRAINING

Importance of training-identification of training needs-training methods – programme, seminars, conferences, competitions – method of promoting safe practice - motivation – communication - role of government agencies and private consulting agencies in safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign – Domestic Safety and Training.

**Suggested Readings**


1. Accident Prevention Manual for Industrial Operations, 3rd edition, N.S.C. Chicago, 2010(digital).
2. Krishnan N.V, Safety Management in Industry, 1st edition, Jaico Publishing House, Bombay, 1997.
3. John R Ridley, Safety at Work,3rd edition, Elsevier,2014
4. L M Deshmukh, Industrial safety management,1stedition, TATA McGraw Hill, 2005

**18BEMEOE03 TRANSPORT PHENOMENA 3H-3C**

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objective**

- To generalized equations for mass, momentum and heat.
- To understand the concepts of Reynolds and Gauss theorems.
- To learn combined diffusive and convective transport.
- To apply Film- and penetration models for mass and heat transfer.
- To apply Stefan-Maxwells equations for multi-component diffusion.
- To solve the given set of equations either analytically or numerically.

**Course Outcomes**

- Generalized equations for mass, momentum and heat.
- Understand the concepts of Reynolds and Gauss theorems.
- Learn combined diffusive and convective transport.
- Apply Film- and penetration models for mass and heat transfer.
- Apply Stefan-Maxwells equations for multi-component diffusion.
- Solve the given set of equations either analytically or numerically.

**UNIT I INTRODUCTION AND BASIC CONCEPTS**

General overview of transport phenomena including various applications, Transport of momentum, heat and mass , Transport mechanism, Level of transport, Driving forces, Molecular transport (diffusion), convective transport (microscopic)

**UNIT II PROPERTIES, UNITS AND OTHER PHYSICAL PARAMETERS**

Unit systems, temperature, mole, concentration, pressure, Gas laws, laws of conservation, energy and heat units

**UNIT III MOMENTUM TRANSPORT**

Basic concepts in fluid mechanics, Force, unit and dimensions, pressure in fluid, head of fluid, Molecular transport for momentum, heat and mass transfer, Viscosity of fluids, Newton's law, Momentum transfer, Newtonian and non- Newtonian fluids, Fluid flow and Reynolds number, Overall mass balance, Control volume and Continuity equation, Overall energy balance, Bernoulli's equation, Overall momentum balance, Drag coefficient, Stokes law, Flow in packed beds, Flow in fluidized bed

**UNIT IV ENERGY TRANSPORT**

Basic concepts in heat transfer, Heat transfer mechanisms, Fourier's law of heat conduction, thermal conductivity, convective heat transfer coefficient, Conduction heat transfer - through flat slab/wall and through hollow cylinder, Conduction through solids in series, Forced convection heat transfer inside

pipes, Heat transfer outside various geometrics in forced convection, General discussion on natural convection heat transfer, Heat exchangers, General discussion on radiation heat transfer

**UNIT V MASS TRANSPORT**

Basic concepts in mass transport, Some application examples, Modes of mass transfer, Molecular diffusion- Fick's law, Analogy between mass, heat and momentum transfer, Dispersion, Hydraulic or Darcy's flow in porous media, Chemical kinetics and activation energy, Film theory, Convective mass transfer, Liquid-solid mass transfer, Liquid-liquid mass transport, Gas-liquid mass transfer, Aeration and oxygen transport, Air stripping

**Suggested Readings**


1. Geankoplis, C. J, Transport Processes and Separation Processes Principles, 4th edition, Prentice Hall, 2013
2. R. Byron Bird, Warren E. Stewart, Edwin N. Lightfoot, Transport Phenomena, 1st edition, John Wiley & Sons, 2007.
3. Edwin N. Lightfoot, Transport phenomena and living systems: biomedical aspects of momentum and mass transport, 1st edition, Wiley, 1973, 2007 (digital)

**18BEMEOE04 INTRODUCTION TO BIOMECHANICS 3H-3C**

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objective**

- To describe the principles of the study of human movement.
- To describe the range of factors that influences the initiation, production and control of human movement.
- To identify the body's lever systems and their relationship to basic joint movement and classification.
- To distinguish between biomechanical principles of kinetics and kinematics when applied to the analysis of human movement.
- To explain joint and muscle function and the forces acting upon the human body during various sporting activities.
- To relate the different body systems necessary for human movement to occur.

**Course Outcomes**

- Describe the principles of the study of human movement.
- Describe the range of factors that influence the initiation, production and control of human movement.
- Identify the body's lever systems and their relationship to basic joint movement and classification.
- Distinguish between biomechanical principles of kinetics and kinematics when applied to the analysis of human movement.
- Explain joint and muscle function and the forces acting upon the human body during various sporting activities.
- Relate the different body systems necessary for human movement to occur.

**UNIT I INTRODUCTION**

Biomechanics - Improving Performance – Applications - Preventing And Treating Injury - Qualitative And Quantitative Analysis - Scholarly Societies - Computer Searches – Biomechanical Knowledge versus Information - Kinds of Sources - Evaluating Sources

**UNIT II KEY MECHANICAL CONCEPTS**

Mechanics - Basic Units - Nine Fundamentals of Biomechanics - Principles and Laws - Nine Principles for Application of Biomechanics

**UNIT III HUMAN ANATOMY AND SOME BASIC TERMINOLOGY**

Gross (Whole-Body) Modeling - Position and Direction Terminology - Terminology for Common Movements - Skeletal Anatomy - Major Joints - Major Muscle Groups - Anthropometric Data

**UNIT IV ANATOMICAL DESCRIPTION**

Key Anatomical Concepts - Directional Terms - Joint Motions - Muscle Actions - Active and Passive Tension of Muscle - Limitations of Functional Anatomical Analysis - Mechanical Method of Muscle Action Analysis - The Need for Biomechanics to Understand Muscle Actions - Sports Medicine and Rehabilitation Applications

**UNIT V MECHANICS OF THE MUSCULOSKELETAL SYSTEM**

Tissue Loads - Response of Tissues To Forces - Biomechanics of The Passive Muscle–Tendon Unit - Biomechanics of Bone - Biomechanics of Ligaments - Three Mechanical Characteristics of Muscle - Stretch-Shortening Cycle (SSC) - Force–Time Principle - Neuromuscular Control

**Suggested Readings**


1. Duane Knudson, Fundamentals of Biomechanics, 1st edition,Springer Science+ Business Media, LLC, 2013
2. C. Ross Ethier Craig A. Simmons, Introductory Biomechanics

**18BESHOE01 SOLID WASTE MANAGEMENT 3H-3C**

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objectives:**

- To make the students conversant with basics of Solid waste sand its classification.
- To make the student acquire sound knowledge of different treatments of solid wastes.
- To acquaint the student with concepts of waste disposals.
- To develop an understanding of the basic concepts of Hazardous waste managements.
- To acquaint the students with the basics of energy generation from waste materials.
- To study the chemical principles in the projects undertaken in field of engineering and tech.

**Course Outcome:**

- Outline the basic principles of Solid waste and separation of wastes (K)
- Identify the concepts of treatment of solid wastes(S)
- Identify the methods of wastes disposals.(S)
- Examine the level of Hazardousness and its management. (S)
- Examine the possible of the energy production using waste materials. (S)
- Integrate the chemical principles in the projects undertaken in field of engineering and technology (A)

**UNIT I SOLID WASTE**

Definitions – Sources, Types, Compositions, Properties of Solid Waste – Municipal Solid Waste – Physical, Chemical and Biological Property – Collection – Transfer Stations – Waste Minimization and Recycling of Municipal Waste

**UNIT II WASTE TREATMENT**

Size Reduction – Aerobic Composting – Incineration – batch type and continuous flow type, Medical/ Pharmaceutical Waste Incineration – Environmental Impacts – Measures of Mitigate Environmental Effects due to Incineration

**UNIT III WASTE DISPOSAL**

Sanitary Land Fill Method of Solid Waste Disposal – Land Fill Classficaition, Types, Methods &Siting Consideration – Layout & Preliminary Design of Land Fills – Composition, Characteristics generation, Movement and Control of Landfill Leachate & Gases – Environmental Monitoring System for Land Fill Gases, Waste landfill Remediation

**UNIT IV HAZARDOUS WASTE MANAGEMENT**

Definition & Identification of Hazardous Waste – Sources and Nature of Hazardous Waste – Impact on Environment – Hazardous Waste Control – Minimization and Recycling -Assessment of Hazardous Waste Sites – Disposal of Hazardous Waste, Underground Storage Tanks Construction, Installation & Closure, Remediaiton, risk assessment.

**UNIT V ENERGY GENERATION FROM WASTE**

Thermal conversion Technologies – Pyrolysis systems, Combustion systems, Gasification systems, Environment control systems, Energy recovery systems. Biological & Chemical conversion technologies – Aerobic composting, low solids. Anaerobic digestion, high solids anaerobic digestion, Energy production from biological conversion products, other biological transformation processes. Chemical transformation processes.

**Suggested Readings:**


1. Dara.S.S,Mishra.D.D, A Text book of Environmental Chemistry and Pollution Control, S.Chand and Company Ltd., New Delhi.2011.
2. Naomi B. Klinghoffer and Marco J. Castaldi,Waste to Energy Conversion Technology (Woodhead Publishing Series in Energy),Woodhead Publishing Ltd., Cambridge, UK,2013.
3. Frank Kreith, George Tchobanoglous,Hand Book of Solid Waste Management- 2nd edition, McGraw Hill Publishing Ltd., Newyork,2002.
4. Shah, L Kanti, Basics of Solid & Hazardous Waste Management Technology, Prentice Hall (P) Ltd.,New Delhi.1999.
5. www.iitk.ac.in/3inetwork/html/reports/IIR2006/Solid_Waste.
6. http://www.unep.or.jp/ietc/ESTdir/Pub/MSW/
7. www.alternative-energy-news.info/technology/garbage-energy/
8. nzic.org.nz/ChemProcesses/environment/

**18BESHOE02 GREEN CHEMISTRY 3H-3C**

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objectives**

- To make the students conversant about the green chemistry
- To make the student acquire sound knowledge of the atom efficient process and synthesis elaborately.
- To acquaint the student with concepts of green technology.
- To develop an understanding of the basic concepts of renewable energy resources.
- To acquaint the students with the basics information on catalysis.
- To make the students acquire more knowledge in agrochemicals

**Course Outcomes**

- Outline the basic principles of green chemistry (K)
- Examine the different atom efficient process and synthesis elaborately (S)
- Apply the concepts combustion of green technology (S)
- Identify and apply the concepts of renewable energy(S)
- Apply the concepts of green catalysts in the synthesis (S)
- Integrate the chemical principles in the projects undertaken in field of engineering and technology (A)

**UNIT I INTRODUCTION TO GREEN CHEMICAL PRINCIPLES**

Definition, tools, and twelve principles of green chemistry, solvent-less reactions and reactions in water, microwaves and fluorous solvents, green resolution of racemic mixtures, materials for a sustainable economy, chemistry of longer wear, agrochemicals: problems and green alternate solutions.

**UNIT II ATOM EFFICIENT PROCESSES**

Atom efficient processes, evaluating chemical reagents according to their yield and atom efficiency, examples of efficient stoichiometric and catalytic processes, atom economy and homogeneous catalysis, halide-free synthesis and alternatives to Strecker synthesis.

**UNIT III BIOTECHNOLOGY AND GREEN CHEMISTRY**

Bio technology and its applications in environmental protection-Bio informatics-Bio remediation, biological purification of contaminated air. Green chemistry for clean technology-Significance of green chemistry-Basic components of green chemistry, Industrial applications of green chemistry, green fuels-e-green propellants and bio catalysts.

**UNIT IV RENEWABLE RESOURCES**

Use of renewable materials, evaluating feedstock and starting materials and their origins, toxicity, sustainability and the downstream implications of the choice of feedstock, commodity chemicals from glucose and biomass conversion.

## UNIT V CATALYSIS IN GREEN CHEMISTRY

Catalysis, energy requirements and usage, optimization of the reaction by minimizing the energy requirements, examples of efficient catalytic reactions including the use of heterogeneous catalysis, zeolites, oxidation using molecular oxygen.

**Suggested Readings:**


1. Sanjay K. Sharma, AckmezMudhoo,Green Chemistry for Environmental Sustainability,CRC Press , London,2010
2. Ahluwalia V. K. and M.Kidwai,New Trends in Green Chemistry 2nd edition,Anamaya publishers., New Delhi,2007.
3. Dr. SunitaRatan,A Textbook of Engineering Chemistry,S.K. Kataria and Sons., New Delhi.,2012.
4. MukeshDoble. Ken Rollins, Anil Kumar,Green Chemistry and Engineering, 1st edition, Academic Press, Elesevier., New Delhi.2007.
5. Desai K. R.,GreenChemistry, Himalaya Publishing House, Mumbai.,2005.
6. Matlack A. S.,Introduction to Green Chemistry.,Marcel Dekker: New York,2001.
7. http://www.organic-chemistry.org/topics/green-chemistry.shtm
8. http://www.essentialchemicalindustry.org/processes/green-chemistry.html
9. http://www.chm.bris.ac.uk/webprojects2004/vickery/green_solvents.htm
10. http://www.epa.gov/research/greenchemistry/
11. http://www.amazon.in/Green-Chemistry-Catalysis

**18BESHOE03 APPLIED ELECTROCHEMISTRY 3H-3C**

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Objectives:**

- To make the students conversant with the information on electrochemical material.
- To make the student acquire sound knowledge of conducting polymers.
- To acquaint the student with concepts of Energy storage devices.
- To develop energy storage devices.
- To impart knowledge on basic principles of solar cells and its applications
- To study and Identify the concepts of storage devices and its applications.

**Course Outcomes:**

1. Outline the basic principles of chemistry in electrochemical material (K)
2. Examine the properties of conducting polymers(S)
3. Apply the concepts of electrochemistry in storage devices.(S)
4. Identify the concepts of storage devices and its applications. (S)
5. Apply the suitable materials for the manufacturing of storage devices. (S)
6. Integrate the chemical principles in the projects undertaken in field of engineering and technology (A)

**UNIT I METAL FINISHING**

Fundamental principles, surface preparation-Electroplating of copper, nickel, chromium, zinc and precious metals (gold & silver)- Electroplating for electronic industry- Alloy plating, brass plating- Electro less plating of nickel- anodizing – Electroforming – Electro winning.

**UNIT II CONDUCTING POLYMERS AND ELECTROCHEMICALS**

Lector polymerisation- anodic and cathodic polymerization-effect of reaction parameters on the course of the reaction- Electrochemical preparation of conducting polymers-poly acetylene- Electrolytic production of perchlorates and manganese dioxide- Electro organic chemicals- constant current electrolysis.

**UNIT III BATTERIES AND POWER SOURCES-I**

Principles of energy conservation- electrochemical energy conservation- thermodynamic reversibility, Gibbs equation. EMF- battery terminology, energy and power density- Properties of anodes, cathodes, electrolytes and separators- Types of electrolytes.

**UNIT IV BATTERIES AND POWER SOURCES-II**

Primary batteries- Dry Leclanche cells, alkaline primary batteries, Lithium batteries- construction, characteristics, problems associated with system- Secondary batteries- Lead acid, nickel cadmium- Fuel cells- Introduction, types of fuel cells, advantages.

## UNIT V ELECTROCHEMICAL MATERIAL SCIENCE

Solar cells- Preparation of $CdS/Cu_2S$ solar cells by screen printing techniques and their characteristics - Amorphous silicon solar cells - Photo electrochemical cells(PEC) for conversion of light energy to electrical energy - PEC cells based on Cd/Se and Ga/As characteristics

**Suggested Readings:**


1. Cynthia G. Zoski,Hand Book of Electrochemistry,Academic Press, Elesevier., UK,2007.
2. D.Pletcher and F.C.Walsh,Industrial Electrochemistry,Chapman and Hall, London,1990.
3. M. Barak,Electrochemical Power Sources,I.EEE series, Peter Peregrinius Ltd, Steverage, U.K.1997.
4. Bruno Scrosati,Applications of Electroactive Polymers,Chapman & Hall, London,1993.
5. http://www.anoplate.com/finishes/
6. http://hyperphysics.phy-astr.gsu.edu/hbase/electric/battery.html
7. http://inventors.about.com/od/sstartinventions/a/solar_cell.htm

| 18BESHOE04 | INDUSTRIAL CHEMISTRY | 3H-3C |
|---|---|---|

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objectives:**

- To make the students conversant with cement and lime and its uses.
- To make the student acquire sound knowledge of abrasives and refractories.
- To acquaint the student with concepts of inorganic chemicals.
- To develop an understanding of the basic concepts explosives.
- To acquaint the students with the basics of agriculture chemicals.
- To study the concepts of explosives and smoke screens

**Course Outcomes:**

- Outline the basic chemistry of cement and lime (K)
- Examine the uses of abrasives and refractories (S)
- Identify the usage of the inorganic chemicals. (S)
- Diagnose the concepts of explosives and smoke screens(S)
- Identify the usage of the agriculture chemicals(S)
- Integrate the chemical principles in the projects undertaken in field of engineering and technology (A)

**UNIT I CEMENT AND LIME**

Manufacture of Portland cement – settling of hardening of portland cement – regauging cement – effect of fineness on setting and hardening – freezing – high early strength cement – high alumina cement Lime – raw materials- manufacture – slaking – lime mortar – types of lime – high – calcium or fat lime – calcium lime or lean lime – magnesian lime – dolomitic lime – hydraulic lime.

**UNIT II ABRASIVES AND REFRACTORIES**

Abrasives – hard abrasives – siliceous abrasives – soft abrasives – artificial abrasives – uses. Refractories – definition – classification – acid refractories – basic refractories – neutral refractories – properties – uses.

**UNIT III INORGANIC CHEMICALS**

Common salt and soda ash – manufacture – different grades – products – alkalis – $Na_2CO_3$, caustic soda and chlor-alkali industry – manufacture principles of electrolytic process – chlorine – storage. Hydrochloric acid – manufacture – absorption – uses, sulphur and sulphuric acid – extraction of sulphur – manufacture of $H_2SO_4$ – chamber – contact processes – industrial uses.

**UNIT IV EXPLOSIVES**

Explosives – uses – properties and tests – explosives for war – nitrocellulose – picric acid and T.N.T. – industrial explosives – nitroglycerin and dynamites – black powder – smoke screens – incendiaries – gas mask.

**UNIT V AGRICULTURE CHEMICALS**

Fertilizers – organic and inorganic – ammoniated superphosphates, sodium nitrate, solid pellets – potassium salts – pesticides – fungicides – herbicides – their preparations and characteristics – environmental impacts.

**Suggested Readings:**


1. Harikrishan, ndustrial Chemistry, Goel Publishing House, Meerut.,2014.
2. B.K. Sharma, Industrial Chemistry, Goel Publishing House, Meerut.,2000.
3. B.N.Chakrabarty, Industrial Chemistry, Oxford and IBH Publishing CO. New Delhi.1998.
4. James A. Kent, Hand Book of Industrial Chemistry, 9th edition, Van Nostrand Reinhold, New York.1992.
5. http://en.wikipedia.org/wiki/Cement
6. http://www.hon.ch/HONselect/Selection/D01.html
7. http://fas.org/man/dod-101/navy/docs/fun/part12.htm
8. http://toxics.usgs.gov/topics/agchemicals.html

**18BESHOE05 TECHNICAL WRITING 3H-3C**

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course objectives**

- Develop abilities to write technically and expressively,
- Recognize writing as a constructive, meaningful process,
- Practice using reading strategies for effective writing.
- Design effective technical documents for both print and digital media
- Identify the qualities of good technical writing
- To enrich the impersonal and formal language developments

**Course outcomes**

Students undergoing this course are able to

- Construct simple sentences, correct common grammatical errors in written English.
- Develop confidence in English language by imbibing lexical and syntax rules.
- Enrich their reading ability for effective writing.
- Elevate them to minimize word, sentence, and paragraph length without sacrificing clarity or substance
- Familiarize with basic technical writing concepts and terms, such as audience analysis, jargon, format, visuals, and presentation.
- Demonstrate the basic components of definitions, descriptions, process explanations, and other common forms of technical writing.

**UNIT I BASICS OF WRITING**

Introduction to Technical Writing – Importance of Writing – Characteristics of Writing– Audience Recognition/ Analysis – Appropriateness of language –– Conciseness and Flow– Bias free and plain writing – Impersonal and Formal Language -Techniques of Technical Writing– Overcoming writer's block – Prioritizing for effective writing– Avoiding plagiarism.

**UNIT II PARAGRAPHS AND ESSAYS**

Expressing Ideas – Paragraph construction – Cohesion and Coherence – Adequate development – Kinds of paragraphs – Writing drafts – Paragraph length and pattern – Types of Essays – Characteristics of Essays – Salient point of sentence constructions.

**UNIT III LETTERS, MEMOS AND EMAIL**

Formal written correspondence – Types of messages – Business letters – Structure of letters – Language in letters – Tense in letters – Cover letters – Resumes – Curriculum vitae – Memos – Emails – Email Etiquette – Effectiveness and purpose.

**UNITIV THE ART OF CONDENSATION AND TECHNICAL PROPOSALS**

Steps to Effective précis writing – Guidelines – Technical Proposals – Types of Proposals – Characteristics – Body of the Proposals – Style and appearance – Evaluation of proposals – Proof Reading – Book /Film Review – Travelogue – Dialogue Writing.

**UNIT V REPORTS AND RESEARCH ARTICLES**

Discussion of newspaper articles -Objectives of Reports – Characteristics of Reports – Structure of Reports – Types of Reports – Writing an article – Writing research articles – Essential features of Dissertation – Organizing the structure of thesis and articles – Writing technical description.

**Suggested Readings**


1. V.N. Arora & Lakshmi Chandra, Improve Your Writing: Revised First Edition, OUP, New Delhi. 2014.
2. David Morley, The Cambridge Intro. to Creative Writing, CUP, New Delhi.2010.
3. Graham King, Collins Improve Your Writing Collins; First edition, UK 2009
4. Crème, P. and M. Lea.Writing at University: A guide for students.OUP, New Delhi.2003
5. http://www.stevepavlina.com/blog/2006/08/10-ways-to-improve-your-technical-skills/http://www.nyu.edu/classes/keefer/brain/net2.html
6. https://www.udemy.com/technical-writing-and-editing/
7. http://techwhirl.com/what-is-technical-writing/

**18BESHOE06 GEOPHYSICS 3H-3C**

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objectives**

- To inculcate the basics of brief history of Earth sciences (K)
- To divulge knowledge on the basics of structure of earth and earth's gravitational field.(S)
- To disseminate the fundamentals of magnetic field and thermal distribution of earth(K)
- To introduce the concepts of seismology and seismic waves (S) .
- To impart the basic knowledge of oceans (K)
- To enrich the impersonal and formal language developments.

**Course Outcomes**

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

- Gain knowledge on the basics of history of Earth sciences.
- Acquire knowledge on concepts of structure of earth and earth's gravitational field.
- Have adequate knowledge on the concepts of magnetic field and thermal distribution of earth
- Obtain knowledge on the basics of seismic waves.
- Understand the basics of oceans and properties of sea water.
- Apply the knowledge gained from this course to solve the relevant problems in engineering stream.

**UNIT I ORIGIN OF EARTH**

A brief history of the development of Earth Sciences . An overview of Geophysical methods and their essential features, Problems of inversion and non-uniqueness in Geophysics, Origin & evolution of Solar system, Earth and Moon structure,.Kepler's law of planetary motion, A review of the Earth's structure and composition

**UNIT II STRUCTURE OF EARTH**

Chemical composition of Earth, Rheological behavior of crust and upper mantle, viscoelasticity and rock failure criteria, Geochronology: Radiometric dating and their advantages, meaning of radiometric ages, Major features of the Earth's gravitational field and relationship with tectonic processes in the crust and upper mantle, concept of isostasy, mathematical concept of Airy and Pratt hypotheses of isostasy

**UNIT III MAGNETIC FIELD AND THERMAL DISTRUBUTION OF EARTH**

Origin of geomagnetic field, polar wandering, secular variations and westward drift, reversals of geomagnetic field, sun spot, solar flares, geomagnetic storms, sea-floor spreading, Paleomagnetism and its uses, Thermal history of the Earth, sources of heat generation and temperature distribution inside the earth, convection in the mantle

**UNIT IV SEISMOLOGY**

Earthquake seismology, Earthquakes and its classifications, Global seismicity and tectonics, Earth's internal structure derived from seismology, Earthquake mechanism and Anderson's theory of faulting, Continental drift and plate tectonics: its essential features, present day plate motions, Triple junctions,

oceanic ridges, Benioff zones, arcs, hot spots, Mantle Plume, Mountain building, origin of Himalaya, Geodynamics of Indian subcontinent.

**UNIT V OCEANS**

Physical properties of seawater and methods of determination, distribution of salinity in the oceans, factors affecting salinity, water masses and water type, TS Diagram, Circulation of currents in major ocean waves. Tides: Dynamical and equilibrium theory of tides. Marine pollution, steps to control marine pollution, Laws of seas, Coastal zone management

**Suggested Readings**


1. B.F. Howell,Introduction to Geophysics, McGraw-Hill,2007.
2. W. Lowrie,Fundamentals of Geophysics, Cambridge University Press,2007.
3. J.A. Jacobs, R.D. Russel,Physics and Geology, McGraw-Hill.2002.
4. www. ocw.mit.edu
5. www.physicsclassroom.com
6. www.nptel.ac.in
7. www.physics.org

**18BESHOE07 ENGINEERING ACOUSTICS 3H-3C**

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objective**

- To disseminate the fundamentals of acoustic waves. (K)
- To inculcate the characteristics of radiation and reception of acoustic waves. (K)
- To divulge knowledge on the basics of pipe resonators and filters.(S)
- To introduce the features of architectural acoustics.**(S)**
- To impart the basic knowledge of transducers and receivers.(K)
- To study about the pipes resonant and filters

**Course Outcome**

- Develop the idea of the fundamentals of acoustic waves.
- Apply the concepts of radiation and reception of acoustic waves.
- Explain the basic ideas of pipe resonators and filters.
- Illustrate the basics of architectural acoustics.
- Illustrate the transducers and receivers and its applications in various electronic devices.
- Apply the knowledge inputs of the course for engineering applications.

**UNIT I INTRODUCTION**

Acoustics waves – Linear wave equation – sound in fluids – Harmonic plane waves - Acoustics intensity – Specific acoustic impedance – spherical waves – Describer scales. Reflection and Transmission: Transmission from one fluid to another normal and oblique incidence –method of images.

**UNIT II RADIATION AND RECEPTION OF ACOUSTIC WAVES**

Radiation from a pulsating sphere – Acoustic reciprocity – continuous line source radiation impedance - Fundamental properties of transducers. Absorption and attenuation of sound. Absorption from viscosity – complex sound speed and absorption – classical absorption coefficient

**UNIT III PIPES RESONATORS AND FILTERS**

Resonance in pipes - standing wave pattern absorption of sound in pipes – long wavelength limit – Helmoltz resonator - acoustic impedance - reflection and transmission of waves in pipe - acoustic filters – low pass, high pass and band pass. Noise, Signal detection, Hearing and speech. Noise, spectrum level and band level – combing band levels and tones – detecting signals in noise – fundamental properties of hearing – loudness level and loudness – pitch and frequency – voice.

**UNIT IV ARCHITECTURAL ACOUSTICS**

Sound in endosure – A simple model for the growth of sound in a room – reverberation time - Sabine, sound absorption materials – measurement of the acoustic output of sound sources in live rooms – acoustics factor in architectural design.
Environmental Acoustics: Highway noise – noise induced hearing loss – noise and architectural design specification and measurement of some isolation design of portions.

**UNIT V TRANSDUCTION**

Transducer as an electives network – canonical equation for the two simple transducers transmitters – moving coil loud speaker– horn loud speaker, receivers – condenser – microphone – moving coil electrodynamics microphone piezoelectric microphone – calibration of receivers

**Suggested Readings**


1. LawerenceE.Kinsler, Austin R.Frey, Fundamentals of Acoustics, John Wiley & Sons, 4th edition 2000.
2. F. AltonEverest & Ken Pohlmann, Master Handbook of Acoustics, McGraw Hill Professional, 6th edition 2014.
3. www.acousticalsociety.org
4. www.acoustics-engineering.com
5. www.nptel.ac.in
6. www. ocw.mit.edu

**B.E Electrical and Electronics Engineering 2019-2020**

| **18BESHOE08** | **INDUSTRIAL MATHEMATICS – I** | **3H-3C** |
|---|---|---|

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objectives**

- To develop analytical skills for solving engineering problems
- To teach the students the basic concepts of LPP,
- To learn the techniques to solve transportation and Assignment problems
- To make the students to study about the Integer Programming and Network Analysis
- To study how to Formulate and solve problems as networks and graphs.
- Analyse the results and propose recommendations to the decision-making processes in Management Engineering

**Course outcomes**

- To define and formulate linear programming problems and appreciate their limitations.
- To solve linear programming problems using appropriate techniques and optimization solvers, interpret the results obtained and translate solutions into directives for action.
- To be able to build and solve Transportation Models, Assignment Models,
- To construct linear integer programming models and discuss the solution techniques.
- To formulate and solve problems as networks and graphs.
- To be able to solve problems in different environments and develop critical thinking

**UNIT I LINEAR PROGRAMMING PROBLEM**

Formulation of LPP - Graphical Method - Simplex Method - Artificial variable technique and two phase simplex method. Duality - Dual and simplex method - Dual Simplex Method .

**UNIT II TRANSPORTATION PROBLEM**

Transportation Model, finding initial basic feasible solutions, moving towards optimality, Degeneracy.

**UNIT III ASSIGNMENT PROBLEM**

Solution of an Assignment problem, Multiple Solution, Hungarian Algorithm, Maximization in Assignment Model, Impossible Assignment.

**UNIT IV INTEGER PROGRAMMING**

Integer Programming Problem – Gromory's fractional cut Method – Branch Bound Method

**UNIT V NETWORK ANALYSIS**

PERT & CPM- network diagram-probability of achieving completion date- crash time- cost analysis.

**Suggested Readings**


1. HamdyTaha. A., Operations Research, Prentice – Hall of India Private Limited, New Delhi.2013.
2. KantiSwarup, Manmohan, Gupta, Operations Research, Sultan Chand & Sons, New Delhi.2010.
3. Natarajan A.M., Balasubramani P., Thamilarasi A, Operations Research, Pearson Education, New Delhi.2005.
4. Srinivasan G, Operations Research: Principles and Applications, PHI Private Limited, New Delhi.2007.
5. Winston, Operations Research, Applications and Algorithms, Cengage Learning India Pvt. Ltd, New Delhi,2004.
6. www.mathworld.
7. Wolfram.com
8. www.mit.edu
9. **www.nptel.com**

**18BESHOE09 INDUSTRIAL MATHEMATICS – II 3H-3C**

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objectives**

- To kindle analytical skills for solving engineering problems
- To impact the knowledge about inventory models
- To learn replacement models and simulation models
- To provide techniques for effective methods to solve nonlinear programming and decision making.
- To analyze the results and propose recommendations to the decision-making processes in Management Engineering
- To study and understand the characteristics of different types of decision-making environments and the appropriate decision making approaches and tools to be used in each type

**Course Outcome**

The students will

- To be able to solve simple models in Inventory problems and Replacement problems.
- To understand different queuing situations and find the optimal solutions using models for different situations.
- Simulate different real life probabilistic situations using Monte Carlo simulation technique.
- To be able to understand the characteristics of different types of decision-making environments and the appropriate decision making approaches and tools to be used in each type.
- Convert and solve the practical situations into replacement models.
- To understand how to model and solve problems using non integer programming.

**UNIT – I INVENTORY MODELS**

Economic order quantity models-techniques in inventory management-ABC analysis.

**UNIT – II NON LINEAR PROGRAMMING**

Khun-tucker conditions with non-negative constraints- Quadratic programming- Wolf's modified simplex method.

**UNIT – III SIMULATION MODELS**

Elements of simulation model -Monte Carlo technique – applications. Queuing model: problems involving (M\M\1): (∞\FIFO) , (M\M\c): (∞\FIFO) Models.

**UNIT -IV DECISION MODELS**

Decision Analysis – Decision Making environment – Decisions under uncertainty – Decision under risk – Decision – Tree Analysis.

**UNIT -V REPLACEMENT MODELS**

Models based on models that gradually detoriate with time-whose maintenance cost increase with time-Replacement of items that fail suddenly and completely.

**Suggested Readings**


1. HamdyTaha. A., Operations Research, Prentice – Hall of India Private Limited, New Delhi.2013.
2. KantiSwarup, Manmohan, Gupta, Operations Research, Sultan Chand & Sons, New Delhi.2010.
3. Natarajan A.M., Balasubramani P., Thamilarasi A, Operations Research, Pearson Education, New Delhi.2005.
4. Srinivasan G, Operations Research: Principles and Applications, PHI Private Limited, New Delhi.2007.
5. Winston, Operations Research, Applications and Algorithms, Cengage Learning India Pvt. Ltd, New Delhi,2004.
6. www.mathworld.
7. Wolfram.com
8. www.mit.edu
9. **www.nptel.com**

**18BESHOE10 FUZZY MATHEMATICS 3H-3C**

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objectives**

- Be able to understand basic knowledge of fuzzy sets and fuzzy logic
- Be able to apply basic knowledge of fuzzy operations.
- To know the basic definitions of fuzzy relations
- Be able to apply basic fuzzy inference and approximate reasoning
- To know the applications of fuzzy Technology.
- To study and acquire the knowledge to comprehend the concepts of fuzzy relations

**Course Outcome**

- To gain the idea of main subject of fuzzy sets.
- To Understand the concept of fuzziness involved in various systems and fuzzy set theory.
- To gain the methods of fuzzy logic.
- To comprehend the concepts of fuzzy relations.
- To analyze the application of fuzzy logic control to real time systems.
- The Engineers will have an exposure on various topics such as fuzzy algebra, fuzzy theory and fuzzy technology.

**UNIT I FUZZY SETS**

Fuzzy Sets : Basics Classical sets vs Fuzzy Sets – Need for fuzzy sets – Definition and Mathematical representations – Level Sets – Fuzzy functions - Zadeh's Extension Principle

**UNIT II OPERATIONS ON FUZZY SETS**

Operations on Fuzzy Sets Operations on [0,1] – Fuzzy negation, triangular norms, tconorms, fuzzy implications, Aggregation Operations, Fuzzy Functional Equations

**UNIT III FUZZY RELATIONS**

Fuzzy Relations Fuzzy Binary and n-ary relations – composition of fuzzy relations – Fuzzy Equivalence Relations – Fuzzy Compatibility Relations – Fuzzy Relational Equations

**UNIT IV FUZZY MEASURES**

Possibility Theory Fuzzy Measures – Evidence Theory – Necessity and Belief Measures – Probability Measures vs Possibility Measures

**UNIT V FUZZY INFERENCE**

Approximate Reasoning Fuzzy Decision Making - Fuzzy Relational Inference – Compositional rule of Inference - Efficiency of Inference - Hierarchical

**Suggested Readings**


1. George J Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic : Theory and Applications, Prentice Hall of India, New Delhi,2003.
2. Zimmermann H.J. Fuzzy Set Theory and its Applications, Kluwer Academic publishers, USA.2001.
3. Michal Baczynski and BalasubramaniamJayaram, Fuzzy Implications, Springer-Verlag publishers, Heidelberg,2008
4. Kevin M Passino and Stephen Yurkovich, Fuzzy Control, Addison Wesley Longman publishers, USA,1998.

**18BESHOE11 MATHEMATICAL PHYSICS 3H-3C**

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course objectives**

- To know the fundamentals of Tensors.
- To know the series solutions to differential equations.
- To introduce the concepts of special functions.
- To study about Calculus of variations and integral equations
- Be familiar with the main mathematical methods used in physics.
- To study and acquire the knowledge to comprehend the concepts of fuzzy relations

**Course Outcomes**

- Students will demonstrate proficiency in mathematics and the mathematical concepts needed for a proper understanding of physics.
- Learn about special type of matrices that are relevant in physics and then learn about tensors.
- Get introduced to Special functions like Bessel, Legendre , Hermite and Laguerre functions and their recurrence relations
- Learn different ways of solving second order differential equations and familiarized with singular points and Frobenius method.
- Students will master in calculus of variations and linear integral equations.
- The students will have the knowledge on Mathematical Physics and that knowledge will be used by them in different engineering and technology applications.

**UNIT I TENSORS**

Definition of tensor - rank, symmetric tensors, contraction, quotient rule - tensors with zero components, tensor equations, metric tensors and their determinants - pseudo tensors

**UNIT II DIFFERENTIAL EQUATIONS-SERIES SOLUTIONS**

Series Solution : Classification of singularities of an ordinary differential equation - Series solution- Method of Frobenius - indicial equation - examples

**UNIT III SPECIAL FUNCTIONS**

Basic properties (Recurrence and Orthogonality relations, series expansion) of Bessel, Legendre ,Hermite and Laguerre functions – Generating Function

**UNIT IV CALCULUS OF VARIATIONS**

Concept of variation and its properties – Euler's equation – Functional dependant on first and higher order derivatives – Functional dependant on functions of several independent variables – Variational problems with moving boundaries – Isoperimetric Problems – Direct methods – Ritz and Kantorovich methods.

**UNIT V LINEAR INTEGRAL EQUATIONS**

Introduction – conversion of a linear differential equation to an integral equations and vice versa – conversion of boundary value problem to integral equations using Green's function – solution of aintegral equation – integral equations of the convolution type – Abel's integral equations –integro– differential equations – integral equations with separable kernels – solution of Fredholm equations with separable kernels.

**Suggested Readings:**


1. Dr. Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi.2013.
2. Murray R Spiegel, Seymour Lipschutz, Dennis Spellman, Vector Analysis, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2010
3. Stephenson, G, Radmore, P.M, Advanced Mathematical Methods for Engineering and Science students, Cambridge University Press India Pvt. Ltd., New Delhi,1990.
4. Andrews, Larry C. Special Functions of Mathematics for Engineers, Oxford Science publishers, New Delhi,1997.
5. www.mathcentre.ac.uk
6. www.mathworld.
7. wolfram.com
8. www.nptel.ac.in

**18BESHOE12 LINEAR ALGEBRA 3H-3C**

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**End Semester Exam:**3 Hours

**Course Objectives**

- To introduce the basic concepts of vector space
- To know the fundamentals of linear Algebra
- To solve system of linear equations
- To study about the linear transformations
- To introduce the concepts of inner product spaces
- To study about the methods of linear equation solvation

**Course Outcomes**

The student will be able to

- To explain the fundamental concepts of advanced algebra and their role in modern mathematics and applied contexts.
- To describe the fundamental concepts of Eigen values and Eigen vectors by using Power method.
- To apply the fundamental concepts in their respective engineering fields
- To visualize linear transformations as matrix form
- To recognize the underlying theory of vector spaces over a field and inner product spaces over real or complex numbers
- To articulate the importance of Linear Algebra and its applications in branches of Mathematics

**UNIT I VECTOR SPACES**

General vector spaces, real vector spaces, Euclidean n-space, subspaces, linear independence, basis and dimension, row space, column space and null space,

**UNIT II EIGEN VALUES AND EIGEN VECTORS**

Eigen values and Eigen vectors - Diagonalization - Power method - QR decomposition

**UNIT III SYSTEM OF LINEAR EQUATIONS**

Direct methods, Gauss elimination method, Gauss Jordan method, Crout's method, iterative methods, Gauss-Jacobi method, Gauss–Seidel method, convergence criteria.

**UNIT IV LINEAR TRANSFORMATIONS**

Linear Transformations - The Null Space and Range - Isomorphisms - Matrix Representation of Linear Transformations – Similarity - Eigenvalues and Eigenvectors Eigen values and Eigen vectors - Diagonalization

**UNIT V INNER PRODUCT SPACES**

The Dot Product on $R^n$ and Inner Product Spaces - Orthonormal Bases - Orthogonal Complements - Application : Least Squares Approximation - Diagonalization of Symmetric M - Application: Quadratic Forms

**Suggested Readings**


1. Kreyszig,E, Advanced Engineering Mathematics, John Wiley & Sons, New Delhi.,2014.
2. Anton and Rorres, Elementary Linear Algebra, Applications version, Wiley India Edition, New Delhi,2012.
3. Jim Defranza, Daniel Gagliardi, Introduction to Linear Algebra with Application, Tata McGraw-Hill, New Delhi.2008.
4. wolfram.com
5. www.sosmath.com
6. www.nptel.ac.in
7. www.mathworld.

## COURSES OFFERED TO OTHER DEPARTMENT

## ELECTRICAL AND ELECTRONICS ENGINEERING

**B.E Electrical and Electronics Engineering** **2019-2020**

| **18BEEEOE01** | **ELECTRIC HYBRID VEHICLE** | **3H-3C** |
|---|---|---|

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**Course Objectives**

- To understand the basic concepts of electric hybrid vehicle.
- To gain the knowledge about electric propulsion unit.
- To gain the concept of Hybrid Electric Drive-Trains.
- To gain the different Energy Management Strategies.
- To study about the effciency manipulation in drives
- To understand and gain the knowledge about various energy storage devices

**Course Outcomes:**

- Summarize the basic concepts in bioprocess Engineering.
- Explain the concept of Hybrid Electric Vehicles.
- Understand the concept of Hybrid Electric Drive-Trains.
- Identify the different Energy Management Strategies.
- Understand the concept of different Energy Storage devices.
- Analyze the different motor drives used in Hybrid Electric Vehicles.

**UNIT I INTRODUCTION**

History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

**UNIT II HYBRID ELECTRIC DRIVE-TRAINS**

Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

**UNIT III ELECTRIC PROPULSION UNIT**

Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

**UNIT IV ENERGY STORAGE**

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices.

**UNIT V ENERGY MANAGEMENT STRATEGIES**

Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.

**Suggested Readings**


1. Iqbal Hussein Electric and Hybrid Vehicles: Design Fundamentals CRC Press – 2nd edition 2010.
2. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design Standardsmedia – 2nd edition 2009.
3. James Larminie, John Lowry Electric Vehicle Technology Wiley – 2nd edition 2012

**18BEEEOE02 ENERGY MANAGEMENT AND ENERGY AUDITING 3H-3C**

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**Course Objectives:**

- To gain the knowledge about energy management.
- To understand the basic concepts in economic analysis in energy management.
- To understand the basic principles of energy audit.
- To gain the knowledge about the basic concept of types of Energy Audit
- To gain and Evaluate the different energy efficient motors
- Understand the concept of Energy conservation.
- To study about the behaviour changes of PF requirement in motor currents

**Course Outcomes:**

At the end of this course, students will demonstrate the ability to

- Understand the concept of Energy Management.
- Analyze the different methods for economic analysis
- Knowledge about the basic concept of Energy Audit and types.
- Evaluate the different energy efficient motors
- Understand the concept of Energy conservation.
- Investigate the different methods to improve power factor.

**UNIT I ENERGY MANAGEMENT**

Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting –Energy Auditor and Energy Manager – Eligibility, Qualification and functions - Questionnaire and check list for top management.

**UNIT II ECONOMIC ASPECTS AND ANALYSIS**

Economics analysis – Depreciation Methods, time value of money, rate of return, present worth method, replacement analysis, life cycle costing analysis - Calculation of simple payback method, net present worth method.

**UNIT III BASIC PRINCIPLES OF ENERGY AUDIT**

Energy audit – definition, concept, type of audit, energy index, cost index, pie charts, Sankey diagrams, load profiles, Energy conservation schemes – Energy audit of industries – energy saving potential, energy audit of process industry, thermal power station, building energy audit.

**UNIT IV ENERGY EFFICIENT MOTORS**

**Electric Motors:** Factors affecting efficiency - Energy efficient motors - constructional details, characteristics - voltage variation –over motoring – motor energy audit-

**Energy conservation**: Importance-energy saving measures in DG set-fans and blowers pumps- air conditioning system- energy efficient transformers.

## UNIT V POWER FACTOR IMPROVEMENT, LIGHTING AND ENERGY INSTRUMENTS

Power factor - methods of improvement, location of capacitors, p.f with non linear loads, effect of harmonics on p.f,- p.f motor controllers –Energy efficient lighting system design and practice- lighting control– Measuring Instruments – wattmeter, data loggers, thermocouples, pyrometers, lux meters, tong testers, application of PLCs.

**Suggested Readings**


1. Murphy W.R. and G.Mckay Butter worth Energy Management Heinemann Publications 2007.
2. John.C. Andreas Energy Efficient Electric Motors Marcel Dekker Inc Ltd – 3rd edition 2005.
3. W.C.Turner Steve Doty Energy Management Handbook Lulu Enterprises, Inc. - 8th Edition Volume II 2013.

**18BEEEOE03 PROGRAMMABLE LOGIC CONTROLLER 3H-3C**

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**Course Objectives**

- To understand the basic principles of PLC systems.
- To gain the knowledge about data handling functions.
- To gain the knowledge of storage techniques in PLC
- To acquire the knowledge about how to handle the data and functions
- To study about flowcharts of ladder and spray process system
- To understand the principles of PID.

**Course Outcome**

- At the end of the course the student will be able to understand the registers and functions in PLC and they are able to do the program.
- To acquire the knowledge of storage techniques in PLC
- Students know how to handle the data and functions
- Students known about advanced controller in PLC applications
- Students gather real time industrial application of PLC
- Students gathered and evaluate the flow charts of ladder and spray process system

**UNIT I INTRODUCTION**

PLC Basics PLC system, I/O modules and interfacing CPU processor programming equipment Programming formats, construction of PLC ladder diagrams, devices connected to I/O modules.

**UNIT II PLC PROGRAMMING**

PLC Programming input instructions, outputs, operational procedures, programming examples using contacts and coils. Drill-press operation. Digital logic gates programming in the Boolean algebra system, conversion examples Ladder diagrams for process control Ladder diagrams and sequence listings, ladder diagram construction and flow chart for spray process system.

**UNIT III REGISTERS AND PLC FUNCTIONS**

PLC Registers: Characteristics of Registers module addressing holding registers input registers, output registers. PLC Functions Timer functions and industrial applications counters counter function industrial applications, Architecture functions, Number comparison functions, number conversion functions.

**UNIT IV DATA HANDLING FUNCTIONS**

Data handling functions: SKIP, Master control Relay Jump Move FIFO, FAL, ONS, CLR and Sweep functions and their applications. Bit Pattern and changing a bit shift register, sequence functions and applications, controlling of two axes and three axis Robots with PLC, Matrix functions.

**UNIT V PID PRINCIPLES**

Analog PLC operation: Analog modules and systems Analog signal processing multi bit data processing , analog output application examples, PID principles position indicator with PID control, PID modules, PID tuning, PID functions

**Suggested Readings**


1. JR Hackworth and F.D Hackworth – Jr Programmable Logic Controllers – Programming Method and Applications Pearson 2006
2. John Webb and Ronald A Reiss Programmable Logic Controllers – Principle and Applications Fifth edition, PHI 2004
3. W.Bolton Programmable Logic controller Elsevier Newnes Publications, 5th Edition 2009

**18BEEEOE04 RENEWABLE ENERGY RESOURCES 3H-3C**

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal**:40** External**:60** Total**:100**

**Course Objectives**

- To gain the knowledge about environmental aspects of energy utilization.
- To understand the basic principles of wind energy conversion, solar cells, photovoltaic conversion.
- To study about solar energy collectors and its storages
- To study about the inter connected system in wind power
- To understand the basic principles fuel cell, Geo thermal power plants.
- To gain the knowledge about hydro energy.

**Course Outcomes**

At the end of this course, students will demonstrate the ability to

- Analyze the Energy Scenario in India
- Understand the concept of Solar Energy
- Understand the concept of Wind Energy
- Understand the concept of Hydro Energy
- Analyze the different energy sources
- Students gathered the real time inter connected system modelling in wind power

**UNIT I INTRODUCTION**

Energy scenario - Different types of Renewable Energy Sources - Environmental aspects of energy utilization - Energy Conservation and Energy Efficiency - Needs and Advantages, Energy Conservation Act 2003.

**UNIT II SOLAR ENERGY**

Introduction to solar energy: solar radiation, availability, measurement and estimation– Solar thermal conversion devices and storage – solar cells and photovoltaic conversion – PV systems – MPPT. Applications of PV Systems – solar energy collectors and storage.

**UNIT III WIND ENERGY**

Introduction – Basic principles of wind energy conversion- components of wind energy conversion system - site selection consideration – basic–Types of wind machines. Schemes for electric generation – generator control, load control, energy storage – applications of wind energy – Inter connected systems.

**UNIT IV HYDRO ENERGY**

Hydropower, classification of hydro power, Turbine selection, Ocean energy resources, ocean energy routes. Principles of ocean thermal energy conversion systems, ocean thermal power plants. Principles of ocean wave energy conversion and tidal energy conversion.

**UNIT V OTHER SOURCES**

Bio energy and types –Fuel cell, Geo-thermal power plants; Magneto-hydro-dynamic (MHD) energy conversion.

**Suggested Readings**


1. Rai.G.D Non-conventional sources of energy Khanna publishers 2011
2. Khan.B.H Non-Conventional Energy Resources The McGraw Hills, Second edition 2009
3. Rao.S. & Parulekar Energy Technology Khanna publishers, Eleventh Reprint 2013
4. Godfrey Boyl Renewable Energy: Power sustainable future Oxford University Press, Third edition 2012.
5. John W Twidell and Anthony D Weir Renewable Energy Resources Taylor and Francis – 3rd edition 2015.