# NATIONAL ENGINEERING COLLEGE

*(An Autonomous Institution Affiliated to Anna University Chennai & Accredited by NAAC)*

**K.R.NAGAR, KOVILPATTI – 628 503**
**www.nec.edu.in**

## REGULATIONS – 2015

## CURRICULUM & SYLLABUS

**B. E. – ELECTRICAL AND ELECTRONICS ENGINEERING**
**Accredited by NBA**

# B. E. – ELECTRICAL AND ELECTRONICS ENGINEERING

CURRICULUM AND SYLLABUS

# DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

## VISION

Promoting active learning, critical thinking coupled with ethical values to meet the global challenges.

## MISSION

- To instill state-of-the-art technical knowledge and research capability that will prepare our graduates for professionalism and life-long learning.
- To update knowledge to meet industrial and real world challenges.
- To inculcate social and ethical values.

## PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

1. Excel in industrial or graduate work in Electrical Engineering and allied fields.
2. Practice their profession conforming to ethical values and active participation in the affairs of the profession.
3. Adapt to evolving technologies and stay current with their profession.

## PROGRAM OUTCOMES (POs)

Pos *describe the expectation of students to know by the time of graduation from the programme*. At the time of graduation, our EEE graduates are expected to:

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

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

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

**4. Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

**5. Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

**6. The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

**7. Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

**8. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

**9. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

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

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

**12. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

## PROGRAM SPECIFIC OUTCOMES (PSOs)

**PSO1:** Apply the basic knowledge of mathematics, science and engineering to identify, formulate, design and investigate complex engineering problems of power electronics and drives, power and energy systems, high voltage engineering, control and instrumentation and applied electronics.

**PSO2:** Apply the modern engineering hardware and software tools in electrical and electronics engineering to adopt in multi disciplinary environments and innovative practices.

## PREAMBLE OF THE CURRICULUM & SYLLABI

The Curriculum and Syllabi under Regulations 2015 is designed keeping in mind the Outcome Based Education (OBE) and Choice Based Credit System (CBCS). The course content of each course shall be fixed in accordance with the Program Educational Objectives (PEOs), Program Outcomes (POs) and Course Outcomes (COs).

The CBCS enables the students to earn credits across programmes and provides flexibility for slow and fast learners in registering the required number of credits in a semester. The CBCS facilitates transfer of credits earned in different departments / Centers of other recognized / accredited universities or institutions of higher education in India and abroad either by studying directly or by online method.

The curriculum of **EEE programme** is designed with total number of credits ***173 (130*** for Lateral entry) and shall have the following category of courses in the curriculum.

1. **Foundation courses**

   a. **Common Foundation Courses (CFC)** include Mathematics, Basic Sciences, Engineering Sciences and Skill Based Courses.

b. **Specific Foundation Courses (SFC)** include the basic courses specific to a programme of study.

2. **Programme Core Courses (PCC)** include the core courses relevant to the chosen programme of study and the Employability Enhancement courses such as Project, Seminar and Inplant training/ Internship.
3. **Programme Elective Courses (PEC)** include the elective courses relevant to the chosen programme of study.
4. **Open Elective Courses (OEC)** include Inter-disciplinary and Trans-disciplinary courses. The students shall study Inter-disciplinary courses offered in other Engineering/Technology Programmes through regular mode and Trans-disciplinary courses through self study mode.
5. **Mandatory courses (MAC)** include the courses recommended by the regulatory bodies such as AICTE, UGC etc as given below:

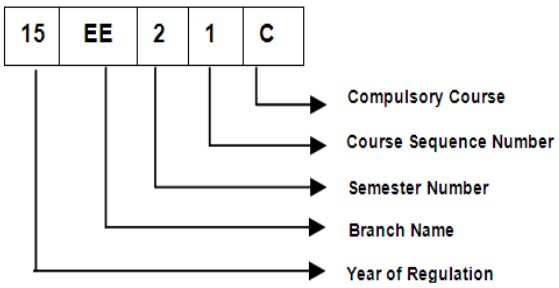
   a. Technical English / Professional English
   b. Professional Ethics and Human Values
   c. Environmental Science and Engineering
   d. Communication Skills Laboratory

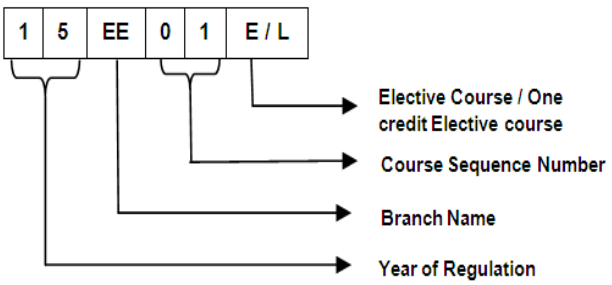
6. Every student shall undergo one Interdisciplinary and one Transdisciplinary course.

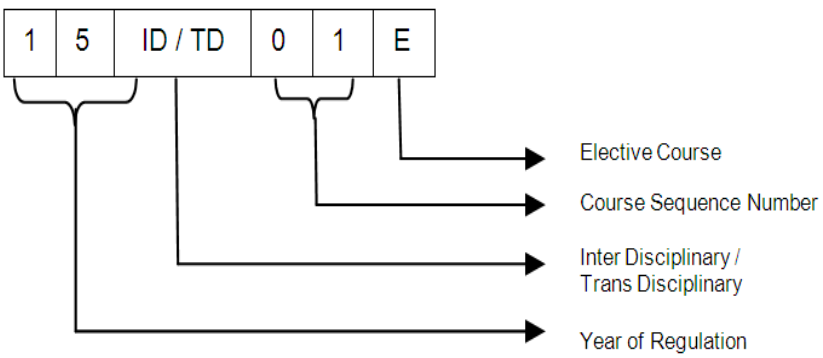
Performance in each course of study shall be evaluated based on Continuous Assessment throughout the semester and end semester examination at the end of the programme. Keeping in mind the content of the courses and delivery methods, different question paper patterns are suggested.

# QP - Question Pattern

| Question pattern | 1 mark | 2 marks | 4 marks | 10 marks | 12 marks | 16 marks | 20 marks | Total |
|---|---|---|---|---|---|---|---|---|
| A | -- | -- | -- | -- | -- | -- | 1 Qn Compulsory & 4 Qns (either or type) | 100 |
| B | -- | 10 | -- | -- | -- | 1 Qn Compulsory & 4 Qns (either or type) | -- | 100 |
| C | 10 | -- | 10 out of 12 | 1 Qn Compulsory & 4 Qns (either or type) | -- | -- | -- | 100 |
| D | 10 | 10 | 5 out of 6 | 1 Qn Compulsory & 4 Qns (either or type) | -- | -- | -- | 100 |
| E | -- | 10 | 5 out of 6 | -- | 1 Qn Compulsory & 4 Qns (either or type) | -- | -- | 100 |
| F | -- | -- | -- | -- | -- | -- | 5 out of 8 | 100 |
| G | -- | 5 | -- | 2 Qns (either or type) | -- | -- | -- | 30 |



## B.E. – ELECTRICAL AND ELECTRONICS ENGINEERING

REGULATIONS – 2015

CURRICULUM AND SYLLABUS

**SEMESTER – I**

| S. No | Course Category | Course Code | COURSE TITLE | L | T | P | C | QP |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | MAC | 15SH11C | Technical English* | 3 | 0 | 0 | 3 | B |
| 2. | CFC | 15SH12C | Mathematical Foundations for Engineers* | 3 | 2 | 0 | 4 | B |
| 3. | CFC | 15SH13C | Engineering Physics* | 3 | 0 | 0 | 3 | B |
| 4. | CFC | 15SH14C | Engineering Chemistry* | 3 | 0 | 0 | 3 | B |
| 5. | CFC | 15SH15C | Introduction to Engineering* | 2 | 0 | 0 | 2 | A |
| 6. | CFC | 15EE25C | C Programming for Engineers* | 3 | 0 | 0 | 3 | B |
| **PRACTICAL** | | | | | | | | |
| 7. | CFC | 15SH17C | Engineering Physics and Engineering Chemistry Laboratory* | 0 | 0 | 2 | 1 | |
| 8. | CFC | 15EE28C | C Programming Laboratory* | 0 | 0 | 2 | 1 | |
| | | | **TOTAL** | **17** | **2** | **4** | **20** | |

**SEMESTER – II**

| S. No | Course Category | Course Code | COURSE TITLE | L | T | P | C | QP |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | MAC | 15EE21C | Professional English* | 3 | 0 | 0 | 3 | B |
| 2. | SFC | 15EE22C | Calculus, Probability and Statistics@ | 3 | 2 | 0 | 4 | B |
| 3. | SFC | 15EE23C | Semiconductor Physics# | 3 | 0 | 0 | 3 | B |
| 4. | SFC | 15EE24C | Circuit Theory | 3 | 2 | 0 | 4 | B |
| 5. | CFC | 15SH16C | Engineering Graphics* | 2 | 0 | 2 | 3 | A |
| 6. | MAC | 15EE26C | Environmental Science and Engineering* | 3 | 0 | 0 | 3 | A |
| **PRACTICAL** | | | | | | | | |
| 7. | SFC | 15EE27C | Semiconductor Physics and Environmental Chemistry Laboratory# | 0 | 0 | 2 | 1 | |
| 8. | CFC | 15SH18C | Engineering Practice Laboratory* | 0 | 0 | 2 | 1 | |
| 9. | SFC | 15EE29C | Electric Circuits Laboratory | 0 | 0 | 2 | 1 | |
| | | | **TOTAL** | **17** | **4** | **8** | **23** | |

MAC - Mandatory Course, CFC - Common Foundation Course, SFC - Specific Foundation Course,
PCC – Programme Core Course, *X*EC - *X* Stands for P or O (PEC – Programme Elective Course,
OEC – Open Elective Course) *****Common to all B.E. / B.Tech., Programmes, @Common to EEE and EIE,
#Common to ECE and EEE

## SEMESTER – III

| S. No | Course Category | Course Code | COURSE TITLE | L | T | P | C | QP |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | SFC | 15EE31C | Fourier Series and Transforms | 2 | 2 | 0 | 3 | B |
| 2. | SFC | 15EE32C | Electromagnetic Theory | 3 | 2 | 0 | 4 | B |
| 3. | PCC | 15EE33C | Electronic Circuits | 3 | 0 | 0 | 3 | E |
| 4. | PCC | 15EE34C | DC Machines and Transformer | 2 | 2 | 0 | 3 | B |
| 5. | PCC | 15EE35C | Linear Integrated Circuits and its Applications | 3 | 0 | 0 | 3 | B |
| 6. | PCC | 15EE36C | Digital Logic Circuits | 3 | 0 | 0 | 3 | B |
| **PRACTICAL** | | | | | | | | |
| 7. | PCC | 15EE37C | DC Machines and Transformer Laboratory | 0 | 0 | 2 | 1 | |
| 8. | PCC | 15EE38C | Integrated Circuits Laboratory | 0 | 0 | 2 | 1 | |
| 9. | PCC | 15EE39C | Electronic Circuits Laboratory | 0 | 0 | 2 | 1 | |
| | | | **TOTAL** | **16** | **6** | **6** | **22** | |

## SEMESTER – IV

| S. No | Course Category | Course Code | COURSE TITLE | L | T | P | C | QP |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | SFC | 15EE41C | Complex, Discrete and Numerical Analysis | 3 | 2 | 0 | 4 | B |
| 2. | PCC | 15EE42C | AC Rotating Machines | 2 | 2 | 0 | 3 | B |
| 3. | PCC | 15EE43C | Control Engineering | 3 | 2 | 0 | 4 | B |
| 4. | PCC | 15EE44C | Measurements and Instrumentation | 3 | 0 | 0 | 3 | E |
| 5. | PCC | 15EE45C | Electrical Power Systems | 3 | 2 | 0 | 4 | B |
| 6. | MAC | 15EE46C | Professional Ethics and Human Values* | 3 | 0 | 0 | 3 | A |
| **PRACTICAL** | | | | | | | | |
| 7. | PCC | 15EE47C | AC Rotating Machines Laboratory | 0 | 0 | 2 | 1 | |
| 8. | PCC | 15EE48C | Control and Instrumentation Laboratory | 0 | 0 | 2 | 1 | |
| 9. | MAC | 15EE49C | Communication Skills Laboratory* | 0 | 0 | 2 | 1 | |
| | | | **TOTAL** | **17** | **8** | **6** | **24** | |

MAC - Mandatory Course, CFC - Common Foundation Course, SFC - Specific Foundation Course,
PCC – Programme Core Course, *X*EC - *X* Stands for P or O (PEC – Programme Elective Course,
OEC – Open Elective Course) *****Common to all B.E. / B.Tech., Programmes, @ Common to EEE and EIE, #Common to ECE and EEE

## SEMESTER – V

| S. No | Course Category | Course Code | COURSE TITLE | L | T | P | C | QP |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | PCC | 15EE51C | Power System Protection, Operation and Control | 3 | 2 | 0 | 4 | B |
| 2. | PCC | 15EE52C | Power Electronics | 3 | 0 | 0 | 3 | B |
| 3. | PCC | 15EE53C | Architecture, Programming and Applications of Microprocessor and Microcontroller | 3 | 0 | 0 | 3 | E |
| 4. | SFC | 15EE54C | Data Structures and Algorithms | 3 | 0 | 0 | 3 | B |
| 5. | PCC | 15EE55C | Digital Signal Processing and its Applications | 3 | 2 | 0 | 4 | B |
| 6. | *X*EC | | Elective –I | 3 | 0 | 0 | 3 | |
| **PRACTICAL** | | | | | | | | |
| 7. | PCC | 15EE56C | Power Electronics Laboratory | 0 | 0 | 2 | 1 | |
| 8. | PCC | 15EE57C | Microprocessor and Microcontroller Laboratory | 0 | 0 | 2 | 1 | |
| 9. | SFC | 15EE58C | Data Structures and Algorithms Laboratory | 0 | 0 | 2 | 1 | |
| | | | **TOTAL** | **18** | **4** | **6** | **23** | |

## SEMESTER – VI

| S. No | Course Category | Course Code | COURSE TITLE | L | T | P | C | QP |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | PCC | 15EE61C | High Voltage Engineering | 3 | 0 | 0 | 3 | E |
| 2. | PCC | 15EE62C | Electrical Energy Utilization and Conservation | 3 | 0 | 0 | 3 | B |
| 3. | SFC | 15EE63C | Object Oriented Programming | 3 | 0 | 0 | 3 | B |
| 4. | PCC | 15EE64C | Design of Electrical Apparatus | 3 | 0 | 0 | 3 | B |
| 5. | MAC | 15EE65C | Project Management and Finance* | 3 | 0 | 0 | 3 | B |
| 6. | *X*EC | | Elective – II | 3 | 0 | 0 | 3 | |
| **PRACTICAL** | | | | | | | | |
| 7. | PCC | 15EE66C | Power System Simulation and High Voltage Laboratory | 0 | 0 | 2 | 1 | |
| 8. | SFC | 15EE67C | Object Oriented Programming Laboratory | 0 | 0 | 2 | 1 | |
| 9. | PCC | 15EE68C | Product Development Laboratory | 0 | 0 | 4 | 2 | |
| 10. | PCC | 15EE69C | Comprehension | 0 | 0 | 2 | 1 | |
| | | | **TOTAL** | **18** | **0** | **10** | **23** | |

MAC - Mandatory Course, CFC - Common Foundation Course, SFC - Specific Foundation Course,
PCC – Programme Core Course, *X*EC - *X* Stands for P or O (PEC – Programme Elective Course,
OEC – Open Elective Course) *****Common to all B.E. / B.Tech., Programmes, @Common to EEE and EIE,
#Common to ECE and EEE

## SEMESTER – VII

| S. No | Course Category | Course Code | COURSE TITLE | L | T | P | C | QP |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | PCC | 15EE71C | Smart Grid | 3 | 0 | 0 | 3 | B |
| 2. | *X*EC | | Elective –III | 3 | 0 | 0 | 3 | |
| 3. | *X*EC | | Elective –IV | 3 | 0 | 0 | 3 | |
| 4. | *X*EC | | Elective –V | 3 | 0 | 0 | 3 | |
| 5. | *X*EC | | Elective –VI | 3 | 0 | 0 | 3 | |
| 6. | *X*EC | | Elective –VII | 3 | 0 | 0 | 3 | |
| **PRACTICAL** | | | | | | | | |
| 6. | PCC | 15EE72C | Mini Project | 0 | 0 | 8 | 4 | |
| 7. | PCC | 15EE73C | Research Paper and Patent Review – Seminar | 0 | 0 | 2 | 1 | |
| | | | **TOTAL** | **18** | **0** | **10** | **23** | |

## SEMESTER – VIII

| S. No | Course Category | Course Code | COURSE TITLE | L | T | P | C | QP |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | *X*EC | | Elective - VIII | 3 | 0 | 0 | 3 | |
| **PRACTICAL** | | | | | | | | |
| 2. | PCC | 15EE81C | Project Work | 0 | 0 | 20 | 10 | |
| 3. | PCC | 15EE82C | Internship / Inplant Training | 0 | 0 | 4 | 2 | |
| | | | **TOTAL** | **3** | **0** | **24** | **15** | |

MAC - Mandatory Course, CFC - Common Foundation Course, SFC - Specific Foundation Course,
PCC – Programme Core Course, *X*EC - *X* Stands for P or O (PEC – Programme Elective Course,
OEC – Open Elective Course) *****Common to all B.E. / B.Tech., Programmes, @Common to EEE and EIE,
#Common to ECE and EEE

## PROGRAMME ELECTIVE COURSES (PEC)

| S. No | Course Category | Course Code | COURSE TITLE | L | T | P | C | QP |
|---|---|---|---|---|---|---|---|---|
| **Power Electronics And Drives** | | | | | | | | |
| 1. | PEC | 15EE01E | Switched Mode Power Conversions | 3 | 0 | 0 | 3 | B |
| 2. | PEC | 15EE02E | Special Electrical Machines | 3 | 0 | 0 | 3 | B |
| 3. | PEC | 15EE03E | Power Electronics for Renewable Energy Systems | 3 | 0 | 0 | 3 | B |
| 4. | PEC | 15EE04E | CAD of Electrical Apparatus | 3 | 0 | 0 | 3 | B |
| 5. | PEC | 15EE05E | Solid State Drives | 3 | 0 | 0 | 3 | B |
| **Power and Energy Systems** | | | | | | | | |
| 6. | PEC | 15EE06E | Advanced Switchgear | 3 | 0 | 0 | 3 | B |
| 7. | PEC | 15EE07E | Solar Photovoltaic Fundamentals and Applications | 3 | 0 | 0 | 3 | E |
| 8. | PEC | 15EE08E | Energy Auditing and Management | 3 | 0 | 0 | 3 | B |
| 9. | PEC | 15EE09E | Power Quality | 3 | 0 | 0 | 3 | B |
| 10. | PEC | 15EE10E | Energy Studies | 3 | 0 | 0 | 3 | B |
| **High Voltage Engineering** | | | | | | | | |
| 11. | PEC | 15EE11E | Electromagnetic Interference and Electromagnetic Compatibility | 3 | 0 | 0 | 3 | E |
| 12. | PEC | 15EE12E | Insulation Technology | 3 | 0 | 0 | 3 | E |
| 13. | PEC | 15EE13E | Flexible AC Transmission | 3 | 0 | 0 | 3 | B |
| 14. | PEC | 15EE14E | EHV AC Power Transmission | 3 | 0 | 0 | 3 | B |
| 15. | PEC | 15EE15E | High Voltage DC Transmission | 3 | 0 | 0 | 3 | B |
| **Control and Instrumentation** | | | | | | | | |
| 16. | PEC | 15EE16E | Linear and Nonlinear Control Systems | 3 | 0 | 0 | 3 | B |
| 17. | PEC | 15EE17E | Logic and Distributed Control System @ | 3 | 0 | 0 | 3 | B |
| 18. | PEC | 15EE18E | Advanced Control Theory | 3 | 0 | 0 | 3 | B |
| 19. | PEC | 15EE19E | Soft Computing for Electrical Engineering | 3 | 0 | 0 | 3 | B |
| 20. | PEC | 15EE20E | MEMS and NEMS | 3 | 0 | 0 | 3 | B |
| **Applied Electronics** | | | | | | | | |
| 21. | PEC | 15EE21E | DSP based System Design | 3 | 0 | 0 | 3 | B |
| 22. | PEC | 15EE22E | Microprocessors, PC hardware and interfacing | 3 | 0 | 0 | 3 | B |
| 23. | PEC | 15EE23E | Advanced Microprocessor and Microcontroller | 3 | 0 | 0 | 3 | B |
| 24. | PEC | 15EE24E | Real Time Operating Systems | 3 | 0 | 0 | 3 | B |
| 25. | PEC | 15EE25E | Automotive Electrical and Electronics | 3 | 0 | 0 | 3 | B |
| 26. | PEC | 15EE26E | Embedded and Real Time Systems | 3 | 0 | 0 | 3 | B |

## ONE CREDIT ELECTIVE COURSES (PEC)

| S. No | Course Category | Course Code | COURSE TITLE | L | T | P | C | QP |
|---|---|---|---|---|---|---|---|---|
| 1. | PEC | 15EE01L | Computational Fluid Dynamics for Electrical Apparatus | 1 | 0 | 0 | 1 | G |
| 2. | PEC | 15EE02L | Design of Power Converters Laboratory | 0 | 0 | 2 | 1 | - |
| 3. | PEC | 15EE03L | Energy storage system | 1 | 0 | 0 | 1 | G |
| 4. | PEC | 15EE04L | LVDC wiring | 1 | 0 | 0 | 1 | G |
| 5. | PEC | 15EE05L | Digital substation | 1 | 0 | 0 | 1 | G |
| 6. | PEC | 15EE06L | Electrical system for smart building | 1 | 0 | 0 | 1 | G |
| 7. | PEC | 15EE07L | Power System Protection and Substation Automation | 1 | 0 | 0 | 1 | G |
| 8. | PEC | 15EE08L | Energy Laboratory | 0 | 0 | 2 | 1 | - |
| 9. | PEC | 15EE09L | HVDC circuit breakers | 1 | 0 | 0 | 1 | G |
| 10. | PEC | 15EE10L | Earthing design | 1 | 0 | 0 | 1 | G |
| 11. | PEC | 15EE11L | Electrical stress analysis | 1 | 0 | 0 | 1 | G |
| 12. | PEC | 15EE12L | Alternate insulating medium | 1 | 0 | 0 | 1 | G |
| 13. | PEC | 15EE13L | Communication technologies for smart grids | 1 | 0 | 0 | 1 | G |
| 14. | PEC | 15EE14L | Non-Conventional instrument Transformer | 1 | 0 | 0 | 1 | G |
| 15. | PEC | 15EE15L | Industrial Controllers Laboratory | 0 | 0 | 2 | 1 | - |
| 16. | PEC | 15EE16L | Soft Computing for Electrical Engineering Laboratory | 0 | 0 | 2 | 1 | - |
| 17. | PEC | 15EE17L | Electronics for safety critical system | 1 | 0 | 0 | 1 | G |
| 18. | PEC | 15EE18L | PCB design and fabrication | 0 | 0 | 2 | 1 | - |
| 19. | PEC | 15EE19L | Embedded System Laboratory | 0 | 0 | 2 | 1 | - |
| 20. | PEC | 15EE20L | Techno commercial project proposal | 1 | 0 | 0 | 1 | G |
| 21. | PEC | 15EE21L | Virtual Instrumentation | 1 | 0 | 0 | 1 | G |
| 22. | PEC | 15EE22L | Electrical Power Capacitors | 1 | 0 | 0 | 1 | G |
| 23. | PEC | 15EE23L | Internet of Things and Embedded Systems | 1 | 0 | 0 | 1 | G |
| 24. | PEC | 15EE24L | High Voltage Testing Techniques | 0 | 0 | 2 | 1 | - |
| 25. | PEC | 15EE25L | | | | | | |

## Open Elective Course (OEC)

**Group – I** (Inter-disciplinary courses)

| S. No | Course Category | Course Code | COURSE TITLE | L | T | P | C | QP |
|---|---|---|---|---|---|---|---|---|
| **Any one of the following course is compulsory** | | | | | | | | |
| 1. | OEC | 15ID01E | Product Design and Development | 3 | 0 | 0 | 3 | A |
| 2. | OEC | 15ID02E | Disaster Management | 3 | 0 | 0 | 3 | A |
| 3. | OEC | 15ID03E | Energy Engineering | 3 | 0 | 0 | 3 | A |
| 4. | OEC | -- | Other Programme Courses | 3 | 0 | 0 | 3 | As specified for the Chosen Course |

**Group-II** (Trans-disciplinary courses) - Self Study Course

| S. No | Course Category | Course Code | COURSE TITLE | L | T | P | C | QP |
|---|---|---|---|---|---|---|---|---|
| **Any one of the following course is compulsory** | | | | | | | | |
| 1. | OEC | 15TD01E | Indian Business Laws | 0 | 0 | 0 | 3 | F |
| 2. | OEC | 15TD02E | Leadership and Personality Development | 0 | 0 | 0 | 3 | F |
| 3. | OEC | 15TD03E | International Business Management | 0 | 0 | 0 | 3 | F |
| 4. | OEC | 15TD04E | Basics of Marketing | 0 | 0 | 0 | 3 | F |
| 5. | OEC | 15TD05E | Retailing and Distribution management | 0 | 0 | 0 | 3 | F |
| 6. | OEC | 15TD06E | International Economics | 0 | 0 | 0 | 3 | F |
| 7. | OEC | 15TD07E | Indian Economy | 0 | 0 | 0 | 3 | F |
| 8. | OEC | 15TD08E | Rural Economics | 0 | 0 | 0 | 3 | F |
| 9. | OEC | 15TD09E | International Trade | 0 | 0 | 0 | 3 | F |
| 10. | OEC | 15TD10E | Global Challenges and issues | 0 | 0 | 0 | 3 | F |
| 11. | OEC | 15TD11E | Indian Culture and Heritage | 0 | 0 | 0 | 3 | F |
| 12. | OEC | 15TD12E | Indian History | 0 | 0 | 0 | 3 | F |
| 13. | OEC | 15TD13E | Sustainable Development and Practices | 0 | 0 | 0 | 3 | F |
| 14. | OEC | 15TD14E | Women in Indian Society | 0 | 0 | 0 | 3 | F |
| 15. | OEC | 15TD15E | Indian Constitution | 0 | 0 | 0 | 3 | F |
| 16. | OEC | 15TD16E | Bio Mechanics in Sports | 0 | 0 | 0 | 3 | F |

**15SH11C** **TECHNICAL ENGLISH** **L T P C**

**(Common to all B.E. / B.Tech. Degree Programmes)** **3 0 0 3**

**COURSE OUTCOMES**

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

CO1: acquire the basics of English communication skills**.** (K3)

CO2: apply the basic language skills to understand various aspects of technical writing. (K3)

CO3: understand main ideas, specific details and implied meaning while listening and develop the factual & imaginative information. (K2, S4)

CO4: coordinate and communicate in a wide range of situation. (K3, S4)

CO5: integrate and apply the acquired skills in real life situation. (K2, S4)

**UNIT I** **9**

Parts of Speech - Sentence Structure (SV/SVO/SVC/SVIODO) - Identifying the kinds of sentences (Statement, Interrogative, Imperative, Exclamatory & Negative) - Informal writing (Diary writing & letter to friend / parent / siblings) - Self Introduction -Listening for general information.

**UNIT II** **9**

Transformation of words into different grammatical forms- Converting one kind of sentence into another sentence (Statement, Interrogative, Imperative, Exclamatory & Negative) - Technical Vocabulary - Tense Usage (Present tense- Past tense - Future tense - Writing passages in all tenses) -Letter writing (Permission letter & Requisition letter) - Listening for specific information.

**UNIT III** **9**

Personality Adjective - Concord - Letter Writing: Invitation / Acceptance letters - Itinerary Writing (with valued points / situation) - Phonetics (Vowels - Consonants - Diphthongs) - Listening and filling up the information - Process Description (with valued points).

**UNIT IV** **9**

IF Conditionals - British & American Vocabulary - Letter Writing (Declining / Thanking letters) - Email writing (with valued points) - Instruction Writing - Listening and giving opinion on the pictures.

**UNIT V** **9**

Reading comprehension **-** Error Spotting (Article, Preposition, Modals and Concord) **-** Presenting article based on newspaper reading- Situational Conversation - Listening and writing dialogues – Checklists.

**L: 45 TOTAL: 45 PERIODS**

**Suggested Activity:** Each student should read the suggested fiction for oral assignment

**TEXT BOOKS**

1. Rizvi. M. Ashraf, “Effective Technical Communication”, 1st Edition, The Mc Graw Hill Education Private Limited, New Delhi, 2005.
2. Dutt P. K., Rajeevan G. and Prakash C.L.N., “A Course in Communication Skills”, 1st Edition, Cambridge University Press, India, 2007.

**REFERENCES**

1. John Sinclair, "Collins Cobuild English Grammar", 3rd Edition, Collins Publishers, London, 2011.
2. Jan Svartvik, Sidney Greenbaum, Geoffery Leech, Randolph Quirk "A Comprehensive Grammar of the English Language", 2nd Edition, Longman Inc., Newyork, 2014.
3. Micheael Vince, Peter Sunderland, "Advanced Language Practice with Key", 3rd Edition, Macmillan Publishers Limited, Italy, 2003.

**Listening files:** Audio files from net sources,
Softwares: ODLL, Globerena.

**15SH12C MATHEMATICAL FOUNDATIONS FOR ENGINEERS L T P C**
**(Common to all B.E. / B.Tech. Degree Programmes) 3 2 0 4**

**COURSE OUTCOMES**

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

CO 1: make use of orthogonal transformation. (K3)
CO 2: use the basic concepts of three dimensional geometry in engineering. (K2)
CO 3: obtain maxima and minima of real valued functions. (K3)
CO 4: solve ordinary differential equations. (K3)
CO 5: solve partial differential equations. (K3)

**UNIT I MATRICES 15**

Characteristic equation – Eigen values and Eigen vectors of a real matrix – Independency and dependency of Eigen vectors – Properties of Eigen values and Eigen vectors (excluding proofs) - Diagonalisation of a matrix by orthogonal transformation - Quadratic forms – Reduction of quadratic form to canonical form by orthogonal transformation and its nature.

**UNIT II THREE DIMENSIONAL ANALYTICAL GEOMETRY 15**

Direction cosines and Direction ratios - Planes and Lines - Equations of plane and line - Intersection of two planes - Shortest distance between two lines - Equation of a sphere - Plane section of a sphere - Tangent Plane - Orthogonal spheres.

**UNIT III FUNCTIONS OF SEVERAL VARIABLE 15**

Euler's theorem on homogeneous functions of two variables - Taylor's Series - Jacobians - Maxima and Minima - Constrained Maxima and Minima by the method of Lagrange multipliers.

**UNIT IV ORDINARY DIFFERENTIAL EQUATIONS 15**

Solutions of higher order linear differential equations with constant coefficients - Cauchy's and Legendre's linear equations - Solutions of simultaneous first order linear equations with constant coefficients - Method of variation of parameters.

**UNIT V PARTIAL DIFFERENTIAL EQUATIONS 15**

Formation of partial differential equations - Lagrange's linear equations - Solutions of standard types of first order partial differential equations - Solutions of homogeneous linear partial differential equations of second and higher order with constant coefficients.

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

**TEXT BOOKS**

1. Grewal.B.S. "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, Delhi, 2012.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India, 2011.

**REFERENCES**

1. Bali.N.P. and Manish Goyal, "A Textbook of Engineering Mathematics", 8th Edition, Laxmi Publications Private Limited, 2011.
2. George B.Thomas, Jr. Ross L.Finney, "Calculus and Analytic Geometry", 9th Edition, Dorling Kindersley Private Limited, 2010.
3. Sharma.G.S and Sarna.I.J.S, "Engineering Mathematics", 10th Edition, CBS Publishers and Distributors, New Delhi, 2005.
4. James C. Robinson, "An Introduction to Ordinary Differential Equations", Cambridge University Press, 2004.
5. Anthony Croft, Robert Davison, Martin Hargreaves and James Flint, "Engineering Mathematics: A Foundation for Electronic, Electrical, Communications and Systems Engineers", 4th Edition, Pearson Education Private Limited, 2013.

**15SH13C ENGINEERING PHYSICS L T P C**

**(Common to all B.E. / B.Tech. Degree Programmes) 3 0 0 3**

**COURSE OUTCOMES**

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

CO 1: summarize the properties and structures of solids. (K2)

CO 2: define the principles of acoustics and ultrasonics and apply the ultrasonic methods for industrial and medical field. (K2)

CO 3: choose the appropriate Laser technique for industrial and medical applications. (K3)

CO 4: describe the different types, fabrication, losses of optical fibers and their applications in communication and instrumentation. (K2)

CO 5: explain the physical properties of photons & electrons and their applications in different electron microscopes. (K3)

**UNIT I PROPERTIES OF MATTER AND CRYSTAL PHYSICS 9**

Hooke's law - Types of moduli of elasticity - Determination of Rigidity modulus and Young's modulus - I shaped Girders.

Miller indices – d spacing - Characteristics of SC, BCC, FCC and HCP structures.

**UNIT II ACOUSTICS AND ULTRASONICS 9**

**Acoustics:** Weber-Fechner law - Sabine's formula - Absorption Coefficient and its determination - factors affecting acoustics of buildings and their remedies.

**Ultrasonics:** Production - magnetostriction generator - piezoelectric generator, Properties - Cavitations - Velocity measurement - acoustic grating, Industrial applications - Medical application - Sonograms.

**UNIT III LASER SYSTEM AND APPLICATIONS 9**

Einstein's A and B coefficients – Types and working of Lasers - $CO_2$ Laser, Nd-YAG Laser, Semiconductor Laser (Homojunction), Determination of wavelength of Laser and Particle size - Industrial applications - Medical applications-Holography.

**UNIT IV FIBER OPTICS AND ITS APPLICATIONS 9**

Numerical aperture and Acceptance angle - Types of optical fibers - Double crucible technique – Splicing - Loss in optical fiber - Fiber optical communication system - Applications - Fiber optic sensors - Endoscope.

**UNIT V QUANTUM PHYSICS 9**

Photo electric effect - Matter Waves - Davisson and Germer experiment - Heisenberg's Uncertainty principle - Schrodinger's wave equation - particle in one dimensional box - Electron microscope - Scanning electron microscope - Transmission electron microscope.

**L: 45 TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. David Halliday, Robert Resnick, Jearl Walker, "Fundamentals of Physics", 10th Edition, John Wiley & Sons Inc.USA, 2014.
2. Arthur Beiser, "Concepts of Modern Physics", 6th Edition, McGraw Hill Publications Private Limited, 2008.

**REFERENCES**

1. Richard P.Feynmann, Robert B Leighton and Mathew Sands, "Feynmann's Lectures on Physics", 4th Edition, Addison Wesley Publication USA, 2010.
2. Yoav Peleg, Reuven Pnini, Elvahu Zaarur, Eugene Hecht, "Schaum's Outline of Quantum Mechanics", 2nd Edition, McGraw Hill Companions Limited, USA, 2010.
3. William T.Silfvast, "Laser Fundamentals", 2nd Edition, Cambridge University Press, NewYork, 2008.

**15SH14C ENGINEERING CHEMISTRY L T P C**

**(Common to all B.E. / B.Tech. Degree Programmes) 3 0 0 3**

**COURSE OUTCOMES**

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

CO 1: identify suitable water treatment techniques for industrial and domestic purpose. (K3)

CO 2: explain the type of corrosion and corrosion control methods. (K3)

CO 3: select the polymer for specific application. (K2)

CO 4: explain the preparation, properties and applications of nano materials. (K2)
CO 5: outline the principle and instrumentation of various analytical techniques. (K2)

**UNIT I WATER TREATMENT 9**

Types of water - hardness - estimation of hardness of water – disadvantages of using hard water in boiler – oils and silica in water; water softening – internal conditioning – external conditioning – domestic water treatment – desalination.

**UNIT II CORROSION AND ITS CONTROL 9**

Chemical corrosion – electrochemical corrosion – mechanism – different types of electrochemical corrosion – factors influencing corrosion – corrosion control methods.

**UNIT III ENGINEERING POLYMERS 9**

Polymers – polymerization – free radical mechanism – plastics – thermo plastics and thermosetting plastics – processing and moulding of plastics – special polymers: fire retardant, conducting, photonic and electro luminescent polymer; composites – polymer matrix composites.

**UNIT IV NANO MATERIALS 9**

Nanoparticles – synthesis of CNT – precipitation, thermolysis, hydrothermal, solvothermal, electrodeposition, chemical vapour deposition, laser ablation – toxic effect of nano materials- properties and applications.

**UNIT V ANALYTICAL TECHNIQUES 9**

Principle, instrumentation and applications of UV-Visible and IR spectroscopy; chromatography: instrumentation and working of gas chromatography and HPLC; conductivity measurements – pH measurements – applications.

**L: 45 TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Jain P.C. and Jain. M., “Engineering Chemistry”, 16th Edition, Dhanpat Rai Publishing Company, New Delhi, Reprint 2013.
2. Dara S.S. and Umare S.S., “A text book of Engineering Chemistry”, S.Chand and Company Limited, New Delhi, 2013.
3. Chawla.S, “A text book of Engineering Chemistry”, 16th Edition, Dhanpat Rai Publishing Company, New Delhi, Reprint 2015.

**REFERENCES**

1. Ahmed Z., “Principles of corrosion engineering and corrosion control”, Butterworth Heinemann, 2006.
2. Ebewele R.O., “Polymer science and Technology”, CFC Press, Newyork, 2000.
3. Charless P. P. and Frank O. J, ,”Introduction to nano technology” John Wiley & Sons, 2008
4. Skoog D.A., James H. F. and Crouch S.R., “Instrumental Analysis”, Cengage Learning India Private Limited, New Delhi, 2011
5. Mc Cash E.M. and Banwell C.N., “Fundamentals of molecular spectroscopy”, 5th Edition, McGraw Hill Education (India) Private Limited, 2013.

**15SH15C INTRODUCTION TO ENGINEERING L T P C**
**(Common to all B.E./B.Tech. Degree Programmes) 2 0 0 2**

**COURSE OUTCOMES**

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

CO 1: recognize the history of engineering through various engineering wonders in past and identify the engineering profession. (K2)

CO 2: recognize and analyze various engineering career paths and preparing for an engineering career. (K3)

CO 3: understand the profile of engineers in various fields. (K3)

CO 4: understand the OBE concepts and its components. (K2)

CO 5: understand learning components and creativity. (K3)

**UNIT I HISTORY OF ENGINEERING AND INTRODUCTION TO ENGINEERING PROFESSION 7**

**History of Engineering:** Definition of Engineering, The Beginnings of Engineering, Overview of ancient Engineering, Traveling through the Ages, A case study of two historic Engineers – Lionardo da Vincy, Gutenberg.

**Introduction to Engineering Profession:** Engineering work is all around you - Engineering as a profession and common traits of Good Engineers – History of Engineering Disciplines – Functions of Engineering.

**UNIT II CAREER PATHS OF ENGINEER AND PREPARING FOR AN ENGINEERING CAREER 8**

**Career Paths for Engineers:** The corporate ladder, The independent entrepreneur, Employment Opportunities in Government, The military, Engineering and social service abroad, The Engineering Professor, Graduate work outside of engineering, A mix of two or more of the first six options.

**Preparing for an Engineering Career**: Making the Transition from High School to College - Budgeting Your Time - Daily Studying and Preparation - Getting Involved with an Engineering Organization - Your Graduation Plan - Other Considerations.

**UNIT III PROFILES OF ENGINEERS 4**

Initial Career Profiles of Civil, Mechanical, Electrical, Electronics, Instrumentation, Communication, Information Technology, Computer Engineering Graduates.

**UNIT IV OVERVIEW OF OBE AND CBCS 4**

Graduate attributes of Washington Accord – Programme Specific Criteria (PSC) – Programme Educational Objectives (PEOs) – Programme Outcomes (POs) – Course Outcomes (COs) – CBCS : Course categories - Scheme of instruction, Assessment and Evaluation.

**UNIT V LEARNING AND CREATIVE THOUGHT 7**

**Introduction**: The successful engineering student - the engineering curriculum - curriculum planning and management - adapting to the college classroom.

**The learning process**: the nature of learning - information processing and memory - determinants of efficient learning - practical suggestions for learning.
**Differences in the way people think**: The four-quadrant model of thinking - hindrances to problem solving.
**On Creativity:** What is creativity? - the nature of creativity - characteristics of creative people - the creative process - overcoming obstacles to creative thinking.

**L: 30 TOTAL: 30 PERIODS**

**REFERENCES**

1. Paul H. Wright, "Introduction to Engineering", School of Civil and Environmental Engineering, 3rd Edition, John Wiley & Sons, Inc, 2002.
2. Saeed Moaveni, "Engineering Fundamentals an Introduction to Engineering", 4th Edition, Cengage Learning, USA, 2011.
3. William C. Oakes, Les L. Leone and Craig J. Gunn, "Engineering Your Future – A Comprehensive Introduction to Engineering", Oxford University Press, USA, 2010.
4. Philip Kosky, George Wise, Robert Balmer and William Keat, "Exploring Engineering An Introduction to Engineering and Design", Academic Press, Elsevier, USA, 2010.

**WEB RESOURCES**

www.ieagreements.org/IEA-Grad-Attr-Prof-Competencies.pdf

| **15EE25C** | **C PROGRAMMING FOR ENGINEERS** | **L T P C** |
|---|---|---|
| | (Common to all B.E. / B.Tech. Degree Programmes) | **3 0 0 3** |

**COURSE OUTCOMES**

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

CO 1: recognize the system fundamentals and the role of hardware components of the Computer. (K3)
CO 2: apply the basic concepts and solve simple problems by analyzing the logics of conditional statements and looping constructs. (K3)
CO 3: handle similar types of data using array and utilize their functionality. (K3)
CO 4: appreciate the call by value and call by reference features in functions. (K5)
CO 5: design programs involving their own derived data types, pointers, memory allocation concepts. (K4)
CO 6: handle the file contents with access permissions. (K3)

**UNIT I COMPUTER FUNDAMENTALS 10**

Introduction – Characteristics of Computers – Evolution of Computers – Computer Generations – Classification of Computers – Basic Computer organization – Number Systems – Problem Analysis – Algorithms – Flow charts – Computer Software – Types of Software.

**UNIT II BASIC C PROGRAMMING 9**

Overview of C Program – Constants, Variables and Data Types – Operators and Expressions – Managing Input and Output operations – Decision Making and Branching – Decision making and Looping.

**UNIT III ARRAYS AND FUNCTIONS 9**

Arrays: One dimensional arrays – Two dimensional arrays – Multi dimensional arrays. Character arrays and Strings: Declaring and initializing String Variables – Comparison of two strings – String handling functions. User defined Functions: Definition – Declaration – Function calls – Category of Functions – Recursion - Storage Classes.

**UNIT IV STRUCTURES AND POINTERS 9**

Structures and Unions: Definition – Declaration – Accessing structures – Initialization of structures – Arrays of structures – Arrays within Structure – Structures within Structures - Structures and functions - Unions. Pointers: Initialization – Pointers and arrays- Array of pointers – Pointers as function arguments – Pointers to functions – Pointers and Structure.

**UNIT V FILES AND DYNAMIC MEMORY ALLOCATION 8**

File management in C – Defining and opening a file – closing a file - Input and Output operations on file – Error handling during IO operations – Random access to files – Command line Arguments. Dynamic memory allocation: Allocating a block of memory - Allocating a multiple block of memory – Releasing the used space – Altering the size of a block.

**L: 45 TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Ashok.N.Kamthane, “Computer Programming”, Pearson Education, India, 2008.
2. E. Balagurusamy, “Programming in ANSI C”, 6th Edition Multicolor, 2013.

**REFERENCES**

1. Pradip Dey, Manas Ghosh, “Fundamentals of Computing and Programming in C”, 1st Edition, Oxford University Press, 2009
2. Stephen G.Kochan, “Programming in C”, 3rd Edition, Pearson Education, India, 2005.
3. Brian W.Kernighan and Dennis M.Ritchie, “The C Programming Language”, Pearson Education Inc., 2005.

## 15SH17C ENGINEERING PHYSICS AND ENGINEERING CHEMISTRY LABORATORY

**(Common to all B.E./B.Tech. Degree Programmes)** **L T P C**

**0 0 2 1**

**PART A – ENGINEERING PHYSICS LABORATORY**

**COURSE OUTCOMES**

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

CO1: demonstrate the properties of light waves. (K3, S3)

CO2: interpret the production of ultrasounds and how the velocity of ultrasounds varies with respect to medium.(K3, S3)

CO3: illustrate the mechanical and electrical properties of materials. (K3, S3)

**LIST OF EXPERIMENTS**

1. Determination of thickness of a thin wire – Air wedge method.
2. Determination of velocity of sound and compressibility of the liquid – Ultrasonic Interferometer.
3. Determination of Dispersive power of a prism using Spectrometer.
4. Determination of Young's modulus – Uniform bending method.
5. Torsional pendulum – Determination of Moment of Inertia of the disc and Rigidity modulus of the material of the wire.
6. Determination of specific resistance of a given coil of wire – Carey Foster's Bridge.
7. Calibration of voltmeter / ammeter using potentiometer.
8. Determination of Frequency of A.C. mains using Sonometer.
9. Determination of the angular divergence of a laser beam using He-Ne laser or diode laser.
10. Determination of temperature coefficient of resistance.

**P:15 TOTAL: 15 PERIODS**

## PART B - ENGINEERING CHEMISTRY LABORATORY

**COURSE OUTCOMES**

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

CO 1: estimate the amount of hardness of the water sample (K5, S3)

CO 2: determine the rate of corrosion (K5, S3)

CO 3: synthesize a polymer and to determine molecular weight of the polymer (K6, S3)

CO 4: synthesize silver nano particles (K6,S3)

CO 5: quantify different ions by different analytical techniques (K5,S3)

**LIST OF EXPERIMENTS**

1. Estimation of hardness of water sample by EDTA method
2. Rate of corrosion- weight loss method
3. Synthesis of urea-formaldehyde resin
4. Determination of molecular weight of a polymer – Oswald's viscometer
5. Synthesis and characterization of silver nano particles.
6. Estimation of iron ($Fe^{2+}$) in water sample by dichrometry
7. Estimation of hydrochloric acid by conductometric method
8. Estimation of mixture of acids by conductometric method
9. Determination of purity of simple organic compounds using HPLC- (Demo).

**P: 15 TOTAL: 15 PERIODS**

- A minimum of FIVE experiments shall be offered.
- Laboratory classes on alternate weeks for Physics and Chemistry.

**REFERENCES**

1. Harris D.C., "Quantitative Chemical Analysis: International Edition", 8th Edition, W.H. Freeman, 2010.
2. Mendham J., "Vogel's Quantitative Chemical Analysis", 6th Edition, Pearson Publisher, 2009.
3. Vogel A.I., "Vogel's Textbook of Quantitative Chemical Analysis", 5th Edition, Longman Scientific & Technical, 1989.

| **15EE28C** | **C PROGRAMMING LABORATORY** | **L T P C** |
|---|---|---|
| | (Common to all B.E. / B.Tech. Degree Programmes) | **0 0 2 1** |

**COURSE OUTCOMES**

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

CO 1: solve the given problem using the syntactical structures of C language. (K3)

CO 2: develop, execute and document computerized solution for various logic based problems using the flow control features of C language. (K3)

CO 3: enhance the programming skills in C by discriminating constants, variables and arrays and the functionality. (K3)

CO 4: learn about the connection between function return values and variables. (K5)

CO 5: develop programs using string manipulation and file manipulation functions. (K3)

Simple programs

1. Solve problems such as temperature conversion, student grading, interest calculation.
2. Solving the roots of a quadratic equation
3. Designing a simple arithmetic calculator. (Use switch statement)
4. Given distance traveled by a vehicle as d = ut + 1/2at2, where 'u' and 'a' are the initial velocity and acceleration. Calculate the distance traveled for different time intervals

Programs using different control structures

5. Performing the following operations:
    a. Generate Pascal's triangle.
    b. Construct a Pyramid of numbers.
6. Generation of the first 'n' terms of the Fibonacci sequence and prime sequence.
7. Computing Sine series and Cosine series.
8. Finding the 2's complement of a binary number.

Programs using arrays

9. Performing the following operations:
    a. Matrix addition.
    b. Transpose of a matrix.
    c. Matrix multiplication by checking compatibility.

Programs using string manipulation

10. Performing the following operations to a string:
    a. To insert a sub-string into main string at a given position.
    b. To delete 'n' characters from a given position in a string.
    c. To replace a character of string either from beginning or ending or at a specified location.

Programs using functions

11. Performing the following operations: (Use recursive functions)
    a. To find the factorial of a given integer.
    b. To find the GCD (Greatest Common Divisor) of two given integers.
    c. To solve Towers of Hanoi problem.

Programs using files

12. Performing the Student Information Processing using Structures and File handling concepts.

**P: 30 TOTAL: 30 PERIODS**

| **15EE21C** | **PROFESSIONAL ENGLISH** | **L T P C** |
|---|---|---|
| | **(Common to all B.E. / B.Tech. Degree Programmes)** | **3 0 0 3** |

**COURSE OUTCOMES**

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

CO 1: contribute the lingual power to frame sentences in different context. (K2, A2)
CO 2: write effectively in any Professional context. (K3, A2)
CO 3: acquire the skills related to Group discussion. (K3, A2)
CO 4: communicate and respond in different social and professional contexts. (K3, A3)
CO 5: recall the acquired skills in solving competitive exam. (K2, S3)

**UNIT I** **9**

Phrasal Verbs (Based on root words: call, come, get, look, put, run, and take) - Foreign Words and Phrases (from the given list) - Listening to audio files and finding the technical words and framing different sentences - Channel conversion- Descriptive writing on various charts.

**UNIT II** **9**

Idioms and Phrases (with animal names from the given list) - Report writing (types- structure- stages in report writing- model report) - Job Application Letter with curriculum vitae.

**UNIT III** **9**

One word substitution (from the list given) Group Discussion (Why is GD a part of selection process? - Structure of GD – Strategies in GD – Team Work - Body Language - Video Samples-GD).

**UNIT IV** **9**

Choosing a suitable connotation (from the given list) - Note making – Preparing Circular and Minutes of meeting – Listening to TED Talks – Giving opinion on the given TED Talks and interviewing the TED talkers.

**UNIT V** **9**

Error Spotting (Tense, Relative Pronouns, Conjunctions, Sentence Structure, Adverb Placement) Sentence Completion - Reading comprehension.

**L: 45 TOTAL: 45 PERIODS**

**Activity:** Each student should read the suggested fiction for oral assignment.

**TEXT BOOK**

1. Tyagi Kavita and Padma Misra, "Advanced Technical Communication", 1st Edition, PHI Learning Private Limited, New Delhi, 2011.

**REFERENCES**

1. Smith-Worthington, Darlene & Sue Jefferson. "Technical Writing for Success", 1st Edition, Cengage Mason, USA, 2007.
2. Bovee, Courtland L., John V.Thill. "Business Communication Today", 12th Edition, Pearson Education, New Delhi, 2013.
3. Anderson, Paul V. "Technical Communication: A Reader - Centered Approach", 8th Edition, Cengage, New Delhi, 2013.

**Listening files:** Audio files from net sources and softwares: ODLL, Globerena.

| 15EE22C | CALCULUS, PROBABILITY AND STATISTICS<br>(Common to EEE and EIE) | L T P C<br>3 2 0 4 |
|---|---|---|

**COURSE OUTCOMES**

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

CO 1: compute and change variables in double and triple integrals.(K3)
CO 2: analyze the concepts related to vector calculus and apply them in engineering field. (K3)
CO 3: use the concepts of multivariate random variables. (K2)
CO 4: calculate the various measures of dispersion. (K3)
CO 5: explain and successfully apply all aspects of appropriate testing techniques. (K3)

**UNIT I MULTIPLE INTEGRALS** **15**

Double integration – Cartesian and polar coordinates - Change of order of integration - Change of variables - Cartesian to polar coordinates - Area as double integral - Triple integration - Cartesian and polar coordinates – Change of Variables- Cartesian to spherical and cylindrical coordinates.

**UNIT II VECTOR CALCULUS 15**

Gradient, Divergence and Curl – Directional derivatives – Irrotational and solenoidal vector fields- Vector integration – Line, Surface and Volume Integrals - Green's theorem in a plane, Gauss divergence theorem and Stokes' theorem (excluding proofs) – Simple applications involving cubes and rectangular parallelopipeds.

**UNIT III PROBABILITY 15**

Discrete and continuous random variables – Moments - Moment generating function and their properties- Normal Distribution - Joint distributions - Marginal and conditional distributions - Covariance - Correlation and Regression.

**UNIT IV STATISTICS 15**

Mean, median, mode and standard deviation – Moments – Skewness – Kurtosis - Correlation of single and bivariate frequency distributions – Regression lines.

**UNIT V TESTING OF HYPOTHESIS 15**

Sampling distributions - Tests for single mean, Proportion, Difference of means (for large samples) – Tests for single variance and equality of variances – t-test, F-test and Chi-square test for goodness of fit – Independence of attributes.

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

**TEXT BOOKS**

1. Grewal.B.S., "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, Delhi, 2012.
2. Ronald E.Walpole, Raymond H.Myres, Sharon L.Myres, Keying E. Ye, "Probability and Statistics for Engineers and Scientists", 9th Edition, Pearson Education Private Limited, Delhi, 2011.
3. Gupta S.C, and Kapoor V.K, "Fundamentals of Mathematical Statistics: A modern approach", 10th Edition, Sultan Chand & Sons, Delhi.

**REFERENCES**

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India, 2011.
2. Richard Arnold Johnson, Irwin Miller, John E Freund, "Miller and Freund's Probability and Statistics for Engineers", 8th Edition, Pearson Education Private Limited, 2013.
3. Robert V.Hogg, Joseph W.Mckean, Allen Thornton Craig, "Introduction to Mathematical Statistics", 6th Edition, Pearson Education Private Limited, 2005.

**15EE23C SEMICONDUCTOR PHYSICS L T P C**

**(Common to ECE & EEE) 3 0 0 3**

**COURSE OUTCOMES**

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

CO1: explain the basics of semiconductors.(K2)

CO2: discuss the V - I characteristics of diode and apply the diode concept in rectifiers. (K2)

CO3: compare the characteristics of various transistors.(K3)

CO4: describe the operation and characteristics of different types of semiconductor devices (K2)

CO5: express the properties and applications of the optical materials. (K2)

**UNIT I SEMICONDUCTORS 9**

Intrinsic semiconductor – carrier concentration – determination of bandgap energy - Extrinsic semiconductors – carrier concentration - Hall effect.

**UNIT II PN JUNCTION DIODE AND ITS APPLICATIONS 9**

Theory of PN junction diode - Energy Band Structure - Biasing of PN Junction - Forward bias and Reverse bias - current equation - Space charge and diffusion capacitances – effect of temperature and breakdown mechanism, Zener diode and its characteristics , Applications – Half wave and Full wave rectifiers, Shunt Regulator.

**UNIT III TRANSISTORS 9**

**BJT:** Construction and Operation of NPN and PNP Transistors - Study of CE, CB and CC configurations and comparison of their characteristics – Breakdown in Transistors.

**FET:** Construction and Operation of N-Channel JFET – Expression for Drain Current, Comparison of JFET and BJT. **MOSFET:** Structure and Operation of N MOS and P MOS in Enhancement and Depletion nodes – characteristics of N type MOSFET – Comparison of MOSFET with JFET

**UNIT IV SPECIAL SEMICONDUCTOR DEVICES 9**

SCR – UJT – DIAC and TRIAC –Tunnel diode - PIN diode – Photodiode - Phototransistor – Varactor diode, LDR.

**UNIT V OPTICAL MATERIALS 9**

Optical properties of metals, insulators and semiconductors - Liquid Crystal Display – LED – Thermography - Solar cell.

**L:45 TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. J. Millman and Halkins, Satyebranta Jit, “Electronic Devices and Circuits”, 2nd Edition, Tata McGraw Hill, 2008.
2. David A. Bell, “Fundamentals of Electronic Devices and Circuits”, 5th Edition, Oxford University Press, 2009.
3. Charles Kittel, “Introduction to Solid State Physics”, 7th Edition, John Wiley and Sons, Singapore, 2007.

**REFERENCES**

1. Salivahanan.S, Suresh kumar.N and Vallavaraj.A, “Electronic Devices and Circuits”, 2nd Edition, Tata McGraw Hill, 2011.
2. Robert T. Paynter, “Introductory Electronic Devices and Circuits”, 7th Edition, Pearson Education, 2008.
3. Donald A.Neamen “Semiconductor Physics and Devices”, 4th Edition, Tata McGraw Hill Publication, New Delhi, 2012.
4. Thomas L. Floyd and David M. Buchla, “Electronics Fundamentals: Circuits, Devices and Applications”, 8th Edition, Pearson College Div, 2010.

**15EE24C CIRCUIT THEORY L T P C**
**3 2 0 4**

**COURSE OUTCOMES**

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

CO 1: describe the basic concepts of electric circuits. (K2)
CO 2: illustrate the network theorems for DC and AC circuits. (K3)
CO 3: explain the concepts of resonant circuits. (K2)
CO 4: analyze the dynamic behavior of electric circuits. (K4)
CO 5: analyze the three phase electric circuits. (K4)

**UNIT I BASIC CIRCUITS ANALYSIS 15**

Ohm's Law – Kirchoff's laws – DC and AC Circuits – Resistors in series and parallel circuits – Mesh current and node voltage method of analysis for D.C and A.C. circuits.

**UNIT II NETWORK REDUCTION AND NETWORK THEOREMS FOR DC AND AC CIRCUITS 15**

Network reduction: voltage and current division, source transformation – Star-delta conversion - Thevenin's and Norton's Theorem – Superposition Theorem – Maximum Power Transfer Theorem – Reciprocity Theorem.

**UNIT III RESONANCE AND COUPLED CIRCUITS 15**

Series and parallel resonance – Quality factor and Bandwidth – Self and mutual inductance – Coefficient of coupling – Single tuned circuits.

**UNIT IV TRANSIENT RESPONSE ANALYSIS 15**

Transient response of RL, RC and RLC Circuits using Laplace transform for DC input and AC with sinusoidal input.

**UNIT V ANALYSIS OF THREE PHASE CIRCUITS 15**

Three phase balanced / unbalanced voltage sources – Analysis of three phase 3-wire and 4- wire circuits with star and delta connected loads, balanced and unbalanced loads – Phasor diagram of voltages and currents – power and power factor measurements in three phase circuits.

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

**TEXT BOOKS**

1. Sudhakar A and Shyam Mohan S.P., "Circuits and Network Analysis and Synthesis", 4th Edition, Tata McGraw Hill, 2007.
2. William H. Hayt Jr Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", 6th Edition, Tata McGraw Hill publishers, New Delhi, 2002.

**REFERENCES**

1. John Bird, "Electrical Circuit Theory and Technology", 4th Edition, Newnes Publication, 2010.
2. Paranjothi S.R., "Electric Circuits Analysis", 2nd Edition, New Age International Limited, New Delhi, 2000.

3. Joseph A.Edminister, Mahmood Nahri, "Electric Circuits", Schaum's series, Tata McGraw Hill, New Delhi, 2001.
4. Chakrabati A., "Circuits Theory (Analysis and synthesis)", Dhanpath Rai and Sons, New Delhi, 2008.
5. Charles K.Alexander, Mathew N.O.Sadik, "Fundamentals of Electric Circuits", 2nd Edition, McGraw Hill, 2003.

**15SH16C ENGINEERING GRAPHICS L T P C**
**(Common to all B.E./B.Tech. Degree Programmes) 2 0 2 3**

**COURSE OUTCOMES**

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

CO 1: use the drawing instruments effectively. (K2, S4, A3)
CO 2: draw the projections of points, straight lines, planes. (K2,S3,A3)
CO3: construct the projections of various solids in different positions. (K3, S3, A3)
CO 4: draw the sectional views of various solids and construct the true shape of the section. (K3, S3, A3)
CO 5: identify and draw the surface areas of simple solids. (K3, S3, A3)
CO 6: draw perspective views of simple solids and draw the orthographic views of simple objects. (K3, S3, A3)

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

Drawing Instruments- IS specifications on lines- drawing sheets- Printing letters and dimensioning- scales - First angle projection. (Not for examination).
Projections of points and straight lines located in the first quadrant- Determination of true lengths and true inclinations. Projections of regular polygonal surfaces and circular lamina inclined to both reference planes

**UNIT II PROJECTION OF SOLIDS 12**

Projections of simple solids - axis inclined to one reference plane - change of position method.

**UNIT III SECTION OF SOLIDS 12**

Sectioning of simple solids - cutting planes inclined to one reference plane and perpendicular to the other.

**UNIT IV DEVELOPMENT OF SURFACES AND ISOMETRIC PROJECTIONS 12**

Development of lateral surfaces of simple and truncated solids - Principles of isometric projection and view of simple solids - truncated prism and pyramids.

**UNIT V PERSPECTIVE PROJECTIONS AND ORTHOGRAPHIC PROJECTIONS 12**

Perspective projection of cube, prisms and pyramids by visual ray method and vanishing point method. Orthographic projection – simple objects with straight and curved surfaces.

**L: 30 P: 30 TOTAL: 60 PERIODS**

**TEXT BOOKS**

1. Bhatt N.D, "Engineering Drawing", 53rd Edition, Charotar Publishing House, 2014.
2. Natrajan K.V, "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2009.

**REFERENCES**

1. Kumar M.S, "Engineering Graphics", D.D. Publications, 2007.
2. Venugopal K and Prabhu Raja V, "Engineering Graphics", New Age International Private Limited, 2008.
3. Shah M.B and Rana B.C, "Engineering Drawing", Pearson Education, 2005.
4. Gopalakrishna K.R, "Engineering Drawing", 32nd Edition, Subhas Publications, 2005.
5. Dhananjay Jolhe A, "Engineering Drawing with an Introduction to AutoCAD", Tata McGraw Hill Publishing Company Limited, 2008.
6. Basant Agarwal and Agarwal C.M, "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.

**15EE26C ENVIRONMENTAL SCIENCE AND ENGINEERING L T P C**

(Common to all B.E. / B.Tech. Degree Programmes) **3 0 0 3**

**COURSE OUTCOMES**

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

CO 1: explain the structure and function of ecosystem. (K2)
CO 2: recognize the values of biodiversity and natural resources and the ways to protect the biodiversity of his /her locality. (K2)
CO 3: explain the causes and effects of pollution. (K2)
CO 4: describe social issues related to the environment and the environment act. (K2)
CO 5: identify the nutrients in food and impact of metals on human health. (K2)

**UNIT I ENVIRONMENT AND ECOSYSTEMS 9**

Scope and importance of environment – need for public awareness – ecosystem – structure and function of an ecosystem – energy flow in the ecosystem – forest and aquatic ecosystems – Field study of simple ecosystems – pond and forest.

**UNIT II BIODIVERSITY AND NATURAL RESOURCES 9**

Biodiversity: genetic, species and ecosystem diversity – threats to biodiversity – endangered and endemic species in India – conservation of biodiversity; forest resources: use and over-exploitation – deforestation - dams and their effects on forests and tribal people – water resources: use and overutilization of surface and ground water – role of an individual in conservation of natural resources.

**UNIT III ENVIRONMENTAL POLLUTION 9**

Causes, effects and control measures of air pollution, water pollution, soil pollution, noise pollution and nuclear hazards – solid waste management – e-waste – toxic substances in e-waste – risks related to toxic substances – role of an individual in prevention of pollution.

**UNIT IV SOCIAL ISSUES, HUMAN POPULATION AND ENVIRONMENTAL LAW 9**

Water conservation – rain water harvesting – climate change – global warming, acid rain, ozone layer depletion – population growth – population explosion – family welfare programme; environment laws: the water (prevention and control pollution) act 1974-the air (prevention and control of pollution) act 1981-environmental (protection) act 1986-the wild life (protection) act 1972.

**UNIT V FOOD AND HUMAN HEALTH 9**

Carbohydrates, amino acids, proteins, lipids and vitamins in balanced diet food; disease caused by deficiency of carbohydrates, amino acids, proteins, lipids and vitamins - food adulteration - simple test for food adulterants; environmental toxicology: metals in environment- impacts of lead, arsenic, cadmium, mercury and chromium on human health.

**L: 45 TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Miller G. and Spoolman S, “Environmental Science”, 14th Edition, Brooks/Cole Publishing Co., 2012.
2. Maczulak A.E., “Environmental Engineering”, Facts on file Inc., 2009
3. Han D, “Concise Environmental Engineering”, PhD & Ventus Publishing ApS, 2012

**REFERENCES**

1. Weller K. “Environmental Science and Biological Engineering”, 1st Edition, WIT Press, 2015
2. Strange C. “Environmental Science and production” Nason Trest Publisher, 2010

**15EE27C SEMICONDUCTOR PHYSICS AND ENVIRONMENTAL CHEMISTRY LABORATORY**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 2 | 1 |

**(Common to ECE and EEE)**

**PART A – SEMICONDUCTOR PHYSICS LABORATORY**

**COURSE OUTCOMES**

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

CO 1: demonstrate the properties of optical materials. (K2, S3)
CO 2: analyze the characteristics of semiconducting materials and devices. (K3,S3)
CO 3: design the rectifier using PN diode (K3,S3)

**LIST OF EXPERIMENTS**

1. (a) Determination of wave length of Laser source.

(b) Particle size determination using Diode Laser.
(c) Determination of Numerical aperture and acceptance angle of an optical fiber.

2. Determination of Band Gap of a semiconductor material.
3. V-I Characteristics of PN junction diode/ Zener diode.
4. Transistor Characteristics of BJT (CB & CE) and FET.
5. V-I Characteristics of UJT/Photo diode/ Photo Transistor.
6. V- I Characteristics of SCR.
7. Characteristics of LED/LCD/LDR.
8. Half Wave and Full Wave Rectifiers.

**P:15 TOTAL: 15 PERIODS**

## PART - B ENVIRONMENTAL CHEMISTRY LABORATORY

### COURSE OUTCOMES

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

CO 1: quantify the amount of acidity, alkalinity, DO and COD present in water sample. (K5,S3)
CO 2: analyse the ions present in the soil. (K4,S3)
CO 3: quantify the amount of chloride ion in water sample. (K5,S3)
CO 4: identify the adulteration in food samples. (K1,S3)
CO 5: estimate the amount of metal ions in water sample. (K5,S3)

### LIST OF EXPERIMENTS

1. Estimation of acidity of Water sample.
2. Estimation of alkalinity of Water sample.
3. Determination of Dissolved Oxygen (DO) in water sample (Winkler's method).
4. Determination of COD in water sample.
5. Soil Analysis: Determination of colour, pH, nitrate, phosphate, chloride and sulphate ions.
6. Soil analysis: Estimation of Na/K/Ca in soil.
7. Estimation of chloride ion in water sample by argentometric method.
8. Simple adulteration test in food samples.
9. Estimation of copper in water sample by EDTA method.
10. Estimation of nickel in water sample.

**P:15 TOTAL: 15 PERIODS**

- A minimum of FIVE experiments shall be offered.
- Laboratory classes on alternate weeks for Physics and Chemistry.

### REFERENCES

1. Harris D.C. "Quantitative Chemical Analysis: International Edition", 8th Edition, W.H.Freeman, 2010
2. Mendham J. "Vogel's Quantitative Chemical Analysis", 6th Edition, Pearson Publisher, 2009.
3. Vogel A.I., "Vogel's Textbook of Quantitative Chemical Analysis", 5th Edition, Longman scientific & Technical, 1989.

**15SH18C ENGINEERING PRACTICE LABORATORY L T P C**
**(Common to all B.E./B.Tech. Degree Programmes) 0 0 2 1**

## PART A - MECHANICAL LABORATORY

**COURSE OUTCOMES**

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

CO 1: prepare basic carpentry jobs (at least three joints). (K3,S2, A2)

CO 2: prepare the welded joint (minimum three) using arc and gas welding. (K3, S2, A2)

CO 3: Machine metals using lathe, shaper and drilling machine (each one job). (K3, S2, A2)

**UNIT I CARPENTRY PRACTICES 5**

Study of carpentry tools – preparation of joints like half lap, Tee and dove tail in wood.

**UNIT II WELDING 5**

Study of welding tools – Preparation of welded joints with Mild steel specimen like lap, butt and tee joints using ARC and Gas welding. (any one exercise should be given using Gas welding among three)

**UNIT III BASIC MACHINING PRACTICES 5**

Simple turning and taper turning using lathe – use of shaper and drilling machine for basic operations (Minimum three exercises should be given for students)

**P: 15 TOTAL: 15 PERIODS**

**TEXT BOOK**

1. Bawa H.S, “Workshop Practice”, Tata McGraw Hill Publishing Company Limited, 2007.

**REFERENCES**

1. Ramesh Babu V, “Engineering Practices Laboratory Manual”, Revised Edition, VRB Publishers Private Limited, Chennai, 2014.
2. Jeyachandran K, Natarajan S. and Balasubramanian S, “A Primer on Engineering Practices Laboratory”, Anuradha Publications, 2007.
3. Jeyapoovan T, Saravanapandian M. and Pranitha S, “Engineering Practices Lab Manual”, Vikas Publishing House Private Limited, 2006.
4. Rajendra Prasad A and Sarma PMMS, “Workshop Practice”, Sree Sai Publication, 2002
5. Kannaiah P and Narayana KL, “Manual on Workshop Practice”, Scitech Publications, 1999.

## PART – B ELECTRICAL AND ELECTRONICS LABORATORY

**COURSE OUTCOMES**

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

CO 1: develop simple residential wiring circuits. (K6)

CO 2: calculate the basic electrical quantities. (K4)

CO 3: identify the value of resistance using appropriate methods. (K4, A4)

CO 4: realize the fundamentals of Boolean algebra using digital logic gates. (A4)
CO 5: practice soldering to design PCB for electronic circuits. (A5)

**I. ELECTRICAL ENGINEERING PRACTICE** **8**

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair-case wiring.
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of electrical equipment.

**II. ELECTRONICS ENGINEERING PRACTICE** **7**

1. Study of Electronic components and equipments – Resistor, colour coding, measurement of AC signal parameters (peak-peak, rms period, frequency) using CRO
2. Study of logic gates AND, OR, XOR and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components, Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

**P: 15 TOTAL: 15 PERIODS**

**REFERENCES**

1. Jeyachandran K, Natarajan S and Balasubramanian S, “A Primer on Engineering Practices Laboratory”, Anuradha Publications, 2007.
2. Jeyapoovan T, Saravanapandian M and Pranitha S, “Engineering Practices Lab Manual”, Vikas Publishing House Private Limited, 2006.
3. Bawa H.S, “Workshop Practice”, Tata McGraw Hill Publishing Company Limited, 2007.
4. Rajendra Prasad A and Sarma P.M.M.S., “Workshop Practice”, Sree Sai Publication, 2002.
5. Kannaiah P and Narayana K.L, “Manual on Workshop Practice”, Scitech Publications, 1999.

**15EE29C** **ELECTRIC CIRCUITS LABORATORY** **L T P C**
**0 0 2 1**

**COURSE OUTCOMES**

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

CO 1: illustrate the basic concepts of electric circuits. (K2)
CO 2: relate the physical observations in network theorems of electrical circuits to theoretical principles. (K1)
CO 3: examine the electric circuits using mesh and nodal analysis. (K4)

CO 4: analyze the dynamic behavior of electric circuits using PSIM. (K4)
CO 5: compute the frequency response of resonant and tuned circuits.(K3)

**LIST OF EXPERIMENTS**

1. Verification of Ohm's laws and Kirchoff's laws
2. Verification of Thevenin's and Norton's theorem
3. Verification of Superposition theorem
4. Verification of Maximum Power Transfer theorem
5. Verification of Reciprocity theorem
6. Measurement of self inductance of a coil
7. Verification of mesh and nodal analysis
8. Transient response of RL and RC circuits for DC input
9. Frequency response of series and parallel resonance circuits
10. Frequency response of single tuned coupled circuits

**P: 30 TOTAL: 30 PERIODS**

**15EE31C FOURIER SERIES AND TRANSFORMS L T P C**
**2 2 0 3**

**COURSE OUTCOMES**

Upon completion of this course, the students will be able to
CO1: perform Fourier series analysis of the functions. (K2)
CO2: compute the Fourier transforms of various functions. (K2)
CO3: calculate the Fourier series solution of Wave and Heat equations. (K3)
CO4: apply Laplace Transform techniques to solve ordinary differential equations. (K3)
CO5: solve difference equations using Z–Transforms. (K3)

**UNIT I FOURIER SERIES 12**

Dirichlet's conditions – General Fourier series – Half range series – Complex form of Fourier series – Parseval's identity – Harmonic analysis.

**UNIT II FOURIER TRANSFORMS 12**

Fourier Integral theorem (without proof) – Fourier transform pair – Fourier Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

**UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 12**

Classification of second order partial differential equations – Fourier series solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction (Insulated edges excluded).

**UNIT IV LAPLACE TRANSFORMS 12**

Definition of Laplace transform and its inverse – Transforms of elementary functions – Properties(excluding proofs) – Transforms of periodic functions – Initial and Final value

theorems – Convolution theorem (excluding proof) – Solutions of linear ordinary differential equations of second order with constant coefficients.

**UNIT V Z – TRANSFORMS 12**

Z–transform – Elementary properties – Inverse Z–transform – Convolution theorem – Formation of difference equations – Solutions of difference equations using Z–transform.

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

**TEXT BOOKS**

1. Grewal.B.S "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, Delhi, 2012.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India, 2011.

**REFERENCES**

1. Bali.N.P. and Manish Goyal, "A Textbook of Engineering Mathematics", 8th Edition, Laxmi Publications Private Ltd., 2011.
2. Ramana B.V, "Higher Engineering Mathematics", Tata Mc-Graw Hill Publishing Company, New Delhi, 2007.
3. Jain.R.K. and Iyengar.S.R.K., "Advanced Engineering Mathematics", 3rd Edition, Narosa Publishing House Private Limited, 2007.

**15EE32C ELECTROMAGNETIC THEORY L T P C**
**3 2 0 4**

**COURSE OUTCOMES**

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

CO1: explain the vector calculus applied for static electric and magnetic fields. (K2)
CO2: discuss the concepts of electrostatic fields and boundary conditions for different mediums. (K2)
CO3: discuss the concepts of magnetostatic fields and boundary conditions for different mediums. (K2))
CO4: infer the significance of Maxwell's equations in static and dynamic fields. (K2)
CO5: employ the Maxwell equations for electromagnetic wave propagation.(K3)

**UNIT I INTRODUCTION 15**

Sources and effects of electromagnetic fields – Vector fields – Different co-ordinate systems – Vector calculus – Gradient, Divergence and Curl – Divergence theorem – Stoke's theorem.

**UNIT II ELECTROSTATICS 15**

Coulomb's Law – Electric field intensity – Field due to point and continuous charges – Gauss's law – Electric potential – Electric field and equipotential plots – Electric field in free space, conductors, dielectric – Dielectric polarization – Dielectric strength – Electric

field in multiple dielectrics – Boundary conditions – Poisson's and Laplace's equations – Capacitance – Energy density.

**UNIT III MAGNETOSTATICS 15**

Lorentz Law of force, magnetic field intensity – Biot Savart's Law – Ampere's Law – Magnetic field due to straight conductors, circular loop, infinite sheet of current – Magnetic flux density (B) – B in free space, conductor, magnetic materials – Magnetization – Magnetic field in multiple media – Boundary conditions – Scalar and vector potential – Magnetic force – Inductance – Energy density – Magnetic circuits.

**UNIT IV ELECTRODYNAMIC FIELDS 15**

Faraday's laws – Induced EMF – Transformer and motional EMF – Forces and Energy in quasi - stationary Electromagnetic Fields – Maxwell's equations (differential and integral forms) – Displacement current – Relation between field theory and circuit theory.

**UNIT V ELECTROMAGNETIC WAVES 15**

Electromagnetic wave equations – Wave parameters; velocity, intrinsic impedance, propagation constant – Waves in free space, lossy and lossless dielectrics, conductors – Skin depth – Poynting vector – Transmission lines – Line equations – Input impedances – Standing wave ratio and power.

**L: 45; T: 30; TOTAL: 75 PERIODS**

**TEXT BOOKS**

1. Mathew N. O. Sadiku, "Elements of Electromagnetics", 6th India Edition, Oxford University press Inc., 2014.
2. Ashutosh Pramanik, "Electromagnetism – Theory and Applications", Prentice Hall Private Limited, New Delhi, 2009.

**REFERENCES**

1. Joseph. A. Edminister, "Theory and Problems of Electromagnetics", 3rd Edition, Schaum Series, Tata McGraw Hill Private Limited, 2010.
2. William. H. Hayt, "Engineering Electromagnetics", Tata McGraw Hill Private Limited, 2011.
3. Kraus and Fleish, "Electromagnetics with Applications", 5th Edition, Tata McGraw Hill Private Limited, 2010.

**15EE33C ELECTRONIC CIRCUITS L T P C**
**3 0 0 3**

**COURSE OUTCOMES**

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

CO1: Demonstrate the different BJT Biasing Circuits and its applications. (K2)
CO2: Illustrate the small signal parameters for amplifiers. (K2)
CO 3: Describe the operation of Feedback amplifiers. (K2)
CO 4: Discuss the operation of Pulse circuits. (K2)
CO5: Explain rectifiers, filters and voltage regulators. (K2)

**UNIT I TRANSISTOR BIASING AND STABILITY ANALYSIS 9**

Need for BJT Biasing Circuits – Load line – Operating point – Stability Factors – biasing circuits – Variation of quiescent point – Bias compensation: Diode, Thermistor compensations – Biasing circuits for JFET.

**UNIT II AMPLIFIERS 9**

CE, CB and CC Amplifiers – *h*-Parameters – Simplified CE hybrid model – Frequency response – Low and high frequency analysis – Classification of amplifiers – Complementary symmetry (class B) push-pull amplifier – Darlington connection.

**UNIT III FEEDBACK AMPLIFIER AND OSCILLATORS 9**

Differential amplifiers: Common mode and differential mode – CMRR – Feedback amplifiers – Condition for oscillation – Oscillators – LC, RC phase shift and crystal oscillators

**UNIT IV PULSE CIRCUITS 9**

RC integrator – Differentiator– Clipper – Clamper **–** Multivibrators – Schmitt triggers – UJT Relaxation oscillator

**UNIT V RECTIFIERS AND POWER SUPPLIES 9**

Rectifiers – Analysis of output voltage and ripple voltage – Filter – Voltage regulators – Voltage doublers– Switched mode power supply (SMPS) – Dual Power supply.

**L: 45; TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. David Bell, “Electronic Devices and Circuits”, Prentice Hall Private Limited, 2007
2. S.Salivahanan, N. Suresh Kumar and A.Vallavaraj, “Electronic Devices and Circuits”, 3rd Edition, Tata McGraw Hill Private Limited, 2012.

**REFERENCES**

1. Robert L. Boylestad and Louis Nashelsky, “Electronic Devices and Circuit Theory”, 11th Edition, Prentice Hall Private Limited, 2012.
2. Thomas L. Floyd and David M. Buchla, “Electronics Fundamentals: Circuits, Devices and Applications”, Pearson College Div, 2009.
3. Theodre F. Boghert, “Electronic Devices & Circuits” 6th Edition, Pearson Education, 2003.

**15EE34C DC MACHINES AND TRANSFORMER L T P C**
**2 2 0 3**

**COURSE OUTCOMES**

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

CO1: describe the concepts of electromechanical energy conversion. (K2)
CO2: discuss theory, operation and characteristics of DC Generator. (K2)
CO3: recognize the characteristics, speed control and Applications of DC motors. (K2)

CO4: Illustrate the performance of transformers. (K3)
CO5: Interpret the efficiency of DC machines and transformers by conducting Suitable tests. (K3)

**UNIT I BASIC CONCEPTS OF ROTATING MACHINES 12**

Electrical machine types – Introduction to magnetic circuits – Magnetically induced EMF– AC operation of magnetic circuits – Iron losses – Energy in magnetic systems – Single and Multiple excited systems – MMF of distributed windings – Magnetic fields in rotating machines.

**UNIT II DC GENERATORS 12**

Constructional features of DC machine – Principle of operation – EMF equation – Methods of excitation – Types – Characteristics – Armature reaction – Methods of compensation – Commutation – Parallel operation.

**UNIT III DC MOTORS 12**

Principle of operation – Back EMF – Torque equation – Types – Speed-Torque characteristics –Starters – Speed control of DC series, shunt and compound motors – Losses and efficiency – Permanent Magnet DC motors.

**UNIT IV TRANSFORMERS 12**

Principle of operation – Constructional features of single phase and three phase transformers – EMF equation – Phasor diagram – Equivalent circuit – Regulation – Three phase transformer connections – Parallel operation of single phase and three phase transformer – Auto transformers.

**UNIT V TESTING OF DC MACHINES AND TRANSFORMERS 12**

Losses and efficiency – Condition for maximum efficiency –Testing of DC machines: Brake test, Swinburne's test, Retardation test, Hopkinson's test – Testing of transformer: polarity test, load test,opencircuit and short circuit test, Sumpner's test – All day efficiency.

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

**TEXT BOOKS**

1. Nagrath. I.J and Kothari. D.P., "Electric Machines", Tata McGraw Hill Private Limited, 2010.
2. Bimbhra. P.S., "Electrical Machinery", Khanna Publishes, 7th Edition, 2011.

**REFERENCES**

1. Fitzgerald. A.E., Charles kingsely Jr and Stephen D. Umans, "Electric Machinery", Tata McGraw Hill Private Limited, 2013
2. Theraja. B.L. and Theraja. A.K., "A text book on Electrical Technology", Volume–II, S.Chand and Company Limited, 2009.
3. Sen. P.C., "Principles of Electrical Machines and Power Electronics", John Wiley and Sons, 2014.
4. Murugesh Kumar. K, "Electric Machines", Vikas Publishing House Private Limited, 2010.

5. Irving L. Kosow, "Electric Machinery and Transformers", 2nd Edition, Reprint, Prentice Hall Private Limited, 2007.
6. Stephen J. Chapman, "Electric Machinery Fundamentals", 4th Edition, Tata McGraw Hill Private Limited, 2005.
7. Vincent Del Toro, "Electrical Engineering Fundamentals", Prentice Hall Private Limited, 2003.

**15EE35C LINEAR INTEGRATED CIRCUITS AND ITS APPLICATIONS L T P C**
**3 0 0 3**

**COURSE OUTCOMES**

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

CO1: describe the IC fabrication procedure for basic electronic circuits. (K2)
CO2: infer the characteristics of OP -AMP ICs. (K2)
CO3: design and construct the basic applications of Op–amp. (K3)
CO4: interpret the internal functional blocks and the applications of special ICs. (K2)
CO5: illustrate the operation of application ICs. (K3)

**UNIT I IC FABRICATION 9**

IC classification – Various processes in monolithic IC technology – Fabrication of diodes, capacitance, resistance and FETs

**UNIT II CHARACTERISTICS OF OP–AMP 9**

Ideal OP-AMP – DC and AC Characteristics – Inverting and Non–inverting Amplifier – Differential amplifier – Summer, differentiator and integrator.

**UNIT III APPLICATIONS OF OP–AMP 9**

Instrumentation amplifier – Filters – Comparators – Multivibrators – Peak detector, Sample and Hold circuit – D/A converters – A/D converters.

**UNIT IV SPECIAL ICs 9**

555 timers – Monostable and Astable Multivibrators – Schmitt Triggers – Voltage Controlled Oscillator – Phase Locked Loops – Applications.

**UNIT V APPLICATION ICs 9**

IC voltage regulators – LM78XX, 79XX – Variable voltage regulators switching regulators LM317,723 – LM 380 power amplifier, ICL 8038 function generator– Opto couplers

**L: 45; TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Ramakant A. Gayakward, "Op–amps and Linear Integrated Circuits", 4th Edition, Pearson Education, 2007.
2. Roy Choudhary. D, Sheil B. Jani, "Linear Integrated Circuits", 7th Edition, New Age, 2014.

**REFERENCES**

1. Jacob Millman, Christos C. Halkias, "Integrated Electronics – Analog and Digital circuits system", Tata McGraw Hill Private Limited, 2003.
2. Robert F. Coughlin, Fredrick F. Driscoll, "Op–amp and Linear ICs", 4th Edition, Pearson Education, 2002.
3. David A. Bell, "Op–amp & Linear ICs", 2nd Edition, Prentice Hall Private Limited, 1997.
4. K.R.Botkar, "Integrated Circuits," 10th Edition ,Khanna Publishers, 2010.

**15EE36C DIGITAL LOGIC CIRCUITS L T P C**
**3 0 0 3**

**COURSE OUTCOMES**

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

CO1: Simplify Boolean functions and illustrate the various combinational circuits.(K2)
CO2: Illustrate the behavior of synchronous sequential circuits (K2)
CO3: Build and analyze the behavior of asynchronous sequential circuits. (K3)
CO4: Summarize the characteristics of digital ICs and memory devices. (K2)
CO5**:** Explain VHDL coding for simple circuits. (K2)

**UNIT I BOOLEAN ALGEBRA AND COMBINATIONAL CIRCUITS 9**

Review of number systems – Binary codes – Boolean simplification using K-maps and Quine McCluskey method – Parity checker – Design of combinational circuits.

**UNIT II ANALYSIS AND DESIGN OF SYNCHRONOUS SEQUENTIAL CIRCUITS 9**

Realization of Flip-flops – SR, D, JK and T – Level Triggering – Edge Triggering – Analysis of synchronous sequential circuits: Moore and Mealy model – Design of synchronous sequential circuits – Shift Registers – Counters.

**UNIT III ANALYSIS AND DESIGN OF ASYNCHRONOUS SEQUENTIAL CIRCUITS 9**

Analysis of asynchronous sequential logic circuits – Transition Table – Flow Table – state assignment – Asynchronous design problem.

**UNIT IV DIGITAL INTEGRATED CIRCUITS 9**

Characteristics of digital ICs – Digital logic families: TTL, ECL**,** NMOS, CMOS – Memories: ROM, PROM, EPROM, PLD, PAL, PLA and FPGA – Trouble shooting.

**UNIT V VHDL 9**

RTl Design – Behavior, Data flow and Structural modeling – Data Types – Operators – Packages – Sub programs – Test Benches.

**L: 45; TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Morris Mano. M, "Digital Design", 5th Edition, Pearson Education, 2012.

2. Donald P. Leach, Albert Paul Malvino, Goutam Sha, "Digital Principles and Applications", 6th Edition, Tata McGraw Hill Private Limited, 2007.

**REFERENCES**

1. Charles H. Roth, "Fundamentals Logic Design", 6th Edition, Jaico Publishing House, 2006.
2. Floyd and Jain, "Digital Fundamentals", 10th Edition, Pearson Education, 2005.
3. John F. Wakerly, "Digital Design Principles and Practice", 4th Edition, Pearson Education, 2005
4. Ronald J. Tocci, "Digital Systems: Principles and applications", 10th Edition, Pearson Education, 2009.
5. RajKamal, "Digital systems –Principles and Design", 2nd Edition, Pearson Education, 2007.
6. Salivahanan. S and Arivazhagan. S, "Digital Circuits and Design", 4th Edition, Vikas Publishing House Private Limited.
7. Roth. C. H, "Digital Systems Design using VHD", Thomson Asia, 2007.

**15EE37C DC MACHINES AND TRANSFORMER LABORATORY L T P C**
**0 0 2 1**

**COURSE OUTCOMES**

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

CO 1: describe to performance of DC generators. (K2)
CO 2: summarize the characteristics of DC motors under loaded conditions. (K2)
CO3: Illustrate the performance of DC motors. (K3)
CO 4: apply the speed control in DC shunt motor. (K3)
CO5: summarize the performance of transformers (K2)

**LIST OF EXPERIMENTS**

1. Study of starters.
2. Open circuit and load characteristics of DC Series generator.
3. Open circuit and load characteristics of self – excited DC shunt generators.
4. Load characteristics of DC compound generator.
5. Load characteristics of DC shunt and compound motor.
6. Load characteristics of DC series motor.
7. Swinburne's test and speed control of DC shunt motor.
8. Hopkinson's test on DC motor–Generator set.
9. Load test on single phase transformer.
10. Open circuit and short circuit tests on single phase transformer.
11. Load test on three phase transformer.
12. Sumpner's test on transformers
13. Separation of no load losses in single phase transformer.
14. Study of Parallel operation of single phase transformer.

**P: 30; TOTAL: 30 PERIODS**

**15EE38C INTEGRATED CIRCUITS LABORATORY L T P C**
**0 0 2 1**

**COURSE OUTCOMES**

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

CO1: demonstrate adder, subtractor and code converters. (K2)
CO2: Interpret and realize the basic applications of Op–amp and timer. (K2)
CO3: Construct and implement the 4–bit modulo counters as synchronous and asynchronous types. (K3)
CO4: iIlustrate the various combinational and sequential circuits. (K2)
CO5: Explain the behavior of special ICs. (K2)

**LIST OF EXPERIMENTS**

1. Study of Basic Digital IC's.
2. Implementation of Boolean Functions and Adder/ Subtractor circuits.
3. (a) Code converters (b) Encoders and Decoders.
4. Counters: synchronous and Asynchronous.
5. Shift Registers: SISO, SIPO, PISO, PIPO modes.
6. Multiplexer/ De–multiplexer
7. Timer IC application: Astable and Monostable operation.
8. Application of Op–Amp: inverting and non–inverting amplifier, Voltage follower, Adder, Comparator, Integrator and Differentiator.
9. Analog to Digital Converter and Digital to Analog Converter:
10. Study of VCO and PLL ICs

**P: 30; TOTAL: 30 PERIODS**

**15EE39C ELECTRONIC CIRCUITS LABORATORY L T P C**
**0 0 2 1**

**COURSE OUTCOMES**

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

CO 1: analyze the characteristics of transistor for various configurations. (K4)
CO 2: design transistor based amplifiers and oscillators. (K5)
CO 3: design a power supply with filters and regulators. (K5)

**LIST OF EXPERIMENTS**

1. Analysis of transistor parameters under CE, CC and CB configuration.
2. Design and implementation of various transistor biasing.
3. Frequency response of Common Emitter Amplifier.
4. Complementary symmetry push–pull amplifier
5. Differential amplifier
6. RC Phase Shift Oscillator.
7. Multivibrators and relaxation oscillators
8. JFET and UJT characteristics with application
9. Half Wave and Full Wave Rectifiers with filters.
10. Zener and series voltage regulators
11. Diode Clippers and Clampers.
12. Study of Switched Mode Power Supply

**P: 30; TOTAL: 30 PERIODS**

**15EE41C COMPLEX, DISCRETE AND NUMERICAL ANALYSIS L T P C**
**3 2 0 4**

**COURSE OUTCOMES**

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

CO1: grasp the concepts of analytic functions. (K3)
CO2: evaluate complex integration over contour. (K3)
CO3: use numerical techniques to solve algebraic equation and interpolate. (K3)
CO4: solve differential equations using numerical methods. (K3)
CO5: verify the validity of the arguments. (K2)

**UNIT I ANALYTIC FUNCTIONS 15**

Functions of a complex variable – Analytic functions – Necessary and Sufficient conditions (excluding proofs) – Harmonic and orthogonal properties of analytic functions – Harmonic conjugate – Construction of analytic functions – Conformal mapping: w = z+c, cz, 1/z and bilinear transformation.

**UNIT II COMPLEX INTEGRATION 15**

Cauchy's integral theorem and Cauchy's integral formula (excluding proofs) – Taylor's and Laurent's expansions – Singular points – Residues – Residue theorem (excluding proof) – Application of residue theorem to evaluate real integrals – Unit circle and semi-circular contour(excluding poles on boundaries).

**UNIT III SOLUTION OF ALGEBRAIC EQUATIONS AND INTERPOLATION 15**

Solving non-linear algebraic equations – Newton-Raphson method; Iterative methods – Gauss-Jacobi and Gauss-Seidel methods; Interpolation – Lagrange's and Newton's divided difference formulas – Newton's forward and backward difference formulas.

**UNIT IV NUMERICAL SOLUTION OF DIFFERENTIAL EQUATIONS 15**

Taylor's series method – Euler's method – Modified Euler's method – Fourth order Runge - Kutta method – Finite difference methods for solving second order equations – Solution of two dimensional Laplace and Poisson equations.

**UNIT V LOGIC AND PROOFS 15**

Propositional Logic – Equivalences and Implications – Rules of inference – Introduction to proofs – Proof methods and strategy.

**L: 45; T: 30; TOTAL: 75 PERIODS**

**TEXT BOOKS**

1. Grewal.B.S "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, Delhi, 2012.
2. Grewal, B.S and Grewal,J.S, " Numerical methods in Engineering and Science", 6th Edition, Khanna Publishers, New Delhi, 2004.

**REFERENCES**

1. Trembly J.P and Manohar.R,"Discrete Mathematical Structures with Applications to Computer Science",Tata McGraw Hill Private Limited, New Delhi, 35th Reprint 2008.

2. Ramana B.V, “Higher Engineering Mathematics”, Tata McGraw Hill Private Limited,New Delhi, 2007.
3. Jain M.K, Iyengar S.R.K, Jain R.K., “Numerical Methods for Scientific and Engineering Computation”, 5th Edition, New age international (P) Ltd., Publishers, Reprint 2009.
4. Kenneth H.Rosen, "Discrete Mathematics and its Applications", 7th Edition, Tata McGraw-Hill Private Limited, New Delhi, Special Indian Edition, 2011.

**15EE42C** **AC ROTATING MACHINES** **L T P C**
**2 2 0 3**

**COURSE OUTCOMES**

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

CO1: explain the performance of synchronous generator. (K2)
CO2: discuss the operation, characteristics and speed control of synchronous motor. (K2)
CO3: Construct the circle diagram and discuss the performance of three phase induction motors (K3).
CO4: discuss the starting and speed control methods for three phase induction motor. (K2)
CO5: describe the performance of single phase induction motor and summarize the features of special machines. (K2)

**UNIT I SYNCHRONOUS GENERATOR 12**

Constructional details – Types of rotors – EMF equation – Synchronous reactance – Armature reaction – Voltage regulation – EMF, MMF, ZPF and ASA methods – Synchronizing and parallel operation – Synchronizing power and synchronizing torque – Change of excitation and mechanical input – Salient Pole Machine: Two reaction theory – Phasor diagram using Xd and Xq – Determination of direct and quadrature axis synchronous reactance using slip test.

**UNIT II SYNCHRONOUS MOTOR 12**

Principle of operation – Torque equation – Current loci for constant power input, constant excitation and constant power developed – Equivalent circuit – V–curves and Inverted V–curves – Power input and power developed equations – Starting methods – Operation on infinite bus bars – Hunting – Synchronous condensers.

**UNIT III THREE PHASE INDUCTION MOTOR 12**

Constructional details – Types of rotors – Principle of operation – Slip – Slip-torque characteristics – Condition for maximum torque – Losses and efficiency – Load test – No load and blocked rotor tests – Equivalent circuit – Phasor diagram – Circle diagram – Separation of no load losses – Double cage rotors – Induction generator – Synchronous induction motor.

**UNIT IV STARTING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTOR 12**

Need for starters – Types of starters – Cogging and Crawling – Speed control – Change of voltage, rotor resistance, number of poles and slip – Cascaded connection – Slip power recovery scheme – Electrical Braking.

**UNIT V SINGLE PHASE INDUCTION MOTORS AND SPECIAL MACHINES 12**

Constructional details of single phase induction motor – Double revolving field theory – Types – operation – Equivalent circuit – Performance analysis – Starting methods of single–phase induction motors – Special machines – Universal motor, reluctance motor, repulsion motor, hysteresis motor, stepper motor and AC series motor.

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

**TEXT BOOKS**

1. Kothari. D.P and Nagrath. I.J, “Electric Machines”, Tata McGraw Hill Private Limited, Reprint 2010.
2. Mehta. V.K and Rohit Mehta, “Principle of Electrical Machines”, S. Chand Publishers, 2009.

**REFERENCES**

1. Fitzgerald. A.E, Charles Kingsley, Stephen D. Umans, “Electric Machinery”, Tata McGraw Hill Private Limited, 2013.
2. Theraja. B.L, Theraja. A.K, “A text book on Electrical Technology”, Volume–II, S. Chand Company and Ltd, 2009.
3. Gupta. J.B, “Theory and Performance of Electrical Machines”, S. K. Kataria and Sons, 2009.
4. Murugesh Kumar. K, “Electric Machines”, Vikas Publishing House Private Ltd, 2010.
5. Rajput. R.K, “A Text Book of Electrical Machines”, Firewall Media, 2008.

**15EE43C CONTROL ENGINEERING L T P C**
**3 2 0 4**

**COURSE OUTCOMES**

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

CO1: construct the mathematical model of systems. (K3)
CO2: develop the transient and steady state response of linear time invariant system. (K3)
CO3: explain the open loop and closed loop frequency responses of systems (K2)
CO4: interpret the stability of linear control systems (K2)
CO5: design the compensator and controller tuning (K2)

**UNIT I MODELING OF SYSTEMS 15**

Concepts of feedback – Transfer function: electrical, mechanical and electro mechanical systems – Analogous system – Block diagram reduction technique – Signal flow graph representation – state space model from transfer function.

**UNIT II TIME RESPONSE ANALYSIS 15**

Standard test signals – Time response –First order and second order system – Time domain specifications – Steady state error and error constants – Generalized error series – State transition matrix – Solution of state equation.

**UNIT III FREQUENCY DOMAIN ANALYSIS 15**

Frequency domain specifications – Correlation between frequency and time domain specifications – Bode plot – Polar plot – Closed loop frequency response.

**UNIT IV STABILITY ANALYSIS 15**

Characteristic equation – Routh Hurwitz criterion – Absolute and Relative stability – Root Locus – Nyquist stability criterion – Stability analysis of state model – controllability and observability.

**UNIT V COMPENSATOR DESIGN AND CONTROLLER TUNING 15**

Performance criteria – Lag, Lead and Lag–Lead compensator design using bode plots – Controller and its classification – PID controller – Concepts of controller tuning – Ziegler-Nichols technique – Pole placement by state feedback.

**L: 45; T: 30; TOTAL: 75 PERIODS**

**TEXT BOOKS**

1. Nagrath I.J and Gopal M., "Control Systems Engineering", New Age International Publishers, 5th Edition (Reprint), 2016.
2. Gopal M., "Control Systems:Principles and Design", 4th Edition, Tata McGraw Hill Private Limited, New Delhi, 2012.

**REFERENCES**

1. Benjamin C. Kuo, "Automatic Control systems", Pearson Education, New Delhi, 2009.
2. K. Ogata, "Modern Control Engineering", 5th Edition, Prentice Hall Private Limited, New Delhi, 2010.
3. Richard.C. Dorf and Robert H. Bishop, "Modern Control Systems", Addidon – Wesley, 2011.
4. Salaivahanan. S, Rengaraj. R, Venkatakrishnan. G. R., "Control Systems Engineering", Pearson India Education Services Pvt. Ltd., 2015.

**15EE44C MEASUREMENTS AND INSTRUMENTATION L T P C**

**3 0 0 3**

**COURSE OUTCOMES**

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

CO1: Outline the fundamental concepts of measurement system. (K2)

CO2: Explain the operation of various types of measuring instruments. (K2)

CO3: Choose the suitable bridge circuits for measuring electrical parameters. (K3)

CO4:Identify the appropriate transducers for measurement of non electrical parameters. (K3)

CO5: Summarize the operations of various digital electronic instruments and display devices. (K2)

**UNIT I INTRODUCTION 9**

Concepts of Measurement and instrumentation – Basic elements of measurement systems – Units, Standard and Calibration – Static and Dynamic Characteristics – Classification of error – Error analysis.

**UNIT II MEASURING INSTRUMENTS 9**

Principle and types of analog meters – Moving iron instruments – Moving coil instruments – Extension of meter range – Wattmeters: Dynamometer type, induction type – Induction type energy meters – Instruments transformer – Types and its applications.

**UNIT III BRIDGES 9**

AC, DC Galvanometer – Measurement of resistance, inductance and capacitance – Measurement of frequency – Megger.

**UNIT IV TRANSDUCERS 9**

Active and Passive Transducer – Resistive transducer – Potentiometer – Strain gauge – Inductive transducer – LVDT – Capacitive transducer – Piezo–electric transducers – RTD, thermistor, thermocouple – Applications of transducers in flow, temperature and pressure.

**UNIT V DIGITAL INSTRUMENTS AND DISPLAY DEVICES 9**

Digital voltmeters – Ramp and integrating – Digital multimeter – Digital Energy meter – Power quality analyzer – Dot matrix display – LED and LCD displays – Digital storage Oscilloscope – Data Acquisition system – Data logger .

**L: 45; TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Doebelin. E, “Measurement Systems: Application and Design”, 6th Edition, Tata McGraw Hill Private Limited, 2012.
2. Sawhney. A.K, “A Course in Electrical and Electronics – Measurement and Instrumentation”, 19th Edition, Dhanpal Rai & Sons, New Delhi, 2014.

**REFERENCES**

1. Helfrick, Albert. D and Copper. W.D, “Electronics Instrumentation and Measurement Techniques”, Prentice Hall Private Limited, New Delhi, 2010.
2. Rangan. C.S, Sharma. G.R and Mani. V.S, “Instrumentation Devices and Systems”, 2nd Edition, Tata McGraw Hill Private Limited, 2010.
3. Kalsi. H.S, “Electronic Instrumentation”, Tata McGraw Hill Private Limited, 2011.
4. Arun K. Ghosh, “Introduction to Measurements and Instrumentation”, 2nd Edition, Prentice Hall Private Limited, New Delhi, 2011.

**15EE45C ELECTRICAL POWER SYSTEMS L T P C**
**3 2 0 4**

**COURSE OUTCOMES**

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

CO1: Explain the structure of electric power systems and grounding. (K2)
CO2: Summarize the electrical parameters and infer the performance of Transmission line. (K2)
CO3: Outline the voltage grading and efficiency of insulators and cables. (K2)
CO4: Compute the various methods of power flow Analysis. (K3)
CO5: Infer the different types of fault in power system. (K2)

**UNIT I INTRODUCTION 15**

Structure of electric power system – Comparison of AC and DC system – HVDC links – Substations – Bus–bar arrangements – System and equipment grounding – Neutral grounding and types.

**UNIT II TRANSMISSION LINE PARAMETERS AND PERFORMANCE ANALYSIS 15**

Transmission line Resistance – Inductance and Capacitance calculations for single and three phase transmission lines with single and double circuit lines – Self and mutual GMD – Stranded and bundled conductors – Skin and proximity effects. Classification of transmission lines – Transmission efficiency and voltage regulation – Ferranti effect – Corona.

**UNIT III INSULATORS AND CABLES 15**

Insulators – Types – Voltage distribution in string insulator and grading – Improvement of string efficiency – Underground cables – Constructional features of LT and HT cables – Capacitance of single core and three core cables – Dielectric stress and grading – Thermal characteristics.

**UNIT IV POWER FLOW ANALYSIS 15**

Basic components of a power system – Single line diagram: Generator, Transformer, Transmission line and load representation for different power system studies – Formation of Y-bus and Z-bus – Importance of power flow analysis – classification of buses – Gauss-Seidel method – Newton-Raphson method.

**UNIT V FAULT ANALYSIS 15**

Importance of short circuit analysis – Analysis using Thevenin's theorem – Fault analysis using Z–bus – Computations of short circuit capacity, post fault voltage and currents – Introduction to symmetrical components – Sequence impedances – Sequence circuits of synchronous machine, transformer and transmission lines – Sequence networks analysis of unsymmetrical fault.

**L: 45; T: 30; TOTAL: 75 PERIODS**

**TEXT BOOKS**

1. Wadhwa C.L., "Electric Power Systems", New Age International (P) Ltd., 2014.
2. Kothari D.P. and Nagrath I.J., "Power System Engineering", Tata McGraw Hill Private Limited, New Delhi, 2014.

## REFERENCES

1. Singh S.N., “Electric Power Generation, Transmission and Distribution”, Prentice Hall Private Limited, New Delhi, 2008.
2. Mehta V. K. and Rohit Mehta, “Principles of Power System”, S.Chand Company & Ltd, New Delhi, 2006.
3. Hadi Saadat, “Power System Analysis”, Tata McGraw Hill Private Limited, 2003.
4. Rebennack, S., Pardalos, P.M., Pereira, M.V.F., Iliadis, N.A., “Handbook of Power Systems – I”, Energy system, Springer, 2010.

| 15EE46C | PROFESSIONAL ETHICS AND HUMAN VALUES | L | T | P | C |
|---|---|---|---|---|---|
| | **(Common to all Programmes)** | **3** | **0** | **0** | **3** |

## COURSE OUTCOMES

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

CO1: recognize the core human values that shape the ethical behavior of an engineer. (K2)
CO2: expose awareness on professional ethics. (K2)
CO3: analyze the engineering ethical breach from past study. (K2)
CO4: distinguish and apply safety, responsibility and rights in workplaces. (K2)
CO5: discuss about the global issues with regard to ethics. (K2)

### UNIT I HUMAN VALUES 9

Morals, Values and Ethics - Integrity - Work Ethics - Service Learning - Civic Virtue - Respect for Others - Living Peacefully - Caring - Sharing - Honesty - Courage - Valuing Time - Co-operation - Commitment - Empathy - Self-Confidence - Character – Spirituality.

### UNIT II ENGINEERING ETHICS 9

Senses of 'Engineering Ethics' - variety of moral issued - 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 9

Engineering as experimentation - engineers as responsible experimenters - codes of ethics - a balanced outlook on law - the challenger case study.

### UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS 9

Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - the three mile island and chernobyl case studies. Collegiality and loyalty - respect for authority - collective bargaining - confidentiality - conflicts of interest - occupational crime - professional rights - employee rights - Intellectual Property Rights (IPR) - discrimination.

### UNIT V GLOBAL ISSUES 9

Multinational corporations - Environmental ethics - computer ethics - weapons

development - engineers as managers - consulting engineers - engineers as expert witnesses and advisors - Moral leadership - sample code of Ethics like ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management, Institution of electronics and telecommunication engineers (IETE),India, etc.

**L:45; TOTAL:45 PERIODS**

**TEXT BOOKS**

1. Mike Martin and Roland Schinzinger, “Ethics in Engineering”, Tata McGraw Hill Private Limited, New York 1996.
2. Govindarajan M, Natarajan S and Senthil Kumar VS, “Engineering Ethics”, Prentice Hall Private Limited, New Delhi, 2004.

**REFERENCES**

1. Charles D and Fleddermann, “Engineering Ethics”, Pearson Education / Prentice Hall Private Limited, New Jersey, 2004 (Indian Reprint)
2. Charles E Harris, Michael S Protchard and Michael J Rabins, “Engineering Ethics - Concepts and Cases”, Wadsworth Thompson Learning, United States, 2000 (Indian Reprint now available)
3. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003.
4. Edmund G Seebauer and Robert L Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford 2001.

**15EE47C AC ROTATING MACHINES LABORATORY L T P C**
**0 0 2 1**

**COURSE OUTCOMES**

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

CO 1: compute the regulation of Three Phase Alternator using various methods. (K3)
CO 2: evaluate the performance characteristics of AC motors. (K6)
CO 3: explain the various staring methods of AC motors. (K2)
CO 4: predict the performance characteristics of AC motors. (K3)

**LIST OF EXPERIMENTS**

1. Study of AC Motor Starters.
2. Regulation of Three Phase Alternator by EMF methods.
3. Regulation of Three Phase Alternator by MMF methods.
4. Regulation of Three Phase Alternator by ZPF methods.
5. Regulation of Three Phase Alternator by ASA methods.
6. Regulation of Three Phase Salient Pole Alternator by Slip test.
7. Parallel operation of two Alternators.
8. V and Inverted V curves of Three Phase Synchronous Motor.
9. Load test on Three Phase Induction Motor.
10. Predetermination of performance characteristics of three phase induction motor by circle diagram and equivalent circuit.
11. Separation of No–load losses of Three Phase Induction Motor.

12. Load test on Single Phase Induction Motor.
13. Equivalent Circuit of Single Phase Induction Motor.

**P: 30; TOTAL: 30 PERIODS**

**15EE48C CONTROL AND INSTRUMENTATION LABORATORY L T P C**
**0 0 2 1**

**COURSE OUTCOMES**

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

CO1: Develop transfer function models for electro – mechanical systems. (K2)

CO2: Choose appropriate method for measurement of electrical and non electrical Parameters.(K3)

CO3: Make use of direct loading method to calibrate energy meter. (K2)

CO4: Demonstrate time, frequency domain specifications and stability of system. (K2)

CO5: Design of compensators for the given specifications. (K2)

**LIST OF EXPERIMENTS**

1. Transfer function of AC Servo motor
2. Mathematical modeling of armature and field controlled DC Servo motor
3. AC position control system
4. DC position control system
5. Study of displacement and pressure transducers
6. AC bridges
7. DC bridges
8. Measurement using data acquisition card.
9. Extension of range of voltmeter and ammeter.
10. Calibration of three phase energy meter direct loading.
11. Stability analysis of linear system by root locus method.
12. Time Response analysis of First and Second order systems.
13. Design and implementation of lead and lag compensator.
14. Temperature measurement using thermocouple.

**P: 30; TOTAL: 30 PERIODS**

**15EE49C COMMUNICATION SKILLS LABORATORY L T P C**
(Common to all B.E. / B.Tech., Programmes) **0 0 2 1**

**COURSE OUTCOMES**

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

CO1: interpret any passage after listening and interact at different situations fluently (K2, S3)

CO2: excel appropriately in competitive and professional contexts. (K3, S3)

CO3: acquire the sub-skills required for paper presentations and group discussions which will help them to excel in their workplace. (K3, S3)

**Unit I**

*Lab session:*

i) Listening to audio files:
   - Conversations
   - Speech
   - TED Talks

ii) Listening and responding to any audio files:
   - Drawing the map
   - Picture completing task
   - Transferring data to Graph.

*Practice session:* On the spot Speaking activities: Just a minute speech, Picture description.

**Unit II**

*Lab session*: Read and understand the comprehension passages given in competitive examinations.

*Practice session:* Giving opinions and suggestions, analyzing a social issue.

**Unit III**

*Lab session:* Listening to audio files related to soft skills.

*Practice session:* Practicing Power point presentation, Group discussion and Interview skills.

**P: 30 TOTAL: 30 PERIODS**

**REFERENCES**

1. Rizvi.M.Ashraf, “Effective Technical Communication”, First Edition, The MC Graw Hill Education Private Limited, Companies, New Delhi, 2010.
2. Sangeetha Sharma and Binod Mishra, “Communication Skills for Engineers and scientists”, Prentice Hall Private Limited, Delhi, 2009

**15EE51C POWER SYSTEM PROTECTION, OPERATION AND CONTROL L T P C**
**3 2 0 4**

**COURSE OUTCOMES**

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

CO1:Understand the load characteristics and LFC of single and two area system. (K2)
CO2:Discuss the different types of voltage control methods. (K2)
CO3:Describe the computer based control of power system. (K2)
CO4:Explain the characteristics of relays and protection schemes. (K2)
CO5:Explain the operation of various types of Circuit breakers. (K2)

**UNIT I REAL POWER AND FREQUENCY CONTROL 15**

System load variation and characteristics – Load curve – Reserve requirements – Fundamentals of speed governing mechanism and modeling – Speed-load characteristics – Load sharing – control area, LFC control of single and two area systems – Static and dynamic analysis of uncontrolled and controlled cases.

**UNIT II REACTIVE POWER AND VOLTAGE CONTROL 15**

Generation and absorption of reactive power – Relation between voltage, power and reactive power – Methods of voltage control – Tap changing transformer and OLTC – System level control using generator voltage magnitude setting – MVAR injection of switched capacitors.

**UNIT III COMPUTER CONTROL OF POWER SYSTEMS 15**

Energy control centre – Monitoring, data acquisition and control – System hardware configuration – SCADA and EMS functions – Network topology determination, state estimation, security analysis and control – Operating states of power systems.

**UNIT IV OPERATING PRINCIPLES AND RELAY CHARACTERISTICS 15**

Importance of protection schemes – Essential qualities of protection – Over voltage protection – Electromagnetic relays – Relay types – Apparatus protection – Transformer, generator and Transmission line protection.

**UNIT V CIRCUIT BREAKERS 15**

Arc phenomena and arc interruption – DC and AC circuit breaking – Types of circuit breakers – Air, oil, SF6 and vacuum circuit breakers – Comparative merits of different circuit breakers – Testing of circuit breakers – Routine test and type test – Concept of gas insulated substation.

**L: 45; T: 30; TOTAL: 75 PERIODS**

**TEXT BOOKS**

1. Kothari. D. P and Nagrath. I.J, “Power System Engineering”, Second Edition, Tata McGraw Hill Private Limited, New Delhi, 2014.
2. Allen. J. Wood and Bruce F. Wollenberg, “Power Generation, Operation and Control”, John Wiley & Sons, Inc., 2013.

**REFERENCES**

1. Grigsby. L.L, “The Electric Power Engineering, Hand Book”, CRC Press & IEEE Press, 3rd Edition, 2012.
2. Kundur. P, “Power System Stability and Control”, Tata McGraw Hill Private Limited, USA, .
3. Chakrabarti & Halder, “Power System Analysis: Operation and Control”, Prentice Hall Private Limited, 2010
4. Sunil S. Rao, “Switchgear and Protection”, Khanna Publishers, New Delhi, Thirteenth Edition 2008.
5. Ravindranath. B and Chander. N, “Power System Protection and Switchgear”, Newage International Publishers, 2011
6. Soni. M.L, Gupta. P.V, Bhatnagar. V.S, Chakrabarti. A, “A Text Book on Power System Engineering”, Dhanpat Rai and Company, 2009.
7. Badri Ram, Vishwakarma, “Power System Protection and Switchgear”, Tata McGraw Hill Private Limited, 2nd Edition 2013.

**15EE52C POWER ELECTRONICS L T P C**
**3 0 0 3**

**COURSE OUTCOMES**

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

CO1: distinguish various types of power semiconductor devices. (K2)
CO2: analyze the operation of phase controlled rectifiers. (K2)
CO3: discuss the various topologies of DC–DC switching regulators. (K2)
CO4: describe the different modulation techniques of pulse width modulated inverters. (K2)
CO5: explain the operation of AC voltage controller and Cycloconverter. (K2)

**UNIT I POWER SEMI–CONDUCTOR DEVICES 9**

Basic structure and characteristics of SCR, DIAC, TRIAC, GTO, and Power BJT, Power MOSFET and IGBT – Firing and commutation circuit of SCR– Driver and Snubber circuits.

**UNIT II PHASE–CONTROLLED CONVERTERS 9**

2-pulse, 3-pulse and 6-pulse converters – Performance parameters – Effect of source inductance – Power factor control – Dual converters.

**UNIT III DC TO DC CONVERTERS 9**

Step–down and step-up chopper – Time ratio control and current limit control – Switching mode regulators – Buck, Boost, Buck–Boost and Cuk regulator – Concepts of resonant switching.

**UNIT IV INVERTERS 9**

Single phase and three phase voltage source inverters – PWM techniques – Voltage and harmonic control – Series resonant inverter – Multilevel Inverter – Current source inverter– Uninterrupted power supply topologies.

**UNIT V AC TO AC CONVERTERS 9**

Single phase AC voltage controllers – Integral cycle control – Multistage sequence control – Single and three phase cycloconverters.

**L: 45; TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Rashid M.H., “Power Electronics: Circuits, Devices and Applications”, Pearson Education, Prentice Hall Private Limited, New Delhi, 4th Edition, 2014.
2. Bimbra P.S., “Power Electronics”, Khanna Publishers, 4th Edition, 2012.

**REFERENCES**

1. Singh M. D and Khanchandani K. B., “Power Electronics”, 3rd Edition, Tata McGraw Hill Private Limited, New Delhi, 2008.
2. Ashfaq Ahmed, “Power Electronics for Technology”, Pearson Education, Indian reprint, 2003.
3. Philip T. Krein, “Elements of Power Electronics”, Oxford University Press, 2014.
4. Ned Mohan, Tore M. Undeland, William P. Robbins, “Power Electronics: Converters, Applications and Design”, 3rd Edition, John Wiley and sons, 2007.

5. Bimal K. Bose, “Modern Power Electronics and AC Drives”, Pearson Education, 2005.

**15EE53C ARCHITECTURE, PROGRAMMING AND APPLICATIONS OF MICROPROCESSOR AND MICROCONTROLLER** **L T P C 3 0 0 3**

**COURSE OUTCOMES**

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

CO1: illustrate the architecture of Microprocessor (8085/8086). (K2)
CO2: summarise programs based on the instruction sets of 8085. (K3)
CO3: construct and implement peripheral device interfacing with 8085. (K3)
CO4: illustrate the architecture of 8051 Microcontroller. (K2)
CO5: develop application circuits by programming towards simple project development. (K3)

.

**UNIT I INTRODUCTION TO MICROPROCESSORS** **9**

Architecture of 8085 – Pin outs and signals – Memory interfacing – I/O ports and data transfer concepts – Timing Diagram – Interrupt structure – 8086 processor (Architecture and modes of operation only).

**UNIT II PROGRAMMING OF 8085 PROCESSOR** **9**

Instruction set and addressing modes – Programming: Loop structure with counting & Indexing – Lookup table – Subroutine instructions.

**UNIT III PERIPHERAL INTERFACING** **9**

Study of Architecture and programming of ICs: 8255 PPI, 8259 PIC, 8251 USART, 8279 Key board display controller and 8253 Timer/ Counter – Interfacing with 8085 – A/D and D/A converter– Traffic light interfacing.

**UNIT IV 8051 MICRO CONTROLLER** **9**

Functional block diagram – Instruction set – Addressing modes – Interrupt structure – Timer – I/O ports – Serial communication.

**UNIT V MICROCONTROLLER PROGRAMMING AND APPLICATIONS** **9**

Arithmetical programming – key board interface – LED & LCD display interface – Design of PID controller – Interfacing DC Servo motor – Stepper motor control – Washing machine control.

**L: 45; TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Senthilkumar N., Saravanan M. and Jeevananthan.S, “Microprocessor and Microcontrollers”, Oxford University Press, 2011.
2. Krishna Kant “Microprocessor and Microcontrollers”, Eastern Company Edition, Prentice Hall Private Limited, New Delhi, 2007.

**REFERENCES**

1. Ankaj Gupta, “Microcontroller and Embedded System”, S.K.Kataria and Sons Publishers 2013.
2. Muhammad Ali Mazidi and Janice Gilli Mazidi, Kinely. R, “The 8051 Micro Controller and Embedded Systems (Using Assembly Language and C)”, PHI Pearson Education, 2011.
3. Ramesh Gaonkar, “Microprocessor Architecture Programming and Application”, CBS Publishers 2011.
4. Walter A Tribal and Avtar Singh, “The 8088 & 8086 Microprocessors”, Pearson Education, 2007.
5. Singh B.P. and Renu Singh, “Advanced Microprocessors and Microcontrollers”, New Age International Private Limited, 2009.

**15EE54C DATA STRUCTURES AND ALGORITHMS L T P C**
**3 0 0 3**

**COURSE OUTCOMES**

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

CO1: analyze and apply different sorting and searching techniques to solve the problem. (K4)

CO2: implement basic linear data structures using static and dynamic memory allocation.(K3)

CO3: recognize the data organization and applications of binary trees and binary search trees. (K3)

CO4: identify an appropriate hashing function and heap for an application. (K4)

CO5: apply suitable algorithms for solving problems related to shortest path, network link analysis, and minimum spanning tree. (K3)

**UNIT I SORTING AND SEARCHING ALGORITHMS 9**

Sorting – Internal and External Sorting: Bubble Sort – Insertion Sort – Merge Sort – Quick Sort – Radix Sort, Searching: Linear Search – Binary Search.

**UNIT II LINEAR STRUCTURES 9**

Definition – Types – Applications of Data Structures – Abstract Data Types (ADT) – List ADT – Array–based implementation – Linked List implementation – Doubly–linked lists – Applications of lists – Stack ADT – Balancing Symbols – Infix to Postfix Conversion – Evaluation of Postfix Expression – Queue ADT .

**UNIT III TREE STRUCTURES 9**

Non Linear Data Structures –Tree ADT–Terminologies of Trees –Binary Tree ADT – Tree Traversals – Expression Trees – Binary search Tree ADT – Threaded Binary Trees – Applications of Trees.

**UNIT IV HASHING AND HEAPS 9**

Hash Function – Separate chaining – Open Addressing – Rehashing – Extendible hashing – Heaps – Binary Heaps – Applications of Binary Heaps – Priority Queue.

**UNIT V GRAPHS 9**

Definitions – Terminologies of Graph – Topological sort – Breadth–first traversal – Depth First Traversal – Shortest Path Algorithms – Minimum spanning Tree – Prim's and Kruskal's Algorithms – Biconnectivity.

**L: 45; TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. M. A. Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education, 2007.
2. A.V. Aho, J. E. Hopcroft, and J. D. Ullman, "Data Structures and Algorithms", 1st Edition, Pearson Education, Reprint 2003.

**REFERENCES**

1. R. F. Gilberg, B. A. Forouzan, "Data Structures", 2nd Edition, Thomson India Edition, 2005.
2. Narasimha Karumanchi, "Specifications of Data Structures and Algorithms Made Easy: Data Structure and Algorithmic Puzzles", (Paperback), Career Monk Publications, 2014.
3. Maureen Sprankle and Jim Hubbard, "Problem Solving and Programming Concepts", 9th Edition, Prentice Hall Private Limited, 2012.
4. Seymour Lipschutz, "Data Structures with C (Schaum's Outline Series)", (Paperback), 2010.
5. Langsam Yedidyah, Augenstein J Moshe, Tenenbaum M Aaron, "Data Structures using C and C++", 2nd Edition, 2009.

**15EE55C DIGITAL SIGNAL PROCESSING AND ITS APPLICATIONS L T P C**
**3 2 0 4**

**COURSE OUTCOMES**

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

CO1: outline the fundamental concepts of signals and systems. (K2)
CO2: apply different transform techniques to obtain frequency spectrum of discrete signals. (K2)
CO3: analyze the discrete systems using different types of transforms. (K2)
CO4: design and realize IIR& FIR digital filters. (K3)
CO5: explain the overview of TMS320LF2407 sketch. (K2)

**UNIT I INTRODUCTION TO DIGITAL SIGNAL PROCESSING 15**

Classification of signals – Elementary discrete time signals– Operations on signals – Analog to Digital Conversion – Quantization error, aliasing effect – Classification of systems – concepts of FIR and IIR systems.

**UNIT II DISCRETE TIME SYSTEM ANALYSIS 15**

Convolution – Correlation – System function – response of system by Z transform – Causality – Stability analysis – Discrete Fourier series and its properties – Power density Spectrum – Realization of IIR and FIR filters.

**UNIT III DISCRETE FOURIER TRANSFORMS 15**

Discrete time Fourier transform and its properties – Energy density Spectrum – DFT and its properties – Inverse DFT – Circular Convolution – Overlap add and save methods – Computation of DFT using DIT and DIF FFT algorithms.

**UNIT IV DESIGN OF DIGITAL FILTERS 15**

FIR design: Windowing Techniques – Need and choice of windows – Linear phase characteristics; IIR design: Analog filter design – Butterworth and Chebyshev approximations; digital design using impulse invariant and bilinear transformation methods.

**UNIT V ARCHITECTURE AND APPLICATIONS OF DIGITAL SIGNAL PROCESSORS 15**

Architecture of TMS320LF2407 – On–chip peripherals – Addressing modes – Instruction set of TMS320LF2407 – PWM pulse generation – DSP based Stepper motor and DC motor control (Qualitative treatment only).

**L: 45; T: 30; TOTAL: 75 PERIODS**

**TEXT BOOKS**

1. Proakis J.G. and Manolakis D.G, "Digital Signal Processing Principles, Algorithms and Applications", 4th Edition, Pearson Education, New Delhi, 2006.
2. Venkataramani B. & Bhaskar M, "Digital Signal Processor Architecture, Programming and Application", Tata McGraw Hill Private Limited, 2002.

**REFERENCES**

1. Alan V. Oppenheim, Ronald W. Schafer and John R. Buck, "Discrete – Time Signal Processing", Pearson Education, New Delhi, 2003.
2. Salivahanan S., Vallavaraj A. and Gnanapriya C., "Digital Signal Processing", Tata McGraw Hill Private Limited, New Delhi, 2003.
3. Johny R.Johnson, "Introduction to Digital Signal Processing", Prentice Hall Private Limited, 2002.
4. Mitra S.K., "Digital Signal Processing – A Computer Based Approach", Tata McGraw Hill Private Limited, New Delhi, 2001.
5. Hamid A. Toliyat, Steven G.Campbell, "DSP based Electro – mechanical motion control", CRC press, 2004.
6. Texas Instruments Manual for TMS320LF2407 Processor.

**15EE56C POWER ELECTRONICS LABORATORY L T P C**

**0 0 2 1**

**COURSE OUTCOMES**

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

CO1: illustrate the characteristics of various power semiconductor devices. (K3)
CO2: demonstrate the operation of converter fed drives. (K3)
CO3: analyze the basic topologies of DC–DC converters. (K3)
CO4: make use of different PWM techniques for inverters. (K3)
CO5: evaluate the performance of AC voltage controller and Cycloconverter. (K3)

**LIST OF EXPERIMENTS**

1. Characteristics of SCR, TRIAC and DIAC
2. Characteristics of MOSFET and IGBT
3. AC to DC fully controlled converter
4. AC to DC half controlled converter
5. Step down and Step up chopper
6. IGBT based PWM inverter
7. Series and Parallel inverter
8. AC Voltage Controller
9. Cycloconverter
10. AC to DC converter fed DC drive
11. DC to AC converter fed AC drive

**P: 30; TOTAL: 30 PERIODS**

**15EE57C MICROPROCESSOR AND MICROCONTROLLER LABORATORY L T P C**
**0 0 2 1**

**COURSE OUTCOMES**

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

CO1: develop basic arithmetic operations using microprocessor 8085 and 8051. (K5)
CO2: apply interfacing techniques that provides solutions to real world problems. (K3)
CO3: Choose appropriate peripheral interfacing devices with 8085 and 8051 for specific applications. (K3)

**LIST OF EXPERIMENTS**

**8–bit and 16–bit Microprocessor**

1. Simple arithmetic operations
2. Programming with control instructions
3. Interface Experiments:
   - A/D Interfacing.
   - D/A Interfacing.
   - Traffic light controller.
   - Simple experiments using 8251, 8279, 8254.

**8–bit and 16–bit Microcontroller**

4. Simple arithmetic operations
5. Programming with control instructions
6. Interface Experiments:
   - A/D Interfacing.
   - D/A Interfacing.
   - Stepper motor
7. Study of microcontroller with FLASH memory.
8. Simple VHDL Programs.

**P: 30; TOTAL: 30PERIODS**

**15EE58C DATA STRUCTURES AND ALGORITHMS LABORATORY L T P C**
**0 0 2 1**

**COURSE OUTCOMES**

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

CO1: apply the concepts of sorting and searching techniques. (K3)
CO2: implement linear and non linear data structures using static and dynamic memory allocation. (K3)
CO3: apply the operations of stack and queue to solve problem. (K3)
CO4: implement hashing function and heap for an application. (K3)
CO5: apply suitable algorithms to solve shortest path problems. (K3)

**LIST OF EXPERIMENTS**

1. Write a program to sort the array of n numbers using insertion sort.
2. Write a program to search the position of a given value in the array of n numbers using binary search.
3. a. Implement the following operations using singly linked list
   i) Insert the element at given location
   ii) Delete the particular element
   iii) Display.
   b. Implement the following operations using doubly linked list
   i. Insert at begin
   ii. Insert at end
   iii. Delete at begin
   iv. Delete at end
   v. Display.
4. Represent a polynomial as a linked list and write functions to add the following polynomial and display the resultant polynomial. $4X^4+3X^3+X+5$, $3X^3+2X^2+X+3$.

5. Using Stack ADT, write a program to convert infix expression into postfix expression which includes '(',')','+','–','*' and '/' .

6. Create a double ended queue with 3 elements. Insert two elements at the rear end (Inject) and insert two elements at the front end (Push). Delete an element from the front end (Pop) and rear end (Eject). Display the queue after each operation and number of elements in the queue.

7. Write a program to implement an expression tree. Produce its pre–order, in–order, and post–order traversals.
8. i. Implement basic binary search tree operations.
   ii. While deleting the node with two children, replace it with either in–order successor or in–order predecessor based on choice.

9. Construct binary heap and perform the following :
   i) Delete an item (with random priority)
   ii) Delete minimum element

iii) Sort Heap

10. Implement hashing with open addressing. Resolve the collision with Linear probing

11. Write a program to find a minimum spanning tree using prims and kruskals algorithm in the following weighted graph.

12. For the given route map with cost of transportation between different cities, write a program to find the shortest route from a source to all the other cities.

**P:30; TOTAL: 30 PERIODS**

**LIST OF EQUIPMENTS AND COMPONENTS FOR A BATCH OF 30 STUDENTS (PER BATCH)**

**HARDWARE**

- 30 Systems with core i5 Processor

**SOFTWARE**

- Turbo C++/GCC Compiler – to be installed in all PCs.
- OS – LINUX/ Windows 2000/ Windows XP/ NT

**15EE61C HIGH VOLTAGE ENGINEERING L T P C**
**3 0 0 3**

**COURSE OUTCOMES**

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

CO1: summarize the general concepts and applications of high voltage engineering. (K2)
CO2: explain the generation methods of HVAC, HVDC, Impulse voltage and Current. (K2)
CO3: describe the measurement techniques of HVAC, HVDC, impulse voltages and currents. (K2)
CO4: apply the various testing methods on HV equipments. (K3)
CO5: outline the layout of HV laboratories based on size and ratings. (K2)

**UNIT I INTRODUCTION 9**

Introduction to HV technology – Advantages of transmitting electrical power at high voltages – Electric field stresses – Gas / Vacuum as insulator – Liquid dielectrics, Solids and composite dielectrics – Need for generating high voltages in laboratory –Applications of high voltages: Particle Accelerators – Electrostatic precipitators – X–ray machines.

**UNIT II GENERATION OF HIGH VOLTAGES AND CURRENTS 9**

Generation of high direct current voltages – Generation of high alternating voltages – Generation of impulse voltages – Generation of impulse currents – Tripping and control of impulse generators.

**UNIT III MEASUREMENT OF HIGH VOLTAGES AND CURRENTS 9**

Measurement of high direct current voltages – Measurement of high alternating voltages – Measurement of high impulse voltages – Measurement of high direct currents – Measurement of high alternating and Impulse currents – Oscilloscope measurements for high voltages and currents.

**UNIT IV TESTING TERMINOLOGY AND METHOD 9**

Non destructive testing – Measurement of dielectric constant and loss factor – Partial discharge measurement – Definitions of technical terms and specifications of reference atmospheric conditions – Testing of insulator, transformer, surge diverter

**UNIT V DESIGN, PLANNING AND LAYOUT OF HV LABORATORIES 9**

Test facilities provided in HV laboratories – Activities and studies in HV labs – Classifications of HV labs – Size and ratings of large size HV labs – Grounding of impulse testing laboratories – Insulation coordination.

**L: 45; TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Naidu. M.S, and Kamaraju. V, “High Voltage Engineering”, 5th Edition, Tata McGraw Hill Private Limited, 2013.
2. Kuffel. E, Zaengl. W.S and Kuffel. J, “High Voltage Engineering: Fundamentals”, 2nd Edition, Elsevier, 2000.

**REFERENCES**

1. Wadhwa. C.L, “High Voltage Engineering”, 3rd Edition, New Age Internationals (P) Limited, 2012.
2. Ravindra Arora, Wolfgang Mosch, “High Voltage and Electrical Insulation Engineering”, John Wiley and Sons, 2011.
3. Alston. L. L, “High Voltage Technology”, 1st Indian Edition, Oxford University Press, New Delhi, 2006.
4. Mazen Abdel Salam, Hussein Anis, Ahdan El–Morshedy, Roshdy Radwan, “High Voltage Engineering, Theory and Practice”, 2nd Edition CRC Press, 2000.
5. Razevig. D.V & Chourasia. M.P, “High Voltage Engineering”, 2nd Edition, Khanna Publishers, 2011.
6. Khalifa. M “High Voltage Engineering Theory and Practice”, Marcel Dekker Inc., New York, 1990.

**15EE62C ELECTRICAL ENERGY UTILIZATION AND CONSERVATION L T P C**

**3 0 0 3**

**COURSE OUTCOMES**

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

CO 1: recall the concepts of energy conservation and auditing. (K1)
CO 2: explain the economic aspects of generation. (K2)
CO 3: explain the principle and design of illumination systems. (K2)
CO 4: describe the different methods of heating and welding. (K2)
CO 5: discuss the applications of electric drives in traction. (K2)

**UNIT I CONSERVATION OF ELECTRICAL ENERGY 9**

Energy crisis – Causes and effects of energy crisis – Need for energy conservation – Global and Indian scenario – Energy management and Audit – Need and Type of audit – Energy management approach – Understanding energy costs – Benchmarking – Energy performance – Maximizing system efficiencies.

**UNIT II ECONOMIC ASPECTS OF GENERATION 9**

Economic aspects of power generation –Load and load duration curves – Number and size of units –Cost of electrical energy – tariff. Economics of power factor improvement – Power capacitors – power quality.

**UNIT III ILLUMINATION 9**

Importance of lighting – Properties of lighting scheme – Laws of illumination – Photometry –Types of lamps – Lighting calculations – Basic design of illumination schemes for residential, commercial, street lighting, and sports ground – Energy efficiency lamps.

**UNIT IV INDUSTRIAL HEATING AND WELDING 9**

Role of electric heating for industrial applications – Types – Electric arc furnaces – Electric welding –Welding generator, Welding transformer and the characteristics

**UNIT V ELECTRIC TRACTION 9**

Merits of electric traction – Requirements of electric traction system – Supply systems – Mechanics of train movement – Traction motors and control – Braking – Recent trends in electric traction.

**L: 45; TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Wadhwa. C.L, “Generation, Distribution and Utilization of Electrical Energy”, New Academic Science, Turn bridge Wells, 3rd Edition, 2013.
2. Gupta. B.R, “Generation of Electrical Energy”, S. Chand & Company Limited, 14th Edition, 2011.

**REFERENCES**

1. Partab. H, “Art and Science of Utilisation of Electrical Energy”, Dhanpat Rai and Company, NewDelhi, 2014.
2. Openshaw Taylor. E, “Utilization of Electrical Energy in SI Units”, Orient Longman Private Limited, 2003.
3. Gupta. J.B, “Utilization of Electric Power and Electric Traction”, S.K.Kataria and Sons, 8th Edition, 2009.
4. Gupta, Soni and Bhatnagar, “A Course in Electrical Power”, Dhampat Rai and Sons, 2005.
5. Abbi. Y.P and Shashank Jain, “Handbook on Energy Audit and Environment Management”, 2006.

**15EE63C OBJECT ORIENTED PROGRAMMING L T P C**
**3 0 0 3**

**COURSE OUTCOMES**

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

CO1:recognize and use object oriented programming constructs to write object oriented programs. (K3)

CO2:adopt appropriate constructor and overloading mechanisms to develop the application. (K4)

CO3:understand the role of inheritance, polymorphism, dynamic binding and generic structures in building reusable code. (K5)

CO4:demonstrate exception handling mechanisms to handle runtime errors and generic programming design. (K3)

CO5:Implement rich data handling through files and streaming. (K6)

**UNIT I BASIC CONCEPTS 9**

Object oriented programming concepts – objects – classes – methods and messages – abstraction and encapsulation – inheritance – abstract classes – polymorphism. Introduction to C++ – Classes and objects: classes – structures and classes – unions and classes – friend functions – friend classes – inline functions – parameterized constructors – static class members – scope resolution operator – nested classes – local classes – passing objects to functions – returning objects – object assignment. Arrays, Pointers, References and Dynamic Allocation Operators: Arrays of Objects – Pointers to Objects – Type Checking – This Pointer – Pointers to Derived Types – Pointers to Class Members – References – Dynamic Allocation Operators.

**UNIT II FUNCTION OVERLOADING AND CONSTRUCTORS 9**

Function Overloading – Overloading Constructors – Copy Constructors – Finding the Address of Overloaded Functions – Overload Anachronism – Default Function Arguments – Function Overloading and Ambiguity. Operator overloading: Creating a member Operator Function – Operator Overloading Using Friend Function – Overloading New and Delete – Overloading Special Operators – Overloading Comma Operator.

**UNIT III INHERITANCE AND POLYMORPHISM 9**

Inheritance: Base–Class Access Control – Inheritance and Protected Members – Inheriting Multiple Base Classes – Constructors, Destructors and Inheritance – Granting Access – Virtual Base Classes. Polymorphism: Virtual Functions – Virtual Attribute and Inheritance – Virtual Functions and Hierarchy – Pure Virtual Functions – Using Virtual Functions – Early vs. Late Binding. Run–Time Type ID and Casting Operators: RTTI – Casting Operators – Dynamic Cast.

**UNIT IV TEMPLATES AND EXCEPTION HANDLING 9**

Templates: Generic Functions – Applying Generic Functions – Generic Classes – Type name and Export Keywords – Power of Templates. Exception Handling: Fundamentals – Handling Derived Class Exceptions – Exception Handling Options – Understanding

terminate() and unexpected() – uncaught exception() Function – Exception and bad exception Classes – Applying Exception Handling.

**UNIT V I/O STREAMS 9**

Streams and formatted I/O – Overloading << and >>. File: File Classes – File Operations. Namespaces: Namespaces – std namespace. Standard Template Library: Overview – Container Classes – General Theory of Operation – Lists – String Class – Final Thoughts on STL.

**L:45; TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Herbert Schildt, "C++: The Complete Reference", 4th Edition, Tata McGraw Hill Private Limited, 2006.
2. Paul Deitel, Harvey Deitel, "C++ How to Program", 8th Edition, Prentice Hall Private Limited, 2012.

**REFERENCES**

1. Ira Pohl, "Object Oriented Programming using C++", 2nd Edition, Pearson Education, Reprint 2004.
2. S. B. Lippman, Josee Lajoie, Barbara E. Moo, "C++ Primer", 4th Edition, Pearson Education, 2005.
3. B. Stroustrup, "The C++ Programming language", 3rd Edition, Pearson Education, 2004.
4. E. Balagurusamy, "Object Oriented Programming with C++", Tata McGraw Hill Private Limited, 2008.

**15EE64C DESIGN OF ELECTRICAL APPARATUS L T P C**
**3 0 0 3**

**COURSE OUTCOMES**

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

CO1: Explain Specific Electrical and Magnetic loadings for various electrical DC and AC Machines. (K2)

CO2: Interpret main dimensions (D, L) of armature and field systems for D.C. machines. (K2)

CO3: Outline overall Dimensions of single and three phase transformers core, windings and cooling systems for transformers. (K2)

CO4: Interpret main dimensions of squirrel cage and Slip ring induction machines. (K2)

CO5: Illustrate enhanced dimensions of stator of AC machines. (K2)

**UNIT I INTRODUCTION 9**

Major considerations and Limitations in Electrical Machine Design – Electrical Engineering Materials – Space factor – Specific Electrical and Magnetic loadings – Heating and Cooling of Electrical Machines– Reason for generation of heat in electrical machines – Rating of machines – Standard specifications.

**UNIT II DC MACHINES 9**

Output Equation – Main Dimensions – Magnetic circuit calculations – Carter's Coefficient – Net length of Iron – Real & Apparent flux densities – Selection of number of poles – Design of Armature – Design of commutator and brushes – Design of field winding.

**UNIT III TRANSFORMERS 9**

Output Equations – Main Dimensions – Window space factor – Design of core and windings – Overall dimensions – No load current – Magnetizing current – Temperature rise in Transformers – Design of Tank with cooling tubes – Methods of cooling of Transformers.

**UNIT IV INDUCTION MOTORS 9**

Output equation – 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 poly phase machines – Magnetizing current – Short circuit current .

**UNIT V SYNCHRONOUS MACHINES 9**

Choice of loadings – 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 – Design of field winding – Design of turbo alternators – Design considerations to reduce harmonics

**L: 45; TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Sawhney A.K. and Chakrabarti A, "A Course in Electrical Machine Design", Dhanpat Rai & Sons, 2015.
2. Balbir Singh, "Electrical Machine Design", Vikas Publishing House.

**REFERENCES**

1. Sen S.K., "Principles of Electrical Machine Designs with Computer Programmes", Oxford and IBH Publishing Co. Pvt. Ltd., 2009.
2. Deshpande, "Design and Testing of Electrical Machines", Prentice Hall Private Limited.
3. Rai H.M., "Electrical Machine Design", 3rd Edition, Sathiya Prakashan Publications, 2004.
4. Clayton A.E., "Performance & Design of Direct current Machines", English Language Book society and Sri Isaac Pitman & sons Ltd., 1995.
5. Say .M.G, "The Performance and Design of Alternating current Machines", Isaac Pitman & sons Ltd.

| 15EE65C | PROJECT MANAGEMENT AND FINANCE (Common to all Programmes) | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**COURSE OUTCOMES**

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

CO1: explain the concept of operational and project management. (K2)

CO2: define the scope of a project and develop the project plan. (K2)
CO3: evaluate the technical, business and social environment related to the project. (K3)
CO4: formulate and manage project team successfully. (K5)
CO5: monitor and control projects using tools and techniques. (K3)

**UNIT I BASIC CONCEPT 9**

Concept and categories of project - Project development cycle - Concept, tools and techniques of project management - Logistics and supply chain management - Forms of project organizations.

**UNIT II PROJECT FORMULATION 9**

Project identification, formulation and preparation. Market and demand estimation - Market survey techniques - Demand forecasting. Materials management - Analysis of materials input, technology, production, plant capacity, location and site, civil works, charts, layouts and work schedule. Cost of project - Means of financing, estimates of cost - Financial projections.

**UNIT III PROCESS OF PROJECT APPRAISAL 9**

Technical, Economic, Financial, Legal and Social appraisal of the Industrial Projects. Problems due to rate of discount, wage-rate, exchange rates, treatment of taxes, social cost-benefits - treatment of risk and uncertainty - sensitivity analysis and probability approach - Single as well as multiple projects - Big data analytics - PLM and SLM.

**UNIT IV PROJECT TEAM FORMULATION AND MAXIMIZING PARTICIPATION 9**

Project Team frame works - Project Team cultures - Barriers and challenges - Selecting Team Members - Key skills of effective project leaders - Giving / receiving feedback from different members of the project.

**UNIT V IMPLEMENTATION, MONITORING AND CONTROL OF PROJECTS 9**

Project scheduling, network techniques for resource, cost budgeting and scheduling - project management teams and coordination - Monitoring and post implementation, evaluation of the project - ERP - Project financing.

**L:45; TOTAL:45 PERIODS**

**TEXT BOOKS**

1. Gobalakrishnan P and Ramamoorthy VE “Textbook of Project Management”, Macmillan Publications, 2014.
2. Maylor “Project Management”, 3rd Edition, Pearson Education, 2010.

**REFERENCES**

1. Gido, “Effective project management”, 3rd Edition, Cengage Learning, 2008.
2. Gray and Larson, “Project Management: The Managerial Process”, 3rd Edition, Tata McGraw Hill Private Limited, 2010.
3. Choudhury S, “Project Management”, 1st Edition, Tata McGraw Hill Private Limited, 2007.

**15EE66C POWER SYSTEM SIMULATION AND HIGH VOLTAGE LABORATORY**

**L T P C**
**0 0 2 1**

**COURSE OUTCOMES**

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

CO1: determine the various parameters of power system. (K2)
CO2: compute the parameters for different type of faults in power system network. (K2)
CO3: determine breakdown strength of gaseous dielectric and liquid dielectric. (K2)
CO4: demonstrate the generation methods of High voltage AC, DC and Impulse. (K2)
CO5: infer the field distribution simulation model of single and multiple dielectrics. (K2)

**LIST OF EXPERIMENTS**

1. Generation and measurement of AC, DC and Impulse voltage
2. Analysis of gaseous dielectric breakdown under AC Voltage
3. Analysis of gaseous dielectric breakdown under DC Voltage
4. FEM Simulation of single and composite dielectrics field distribution
5. Measurement of dielectric strength of liquid dielectric
6. Simulation of Lightning and Switching Impulse voltage generator
7. Computation of Parameters and Modelling of Transmission Lines
8. Formation of Bus Admittance and Impedance Matrices and Solution of Networks
9. Load Flow Analysis : Solution of Load Flow And Related Problems Using Gauss–Seidel and Newton–Raphson Methods
10. Symmetrical and unsymmetrical Fault Analysis
11. Transient stability analysis of single machine infinite bus system (SMIB).
12. Load – Frequency Dynamics of Single– Area and Two–Area Power Systems

**P: 30; TOTAL: 30 PERIODS**

**15EE67C OBJECT ORIENTED PROGRAMMING LABORATORY L T P C**

**0 0 2 1**

**COURSE OUTCOMES**

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

CO1: design object oriented programs with static members and friend functions using C++. (K3)
CO2:implement C++ programs with operator overloading and type conversions. (K3)
CO3:develop class templates for various data structures like stack, queue and linked list. (K3)
CO4: apply function templates concepts in standard sorting algorithms such as bubble sort, insertion sort, merge sort and quick sort. (K3)
CO5: construct simple test applications using dynamic polymorphism. (K3)

**LIST OF EXPERIMENTS**

1. Design C++ classes with static members, methods with default arguments, friend functions. (For example, design matrix and vector classes with static allocation, and a friend function to do matrix–vector multiplication).

2. Implement Matrix class with dynamic memory allocation and necessary methods. Give proper constructor, destructor, copy constructor, and overloading of assignment operator.
3. Implement complex number class with necessary operator overloading and type conversions such as integer to complex, double to complex, complex to double etc.
4. Overload the new and delete operators to provide custom dynamic allocation of memory.
5. Develop C++ class hierarchy for various types of inheritances.
6. Design a simple test application to demonstrate dynamic polymorphism and RTTI.
7. Develop a template of linked–list class and its methods.
8. Develop templates of standard sorting algorithms such as bubble sort, insertion sort and quick sort.
9. Design stack and queue classes with necessary exception handling.
10. Write a C++ program that randomly generates complex numbers (use previously designed Complex class) and writes them two per line in a file along with an operator (+, –, *, or /). The numbers are written to file in the format (a + ib). Write another program to read one line at a time from this file, perform the corresponding operation on the two complex numbers read, and write the result to another file (one per line).

**P: 30; TOTAL: 30 PERIODS**

**LIST OF EQUIPMENTS AND SOFTWARE FOR A BATCH OF 30 STUDENTS**

**HARDWARE**

• 30 Systems with core i5 Processor

**SOFTWARE**

• Turbo C++/GCC Compiler – to be installed in all PC's.
• OS – LINUX/ Windows 2000/ Windows XP/ NT

**15EE68C PRODUCT DEVELOPMENT LABORATORY**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 4 | 2 |

**COURSE OUTCOMES**

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

CO 1: understand the integration of customer requirements in product design.
CO 2: Apply structural approach to concept generation, selection and testing.
CO 3: Understand various aspects of design such as industrial design, design for manufacture.

The objective of this course is to make the students learn methodologies for identifying customer needs, developing new product concepts, prototype development, estimation of manufacturing costs, and developing business plans to support the development and marketing of these products. A student or a team of students shall develop their own products based on the users need, build simple prototypes of their design, and write development plans for the products.

**P: 60 TOTAL: 60 PERIODS**

| **15EE69C** | **COMPREHENSION** | **L T P C** |
|---|---|---|
| | | **0 0 2 1** |

**COURSE OUTCOMES**

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

CO1: recognize the Basics of Electrical and Electrical Engineering. (K2)

CO2: prepare for Engineering Competitive exams. (K3)

**Course Content**

**Electric Circuits and Fields:** Network graph, KCL, KVL, node and mesh analysis, transient response of dc and ac networks; sinusoidal steady–state analysis, resonance, basic filter concepts; ideal current and voltage sources, Thevenin's, Norton's and Superposition and Maximum Power Transfer theorems, two–port networks, three phase circuits; Gauss Theorem, electric field and potential due to point, line, plane and spherical charge distributions; Ampere's and Biot–Savart's laws; inductance; dielectrics; capacitance.

**Signals and Systems:** Representation of continuous and discrete–time signals; shifting and scaling operations; linear, time–invariant and causal systems; Fourier series representation of continuous periodic signals; sampling theorem; Fourier, Laplace and Z transforms.

**Electrical Machines:** Single phase transformer – equivalent circuit, phasor diagram, tests, regulation and efficiency; three phase transformers – connections, parallel operation; auto–transformer; energy conversion principles; DC machines – types, windings, generator characteristics, armature reaction and commutation, starting and speed control of motors; three phase induction motors – principles, types, performance characteristics, starting and speed control; single phase induction motors; synchronous machines – performance, regulation and parallel operation of generators, motor starting, characteristics and applications; servo and stepper motors.

**Power Systems:** Basic power generation concepts; transmission line models and performance; cable performance, insulation; corona and radio interference; distribution systems; per–unit quantities; bus impedance and admittance matrices; load flow; voltage control; power factor correction; economic operation; symmetrical components; fault analysis; principles of over–current, differential and distance protection; solid state relays

and digital protection; circuit breakers; system stability concepts, swing curves and equal area criterion; HVDC transmission and FACTS concepts.

**Control Systems:** Principles of feedback; transfer function; block diagrams; steady–state errors; Routh and Niquist techniques; Bode plots; root loci; lag, lead and lead–lag compensation; state space model; state transition matrix, controllability and observability.

**Electrical and Electronic Measurements:** Bridges and potentiometers; PMMC, moving iron, dynamometer and induction type instruments; measurement of voltage, current, power, energy and power factor; instrument transformers; digital voltmeters and multimeters; phase, time and frequency measurement; Q–meters; oscilloscopes; potentiometric recorders; error analysis.

**Analog and Digital Electronics:** Characteristics of diodes, BJT, FET; amplifiers – biasing, equivalent circuit and frequency response; oscillators and feedback amplifiers; operational amplifiers – characteristics and applications; simple active filters; VCOs and timers; combinational and sequential logic circuits; multiplexer; Schmitt trigger; multi–vibrators; sample and hold circuits; A/D and D/A converters; 8–bit microprocessor basics, architecture, programming and interfacing.

**Power Electronics and Drives:** Semiconductor power diodes, transistors, thyristors, triacs, GTOs, MOSFETs and IGBTs – static characteristics and principles of operation; triggering circuits; phase control rectifiers; bridge converters – fully controlled and half controlled; principles of choppers and inverters; basis concepts of adjustable speed dc and ac drives.

**P: 30; TOTAL: 30 PERIODS**

**15EE71C SMART GRID L T P C**
**3 0 0 3**

**COURSE OUTCOMES**

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

CO1: explain the design of smart grid architecture. (K2)
CO2: outline the communication technologies used in smart grid. (K2)
CO3: explain the Smart Grid technologies, different smart meters. (K2)
CO4: summarize the renewable energy resources and storages integrated with smart grid (K3)
CO5: explain the power electronics converters for integration of renewable energy in smart grid. (K3)

**UNIT I SMART GRID ARCHITECTURAL DESIGN 9**

Introduction – Comparison of Power grid with Smart grid – Power system enhancement – Communication and standards – General View of the Smart Grid Market Drivers – Stakeholder Roles and Function – Measures – Representative Architecture – Functions of Smart Grid Components – Wholesale energy market in smart grid – smart vehicles in smart grid.

**UNIT II SMART GRID COMMUNICATIONS AND MEASUREMENT TECHNOLOGY 9**

Communication and Measurement – Monitoring, Phasor Measurement Unit (PMU), Smart Meters, Wide area monitoring systems (WAMS) – Advanced metering infrastructure – GIS and Google Mapping Tools.

**UNIT III SMART GRID TECHNOLOGIES 9**

Technology Drivers – Smart energy resources: Smart substations Substation Automation, Feeder Automation – Transmission systems: EMS, FACTS and HVDC – Wide area monitoring – Protection and control – Distribution systems: DMS, Volt/VAr control, Fault Detection, Isolation and service restoration –Outage management, High Efficiency Distribution Transformers – Phase Shifting Transformers.

**UNIT IV RENEWABLE ENERGY AND STORAGE 9**

Renewable Energy Resources – Sustainable Energy Options for the Smart Grid – Penetration and Variability Issues Associated with Sustainable Energy Technology – Demand Response Issues –Electric Vehicles and Plug-in Hybrids – PHEV Technology – Environmental Implications – Storage Technologies – Grid integration issues of renewable energy sources.

**UNIT V POWER ELECTRONIC CONVERTERS FOR RENEWABLE ENERGY INTEGRATION IN SMART GRID 9**

Power electronic converters-Current source converters – Voltage source converters – Power electronics in the Smart Grid – Renewable energy generation and integration – Fault current limiting-Shunt compensation – Series compensation.

**L: 45; TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. James Momoh, “Smart Grid: Fundamentals of design and analysis”, John Wiley & sons Inc, IEEE press 2012.
2. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, “Smart Grid: Technology and Applications”, John Wiley & sons Inc, 2012.

**REFERENCES**

1. Fereidoon P. Sioshansi, “Smart Grid: Integrating Renewable, Distributed & Efficient Energy”, Academic Press, 2012.
2. Clark W.Gellings, “The smart grid: Enabling energy efficiency and demand response”, Fairmont Press Inc, 2009.
3. Non-Conventional Energy Sources, G.D. Rai, Khanna Publishers, New Delhi, 1999.
4. Peter S. Fox-Penner, “Smart Power: Climate Change, the Smart Grid, and the Future of Electric Utilities”, Island Press.
5. Ali Keyhani, Mohammad N. Marwali, Min Dai, “Integration of Green and Renewable Energy in Electric Power Systems”, Wiley.
6. Tony Flick and Justin Morehouse, “Securing the Smart Grid”, Elsevier Inc.

**15EE72C** **MINI PROJECT** **L T P C**
**0 0 8 4**

**COURSE OUTCOMES**

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

CO1: identify an innovative or creative idea / concept / solution to a problem.(K2)
CO2: design and develop the working model.(K5)
CO3: practice the project along with team members.(K3)
CO4: prepare reports to interpret the results.(K3)
CO5: explain the ideas effectively through presentation.(K2)

**COURSE DESCRIPTION**

- A mini–project which is relevant to the branch of interest of the student or a simulation model developed by the student with the guidance of a faculty member.
- An Evaluation committee formed by the HOD will review the activities and the marks are awarded as follows: Report (40%), Presentation (30%) and oral Examination (30%)

**P: 120; TOTAL: 120 PERIODS**

**15EE73C** **RESEARCH PAPER AND PATENT REVIEW – SEMINAR** **L T P C**
**0 0 2 1**

**COURSE OUTCOMES**

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

CO1: explain the concepts published in reputed journals on their area of interest. (K2)
CO2: examine patents and the procedure available in the database. (K2)

**COURSE DESCRIPTION**

The student shall give at least one technical presentation on recent research publications and patents related to specialization. The presentation will be assessed by a committee constituted by the Head of the Department. The students shall submit a report at the end of the semester.

**P: 30; TOTAL: 30 PERIODS**

**15EE81C** **PROJECT WORK** **L T P C**
**0 0 20 10**

**COURSE OUTCOMES**

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

CO1: select a good project and able to work in a team leading to development of hardware / software product. (K2)
CO2: prepare a good technical report and able to present the ideas with clarity. (K3)

**COURSE DESCRIPTION**

A Project topic must be selected either from published lists or the students themselves may propose suitable topics in consultation with their guides. The aim of the project work is to deepen comprehension of principles by applying them to a new problem which may be the design and manufacture of a device, a research investigation, a computer or management project or a design problem.

The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated jointly by external and internal examiners constituted by the Head of the Department based on oral presentation and the project report.

**P: 300; TOTAL: 300 PERIODS**

**15EE82C INTERNSHIP / INPLANT TRAINING L T P C**
**0 0 4 2**

**COURSE OUTCOMES**

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

CO1: recognize the requirement of the industry and cope up with the industrial scenario (K2)

CO2: prepare a report about the work experience in industry. (K3)

CO3: explain effectively through technical presentation. (K2)

**COURSE DESCRIPTION**

**A. INTERNSHIP**

- Internship undergone in R&D organization and reputed institution.
- An Evaluation committee formed by the HOD will review and the marks are awarded as follows: Internship Report (40%), Presentation (30%) and oral Examination (30%)

**B. INPLANT TRAINING**

- 2 to 4 weeks Training undergone in industries and also in R&D organization are considered as inplant training.
- An Evaluation committee formed by the HOD will review and the marks are awarded as follows: Inplant Training Report (40%), Presentation (40%) and Oral Examination (20%)

**P: 60; TOTAL: 60 PERIODS**

**15EE01E SWITCHED MODE POWER CONVERSIONS L T P C**
**3 0 0 3**

**COURSE OUTCOMES**

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

CO1: describe the concept of reactive elements for power electronic systems. (K2)
CO2: discuss the concepts of switching converters. (K2)
CO3: explain the operation of resonant converters. (K2)
CO4: discuss the operation of transformerized switching converters. (K2)
CO5: distinguish various types of UPS and filters. (K2)

**UNIT I INTRODUCTION 9**

Reactive elements – Design of Inductor, capacitor and transformer for Power electronics applications.

**UNIT II BASIC SWITCHING CONVERTER TOPOLOGIES 9**

Basic concepts of SMPS – DC-DC converters – Characteristics – Constituent elements – Operating principles.

**UNIT III RESONANT CONVERTERS 9**

Classification of resonant converters – Basic resonant circuit concepts – Load resonant converters – Resonant switches converters – Zero voltage switching.

**UNIT IV TRANSFORMERIZED SWITCHING CONVERTERS 9**

Forward converter – Push-pull converter – Half–bridge switching converter – Full – bridge switching converter – Flyback converter – Zero–Current–Switching Quasi–Resonant Half–Bridge converter

**UNIT V POWER CONDITIONERS, UPS AND FILTERS 9**

Power line disturbances – Power conditioners – Offline and Online UPS, Applications – Voltage filters, Series–parallel resonant filters, filter for PWM VSI, current filter, DC filters.

**L: 45; TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Simon S. Ang, “Power Switching Converter”, Marcel Dekker Inc., Taylor and Francis,3rd Edition,2005.
2. Umanand L., Bhat S.R., “Design of magnetic components for switched Mode Power converters” , Wiley Eastern Ltd.,2001.

**REFERENCES**

1. Ned Mohan, Tore M. Undeland, William P. Robbins, “Power Electronics: Converters, Applications and Design”, 3rd Edition, John Wiley and Sons, 2003.
2. Philip T. Krein, “Elements of Power Electronics”, Oxford University Press, 2004.
3. Rashid M.H., “Power Electronics: Circuits, Devices and Applications”, 3rd Edition, Pearson Education, 2004.
4. Keng C. Wu, “Switch–Mode Power Converters: Design and Analysis”, 1st Edition, Academic Press, 2005.
5. Ramanarayanan V., “Course Material On Switched Mode Power Conversion”, IISc Bangalore, 2007.

**15EE02E SPECIAL ELECTRICAL MACHINES L T P C**
**3 0 0 3**

**COURSE OUTCOMES**

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

CO1: develop the knowledge in construction, principle of operation and performance of synchronous reluctance motors. (K5)

CO2: explain the construction, various operating modes, control and performance of stepping motors. (K2)

CO3: analyze the structure and operation, converters, and controllers of switched reluctance motors. (K4)

CO4: review the construction, principle of operation, control and performance of permanent magnet brushless D.C. motors. (K2)

CO5: illustrate the construction, principle of operation and control of permanent magnet synchronous motors. (K3)

**UNIT I SYNCHRONOUS RELUCTANCE MOTORS 9**

Constructional features – Types – Axial and Radial flux motors – Operating principles – Reluctance torque – Phasor diagram – Characteristics.

**UNIT II STEPPING MOTORS 9**

Constructional features – Principle of operation – Variable reluctance motor – Single and multi stack configurations – Permanent Magnet Stepper motor – Hybrid motor – Theory of torque predictions – Modes of excitations – Characteristics – Drive circuits – Closed loop control.

**UNIT III SWITCHED RELUCTANCE MOTORS 9**

Constructional features – Principle of operation – Inductance profile – Characteristics – Torque equation – Power Converters and their controllers – Methods of Rotor position sensing – Current control schemes – Sensorless operation – Closed loop control of SRM.

**UNIT IV PERMANENT MAGNET BRUSHLESS DC MOTORS 9**

Permanent Magnet materials – Magnetic Characteristics – Principle of operation – Types – Commutators : Mechanical and electronic commutators – Square wave permanent magnet brushless motor drives – Sensors – Magnetic circuit analysis – EMF and torque equations – Power controllers – Motor characteristics and control.

**UNIT V PERMANENT MAGNET SYNCHRONOUS MOTORS 9**

Principle of operation – Ideal PMSM – EMF and Torque equations – Armature reaction MMF –Sine wave motor with practical windings – Phasor diagram – Torque / speed characteristics – Power controllers – Converters.

**L: 45; TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Miller T.J.E., "Brushless Permanent Magnet and Reluctance Motor Drives", Clarendon Press, Oxford, 1989.
2. Venkataratnam K., “Special Electric Machines”, Universities Press, 2009.

**REFERENCES**

1. Krishnan R., "Switched Reluctance Motor Drives – Modeling, Simulation, Analysis, Design and Application", CRC Press, New York, 2001.
2. Aearnley P.P., "Stepping Motors – A Guide to Motor Theory and Practice", Peter Perengrinus, London, 2002.
3. Kenjo T. and Nagamori S., '"Permanent Magnet and Brushless DC Motors", Clarendon Press, London, 1988.
4. Gnanavadivel J., Karthikeyan J. and Albert Alexander S., "Special Electrical Machine", Anuradha publications, 3rd Edition, 2007.
5. Kenjo T., "Stepping Motors and Their Microprocessor Controls", Clarendon Press London, 2007.

**15EE03E POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS**

**L T P C**
**3 0 0 3**

**COURSE OUTCOMES**

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

CO1:explain the importance of different renewable energy resources. (K2)
CO2:discuss the principle of wind and solar energy systems. (K2)
CO3:identify the different power converters and MPPT for renewable energy systems. (K3)
CO4:classify the different wind electrical generators. (K2)
CO5:illustrate the grid integrated wind and PV system and its issues. (K3)

**UNIT I INTRODUCTION 9**

Trends in energy consumption – Conventional and renewable energy sources and their availability – Impacts of renewable energy generation on environment (cost GHG Emission) – Need to develop new energy technologies – Hybrid renewable energy system – Case studies.

**UNIT II ANALYSIS OF WIND AND PV SYSTEMS 9**

Solar radiation and measurement – Solar cells and their characteristics – PV arrays – Introduction to flexible solar cells – Electrical storage with batteries – Basic Principle of wind Energy conversion – Components and classification of Wind Energy Conversion System (WECS).

**UNIT III POWER CONDITIONING SCHEMES 9**

Solar: Line commutated converters (inversion–mode) – Boost and buck boost converters – Selection of inverter. Wind: Three phase AC voltage controllers – AC–DC–AC converters – Grid Interactive Inverters – Matrix converters – Control unit – MPPT algorithms.

**UNIT IV ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION 9**

Review of reference theory fundamentals – Principle of operation and analysis: IG, PMSG, SCIG and DFIG.

**UNIT V STANDALONE AND GRID INTEGRATED SYSTEM 9**

Stand alone operation of fixed and variable speed WECS and solar system – Grid integrated PMSG and SCIG based WECS – Grid integrated solar system – Grid connection Issues.

**L: 45; TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Rashid .M. H "power electronics Hand book", Academic press, 2001
2. Rai. G.D, "Non conventional energy sources", Khanna publishes, 4th Edition,2005.

**REFERENCES**

1. S. Rao and Parulekar, "Energy Technology – Non Conventional, Renewable and Conventional", New Delhi, Khanna Publishers, 2009.
2. Paul.C.Krause, O.Wasynczuk, "Analysis of Electrical Machinery and Drive Systems", 3rd Edition, Wiley Publications 2013.
3. Ned Mohan, Tore M. Undeland and William P. Robbins, "Power Electronics: Converters, Applications and Design", New Jersey, John Wiley and Sons, 2003.
4. S.N.Bhadra, D. Kastha, & S. Banerjee, "Wind Electrical Systems", Oxford University Press, 2009
5. Rai. G.D, "Solar energy utilization", Khanna publishes, 2010
6. Gray, L. Johnson, "Wind Energy System", Prentice Hall Private Limited, 1995
7. B.H.Khan, "Non–conventional Energy sources", Tata McGraw Hill Private Limited, NewDelhi.

**15EE04E CAD OF ELECTRICAL APPARATUS L T P C**

**3 0 0 3**

**COURSE OUTCOMES**

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

CO1: compare the conventional and field analysis based design. (K2)
CO2: interpret the basic concept of numerical approach. (K2)
CO3: explain the procedures of CAD packages. (K2)
CO4: apply the knowledge of CAD procedure to design electrical apparatus (K3)
CO5: analyze the design of transformers. (K3)

**UNIT I INTRODUCTION 9**

Outline of Electromagnetic Fields – Electromagnetic field equations – Laplace and Poisson's Equations – Conventional Design Procedures – Limitations – Need for field analysis based design.

**UNIT II PHILOSOPHY OF FEM 9**

Mathematical models – Differential / Integral equations – Finite Difference method – Finite element method – 2D field problems – Charge simulation method.

**UNIT III CAD PACKAGES 9**

Elements of a CAD system – Preprocessing – Modeling – Meshing – governing equations – boundary conditions and material characteristics – Setting up solution – Post processing.

**UNIT IV DESIGN APPLICATIONS 9**

Voltage Stress in Insulators – Capacitance calculation – Design of bushings – Inductance calculation – Torque calculation in Switched Reluctance Motor.

**UNIT V DESIGN OF TRANSFORMERS 9**

Single phase transformer – Computation of the No load Inductances – Estimation of Iron Loses –and leakage inductances.

**L: 45; TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. S.J. Salon, “Finite Element Analysis of Electrical Machines”, Springer, Yes DEE publishers, Indian reprint, 2007.
2. K.J.Binns, P.J.Lawrenson and C.W.Trowbridge, “The Analytical and Numerical Solution of Electric and Magnetic Fields”, John Wiley and sons, 1992.

**REFERENCES**

1. Joao Pedro, A.Bastos and Nelson Sadowski, “Electromagnetic Modeling by Methods”, Marcell Dekker Inc., 2003.
2. S.R.H.Hoole, “Computer Aided Analysis and Design of Electromagnetic Devices”, Elsevier, NewYork, 1989.
3. Matthew N. O. Sadiku, “Principles of Electromagnetics”, (English) 4th Edition, Oxford University Press, New Delhi, 2010
4. Nathan Ida, Joao P A Bastos, “Electromagnetics and calculation of fields”, Springer Verlag, Second Edition, 1997.
5. S.S.Rao, “The Finite Element Method in Engineering”, Elsevier, 2011.

**15EE05E SOLID STATE DRIVES L T P C**
**3 0 0 3**

**COURSE OUTCOMES**

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

CO1: discuss the concepts of multi quadrant dynamics of drives. (K2)
CO2: summarize the fully controlled converter fed separately excited dc drives. (K2)
CO3: infer current and speed controllers for dc drives. (K2)
CO4: explain the various speed control strategies of induction motor. (K2)
CO5: outline different control techniques of synchronous motor. (K2)

**UNIT I DRIVE CHARACTERISTICS 9**

Equations governing motor load dynamics – steady state stability – Multi quadrant dynamics – Acceleration, deceleration, starting and stopping – load torque characteristics of various drives.

**UNIT II CONVERTER / CHOPPER FED DC DRIVE 9**

Steady state analysis of fully controlled converter fed separately excited DC drive – Continuous and discontinuous conduction – Time ratio and current limit control – four quadrant operation of chopper.

**UNIT III DESIGN OF CONTROLLERS FOR DRIVES 9**

Transfer function of converter fed DC drive – current and speed feedback – Armature voltage control and field weakening mode control, Design of current and speed controller – Converter selection and characteristics.

**UNIT IV INDUCTION MOTOR DRIVES 9**

Stator voltage, frequency, V/f control – field weakening mode – Static rotor resistance control– Slip power recovery scheme – voltage/current fed inverters – closed loop control.

**UNIT V SYNCHRONOUS MOTOR DRIVES 9**

V/f control and self–control of synchronous motor – Marginal angle control – power factor control – Permanent magnet synchronous motor.

**L: 45; TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Gopal K. Dubey, “Power Semi conductor controlled drives”, Prentice Hall Private Limited, 1989.
2. Bimal K. Bose., “Modern Power Electronics and AC Drives”, Prentive Hall / Pearson Education Private Limited, 2005.

**REFERENCES**

1. De N. K. and Sen P. K., “Electrical Drives”, Prentice Hall Private Limited, 2006.
2. Murphy J.M.D. and Turnbull, “Thyristor control of AC Motor”, Pergamon Press Oxford, 1990.
3. Krishnan R., “Electric Motor Drives: Modeling, Analysis, and Control”, Prentice Hall Private Limited, 2001.
4. Dubey.G.K., "Fundamentals of Electrical drives", Narora publications, 2010.
5. Vedam Subramanyan, “Thyristor control of Electrical Drives”, Tata McGraw Hill Private Limited, 1996.

**15EE06E ADVANCED SWITCHGEAR L T P C**

**3 0 0 3**

**COURSE OUTCOMES**

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

CO1:summarize the characteristics of arc in relation to circuit breaker.(K2)
CO2 : solve the problems associated with circuit interruption by a circuit breaker. (K3)
CO3:describe the different types of conventional circuit breaker. (K2)
CO4:discuss he recent advancements in circuit breaker. (K2)
CO5: explain the testing of circuit breaker. (K2)

**UNIT I THEORY OF CIRCUIT INTERRUPTION 9**

Arc phenomena – Maintenance of the arc – Losses from plasma – Essential properties of arc – Arc interruption theories – High resistance Interruption – Current zero interruption theory.

**UNIT II CIRCUIT CONSTANTS IN RELATION TO CIRCUIT BREAKING 9**

Introduction – Circuit breaker rating– Circuit constants and circuit conditions – Restriking voltage transient Characteristics of restriking voltage – Interaction between breaker and circuit – Current chopping – Duties of switchgear.

**UNIT III CONVENTIONAL CIRCUIT BREAKERS 9**

Automatic switch – Air–break circuit breaker– Oil circuit breaker – Single and multi break construction – Air–blast circuit breaker– Performance of circuit breakers and system requirements – Modification of circuit breaker duty by shunt resistors – Power factor correction by series resistance – Comparative merits of different types of conventional circuit breakers.

**UNIT IV RECENT DEVELOPMENTS IN CIRCUIT BREAKERS 9**

Modern trends – Vacuum circuit breakers – Sulphur hexafluoride ($SF_6$) circuit breakers – D.C. circuit breaker – High speed DC air break circuit breaker – HVDC circuit breaker – HVDC vacuum circuit breaker.

**UNIT V TESTING OF CIRCUIT BREAKERS 9**

Type tests and routine tests – short circuit testing– Equipments used in the station – Testing procedure – Direct testing – making capacity– Breaking capacity – Indirect testing –unit testing, synthetic testing.

**L: 45; TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. B Ravindranath and M Chander, “Power system Protection and Switchgear”, New Age International Publishers, 2011.
2. Rao Sunil.S, “Switchgear and protection”, Khanna Publishers, 1999.

**REFERENCES**

1. Badri ram and Viswakarma D N, “Power system protection and Switchgear”, Tata McGraw Hill Private Limited, New Delhi, 1995.
2. Wadhwa C.L, “Electricall Power Systems”, New Age international Publishers, 2006, 4th Edition, Reprint August 2007.
3. Ruben D. Garzon, “High Voltage Circuit Breakers: Design and Applications”, CRC Press.
4. Chunikhin A and Zhavoronkov M, “High Voltage Switchgear Analysis and Design”, Mir Publishers, Moscow, 1989.
5. Switchgear Manual, 12th Edition, ABB, 2012.
6. Power Engineering Guide, 7th Edition, Siemens Energy Sector, 2011.

**15EE07E SOLAR PHOTOVOLTAIC FUNDAMENTALS AND APPLICATIONS L T P C**
**3 0 0 3**

**COURSE OUTCOMES**

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

CO 1: explain the fundamentals of solar cells. (K2)

CO 2: recognize the various solar PV technologies and their up gradations along with their benefits. (K2)

CO 3: design and analyze on–grid and off–grid PV applications. (K3)

CO 4: realize cost benefit analysis of PV installations. (K2)

**UNIT I ESSENTIAL BASICS OF SOLAR CELL 9**

Solar cell – physics – Photovoltaics in Global Energy Scenario – Fundamentals of Semiconductors, Energy band, Charge carriers – Motion, PN Junction diode, Solar cells – Design characteristics, Solar radiation.

**UNIT II COMMERCIAL AND DEVELOPING TECHNOLOGIES 9**

Commercial technologies – Mono crystalline and Multi crystalline, Silicon – Wafer based Solar cell, Thin film solar cells – A–Si, Cd–Te and CIGS, Concentrated PV cells, Developing technologies – Organic cells, Dye sensitized cells.

**UNIT III SOLAR PV FOR ON–GRID APPLICATIONS 9**

Solar cells to solar array – On–Grid PV system – With and Without storage – Balance of system – DC–DC converters – Inverters – Net Metering – Design and analysis – Performance evaluation and monitoring – Field visit – Grid tied PV power plant.

**UNIT IV SOLAR PV FOR OFF–GRID APPLICATIONS 9**

Off–Grid stand alone PV system – System sizing – Module and Battery – Storage – Batteries for PV systems – Sun Tracking mechanism – Types of tracking – One–axis, Two–axis – Maximum power point tracking – Design and analysis – Performance evaluation and monitoring – Field visit – Off–grid PV system

**UNIT V COST BENEFIT ANALYSIS FOR SOLAR PV INSTALLATIONS 9**

Cost and manufacturability – Manufacturing economics – Scaling – Pricing – Trends in retail pricing – Energy economics – Grid tied power plant – Solar street lighting system

**L: 45; TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Chetan Singh Solanki, “Solar Photovoltaics Fundamentals, Technologies and Applications”, 2nd Edition, Prentice Hall Limited.
2. James P. Dunlop, “Photovoltaic Systems”, Second Edition, American Technical Publishers

**REFERENCES**

1. Robert Foster, Majid Ghassemi and Alma Cota, “Solar Energy – Renewable Energy and the Environment”, CRC Press
2. www.pveducation.org

**15EE08E ENERGY AUDITING AND MANAGEMENT L T P C**
**3 0 0 3**

**COURSE OUTCOMES**

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

CO1: explain the concept of energy auditing. (K2)
CO2: select energy efficient motor for various applications. (K2)
CO3: identify the possibility of energy conservation in driven equipments. (K2)
CO4: select suitable lighting schemes for various environment(K3)
CO5: describe the concept of Energy Management. (K2)

**UNIT I ELECTRICAL ENERGY AND SAFETY AUDIT 9**

Overview of Electricity Act – Energy conservation act – Electrical energy audit – Types – Tools – Tariff – Load factor improvement – Power factor correction – Power demand control and shifting – Electrical safety Auditing.

**UNIT II ENERGY CONSERVATION IN ELECTRIC MOTORS 9**

Motors efficiency – Motor selection – Factors affecting motor performance – Efficiency at low load – Rewound motors – Variable speed drives – Load reduction – High efficiency motors – Energy savings in transformers – Case studies.

**UNIT III ELECTRICAL ENERGY CONSERVATION IN DRIVEN EQUIPMENTS 9**

Input electrical energy requirements in pumps, fans and compressors – Load factor estimation in the equipment – Energy conservation potential – Electrical energy conservation in refrigeration and air conditioning systems.

**UNIT IV ENERGY CONSERVATION IN INDUSTRIAL LIGHTING 9**

Concept of lighting systems – Choice of lighting – Different lighting technologies – Energy saving – Control of lighting – Lighting standards and requirements – Light meter audit – Methods to reduce costs.

**UNIT V ENERGY MANAGEMENT 9**

Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting – Energy manager, Qualities and functions, language, Questionnaire, Checklist of top level management.

**L: 45; TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. D. Yogi Goswami, Frank Kreith, “Energy Management and Conservation Handbook”, CRC Press, 2008.
2. Marguerite A. H Ruffner, Yacov Y. Haimes, “Energy Auditing and Conservation: Methods, Measurements, Management, and Case Studies”, Taylor and Francis,1980.

**REFERENCES**

1. General Aspects of Energy management and Energy audit, Second Edition 2005, Bureau of Energy Efficiency, Ministry of Power, India.

2. Energy Efficiency in Electrical Utilities, Second Edition 2005, Bureau of Energy Efficiency, Ministry of Power, India.
3. Energy management handbook, John Wiley and Sons – Wayne C. Turner, 2006

**15EE09E POWER QUALITY L T P C**
**3 0 0 3**

**COURSE OUTCOMES**

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

CO1: review the characterization of power quality in electric power system. (K2)
CO2: categorize the causes of power quality problems. (K4)
CO3: describe the estimation techniques and mitigation methods of voltage sag and interruptions. (K6)
CO4: explain the concept of over voltages and harmonic controlling methods. (K2)
CO5: outline the power quality monitoring and improvement techniques. (K3)

**UNIT I INTRODUCTION 9**

Characterization of Electric Power Quality: Transients, short duration and long duration voltage variations, Voltage imbalance, waveform distortion, Voltage fluctuations, Power frequency variation – Harmonics Vs transients – Effect of harmonics – Harmonic distortion – Harmonic indices – Inter harmonics – Resonance – Harmonic distortion evaluation – Power acceptability curves – IEEE and IEC standards.

**UNIT II SOURCES OF POWER QUALITY PROBLEMS 9**

Single phase static and rotating AC/DC converters, Three phase static AC/DC converters, Battery chargers, Arc furnaces, Fluorescent lighting, pulse modulated devices, Adjustable speed drives.

**UNIT III VOLTAGE SAG AND INTERRUPTIONS 9**

Sources of Voltage Sag and Interruptions – Estimating voltage sag performance – Thevenin's equivalent source – Analysis and calculation of various fault condition – Voltage sag due to induction motor starting – Estimation of sag severity – Mitigation of voltage sag using active series compensators – Static transfer switches and fast transfer switches.

**UNIT IV OVERVOLTAGES 9**

Sources of overvoltage – Capacitor switching – Lightning – Ferro resonance – Mitigation of voltage swells – Surge arresters – Power conditioners – Devices for controlling harmonic distortion – Passive and active filters.

**UNIT V POWER QUALITY MONITORING & IMPROVEMENT 9**

Monitoring considerations – Monitoring and diagnostic techniques for various power quality problems– Power line disturbance analyzer – Quality measurement equipment – Harmonic spectrum analyzer – Flicker meters – Disturbance analyzer – Load compensation using DSTATCOM, Voltage regulation using DSTATCOM, protecting sensitive loads using DVR, UPQC.

**L: 45; TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Roger. C. Dugan, Mark. F. McGranagham, Surya Santoso, H.WayneBeaty, "Electrical Power Systems Quality", Tata McGraw Hill Private Limited, 2012.
2. Arrillaga, N.R. Watson, S. Chen, "Power System Quality Assessment", New York: Wiley, 1999.

**REFERENCES**

1. G.T. Heydt, "Electric Power Quality", 2nd Edition, West Lafayette, IN, Stars in Circle Publications, 2013.
2. M.H.J Bollen, "Understanding Power Quality Problems: Voltage Sags and Interruptions", New York: IEEE Press, 1999.
3. C. Sankaran, "Power Quality", CRC Press, 2009.
4. Alexander Kusko and Marc. T. Thompson, "Power Quality in Electrical Systems", Tata McGraw Hill Private Limited, 2007.
5. Angelo Baggini, "Handbook of Power Quality", John Wiley & Sons, 2008.

**15EE10E ENERGY STUDIES L T P C**
**3 0 0 3**

**COURSE OUTCOMES**

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

CO1: recognize the basic of conventional and non conventional Energy sources. (K2)
CO2: describe the basic concepts of Energy generation and Conversion. (K2)
CO3: explain the various energy storage system.(K2)
CO4: discuss the present Energy scenario and its Environmental Impact. (K2)
CO5: discuss the various energy Policies and standards. (K2)

**UNIT I ENERGY SOURCES 9**

Energy classification – Energy sources – Principal sources of energy: conventional and non conventional sources – Bio–mass, fossil fuels, nuclear fuels, solar energy – Energy conversion –prospecting, extraction, resource assessment and their peculiar characteristics.

**UNIT II ELECTRICAL ENERGY GENERATION 9**

Production of electrical energy using thermal energy, chemical energy, electromagnetic energy and mechanical energy – Magneto hydrodynamic conversion – MHD plasmas – Analysis of MHD generators – MHD power applications – Batteries – Basic concepts – electrochemical principles and reactions – Selection and application of batteries – Fuel cells – general characteristics – Low power fuel cell systems – Fuel cell power plants.

**UNIT III ENERGY STORAGE 9**

Energy storage: requirements and methods – Storage of thermal energy – Storage of mechanical energy – Storage of electrical energy – Storage of chemical energy – Storage of nuclear energy.

**UNIT IV ENERGY SCENARIO 9**

Coal, Oil, Natural Gas, Nuclear power and Hydro – Utilization pattern in the past, present and future projections of consumption pattern – Sector–wise energy consumption – Environmental impact of fossil fuels – Energy scenario in India – Growth of energy sector and its planning in India.

**UNIT V ENERGY POLICIES 9**

National energy policy in the last plan periods, Energy use and Energy supply, Overview of renewable energy policy and the Five Year Plan programmes, Basic concept of Input–Output analysis, Concept of energy multiplier and implication of energy multiplier for analysis of regional and national energy policy– Carbon Trading– Renewable Energy Certification – CDM.

**L: 45; TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Messerle, Hugo K., "Magneto hydrodynamic Electric Power Generation", J. Wiley, 1995.
2. Loulou. R, Shukla. P.R, and Kanudia. A, "Energy and Environment Policies for a sustainable Future", Allied Publishers Ltd, New Delhi, 1997.

**REFERENCES**

1. Homas Reddy, David Linden., " Handbook of Batteries, 4th Edition", Tata McGraw Hill Private Limited, 2010
2. Vielstich. W, Yokokawa. H, Gasteiger. H.A, "Handbook of fuel cells– part 1", Volume 5, John Wiley and Sons, 2009.
3. Bent Sorensen, "Renewable Energy", Elsevier, Academic Press, 2011.
4. Twidell, J.W. and Weir, A., "Renewable Energy Sources", 2nd Edition, Taylor & Francis, 2006.
5. IEEE Transactions on Power, Energy and Industry Applications.

**15EE11E ELECTROMAGNETIC INTERFERENCE AND ELECTROMAGNETIC COMPATIBILITY**

**L T P C**
**3 0 0 3**

**COURSE OUTCOMES**

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

CO1: describe the sources of EMI and design for electromagnetic compatibility. (K2)
CO2: discuss the methods of coupling and grounding. (K2)
CO3: summarize the balancing, filtering and shielding methods. (K2)
CO4: explain the digital logic noise and ground noise. (K2)
CO5: list the standard and laboratory techniques for EMI/EMC. (K1)

**UNIT I INTRODUCTION 9**

Sources of EMI – Conducted and radiated interference – Characteristics – Designing for electromagnetic compatibility (EMC) – EMC regulation – Typical noise path – Use of network theory – Methods of eliminating interferences.

**UNIT II GROUNDING 9**

Cabling – Capacitive coupling – Inductive coupling – Shielding to prevent magnetic radiation – shield transfer impedance – Grounding – Safety grounds – Signal grounds – Single point and multipoint ground systems – Hybrid grounds – Functional ground layout – Grounding of cable shields – Ground loops – Guard shields.

**UNIT III BALANCING, FILTERING AND SHIELDING 9**

Power supply decoupling – Decoupling filters – Amplifier filtering – High frequency filtering shielding – Near and far fields – Shielding effectiveness – Absorption and reflection loss – Shielding with magnetic material – Conductive gaskets – Windows and coatings – Grounding of shields.

**UNIT IV DIGITAL CIRCUIT NOISE AND LAYOUT 9**

Frequency versus time domain – Analog versus digital circuits – Digital logic noise – Internal noise sources – Digital circuit ground noise – Power distribution – Noise voltage objectives measuring noise voltages – Unused inputs – Logic families.

**UNIT V ELECTROSTATIC DISCHARGE, STANDARDS AND LABORATORY TECHNIQUES 9**

Static Generation – Human body model – Static discharges – ESD protection in equipment design – ESD versus EMC – Industrial and Government standards – FCC requirements – CISPR recommendations – Laboratory techniques – Measurement methods for field strength.

**L: 45; TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Henry W.Ott, “Noise Reduction Techniques in Electronic Systems”, John Wiley & Sons, 2011.
2. Bernhard Keiser, “Principles of Electro–magnetic Compatibility”, Artech House, Inc., 1987.

**REFERENCES**

1. Bridges J.E., Milleta J. and Ricketts L.W., “EMP Radiation and Protective techniques”, John Wiley and sons, 1976.
2. IEEE National Symposium on “Electromagnetic Compatibility”, IEEE, 445, Hoes Lane, Piscataway, 2007.
3. Raju. G. S. N., “EMP Radiation and Protective techniques”, Pearson Education Private Limited, 1st Edition 2005.
4. Prasad Kodali.W, “Engineering Electromagnetic Compatibility: Principles, Measurements, Technologies, and Computer Models”, Wiley–Blackwell, 2nd Edition, 2001.
5. Henry W. Ott, “Electromagnetic Compatibility Engineering”, Wiley–Blackwell, 2009.
6. Christos Christopoulos, “Principles and Techniques of Electromagnetic Compatibility”, CRC Press, 2nd Edition, 2007.

**15EE12E INSULATION TECHNOLOGY L T P C**
**3 0 0 3**

**COURSE OUTCOMES**

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

CO1: describe the properties of insulating materials. (K2)
CO2: explain the various breakdown mechanisms in gaseous dielectrics. (K2)
CO3: summarize the various breakdown mechanisms in solid dielectrics. (K2)
CO4: explain the various breakdown mechanisms in liquid dielectrics. (K2)
CO5: summarize the application of different insulating materials in electrical equipments. (K3)

**UNIT I GENERAL PROPERTIES OF INSULATING MATERIALS 9**

Requirements of insulating materials – Electrical properties – Molecular properties of dielectrics – Dependence of permittivity on temperature, pressure, humidity and voltage, permittivity of mixtures, practical importance of permittivity – Behavior of dielectric under alternating fields – Complex dielectric constants – Bipolar relaxation and dielectric loss – Dielectric strength.

**UNIT II BREAKDOWN MECHANISMS IN GASEOUS DIELECTRICS 9**

Behavior of gaseous dielectrics in electric fields – Gaseous discharges – Townsend's theory – Streamer theory – Electronegative gases and their influence on gaseous discharge – gaseous discharges in non–uniform fields – Breakdown in vacuum insulation.

**UNIT III BREAKDOWN MECHANISMS IN SOLID DIELECTRICS 9**

Intrinsic breakdown of solid dielectrics – Electromechanical breakdown – Streamer breakdown, thermal breakdown and partial discharges in solid dielectrics – Electrochemical breakdown – tracking and treeing – Breakdown in composite insulation.

**UNIT IV BREAKDOWN MECHANISMS IN LIQUID DIELECTRICS 9**

Liquids as insulators – Conduction and breakdown in pure and commercial liquids – Cryogenic insulation.

**UNIT V APPLICATION OF INSULATING MATERIALS 9**

Application of insulating materials in transformers, rotating machines, Insulators, Isolators/circuit breakers, cables, power capacitors and bushings.

**L: 45; TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Adrinaus, Dekker J., "Electrical Engineering Materials", Prentice Hall Private Limited, New Delhi,2001.
2. Alston L.L, "High Voltage Technology", Oxford University Press, London, 1968 (B.S Publications, 1st Indian Edition 2006).

**REFERENCES**

1. Kuffel E., Zaengl W.S. and Kuffel J., "High Voltage Engineering Fundamentals", Elsvier India Private Limited, 2005.

2. Dieter Kind and Hermann Karner, “High Voltage Insulation Technology”, (Translated from German by Narayana Rao Y., Friedr. Vieweg & Sohn, Braunschweig), 1985.
3. Naidu M.S. and Kamaraju V., “High Voltage Engineering”, Tata McGraw Hill Private Limited, New Delhi, 2009.
4. Ushakov V.Y., “Insulation of High Voltage Equipment”, Springer, ISBN.3–540–20729– 5,
5. Rod V. Latham, “High Voltage Vacuum Insulation: Basic Concepts and Technological Practice”, Academic Press, 1st Edition, 1995.

**15EE13E FLEXIBLE AC TRANSMISSION L T P C**
**3 0 0 3**

**COURSE OUTCOMES**

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

CO1: explain the fundamental idea about FACTS controllers. (K2)
CO2: design of SVC voltage regulator using TCR–TSC logic. (K5)
CO3: describe Transient stability model of TCSC. (K2)
CO4: explain about basic principle of operation of STATCOM. (K2)
CO5: explain controller interactions & its type. (K2)

**UNIT I INTRODUCTION 9**

Flexible AC transmission – uncompensated transmission line – reactive power control – series and shunt compensation. FACTS devices: Static Var Compensator (SVC) – Thyristor Controlled Series capacitor (TCSC) – Unified Power Flow controller (UPFC) – Interphase Power Flow Controller (IPC).

**UNIT II STATIC VAR COMPENSATOR AND APPLICATIONS 9**

Voltage control – advantages of slope in dynamic characteristics – Influence of SVC on system voltage – Applications: enhancement of transient stability and power system damping – Steady state power transfer – Prevention of voltage instability.

**UNIT III THYRISTOR CONTROLLED SERIES CAPACITOR AND APPLICATIONS 9**

Operation of TCSC – Modes – Modeling – Variable reactance model – Applications: improvement of system stability limit – Enhancement of system damping – Voltage collapse prevention.

**UNIT IV EMERGING FACTS CONTROLLERS 9**

Static Synchronous Compensator (STATCOM) – Operating principle – V-I characteristics – UPFC – IPC: Principle and modes of operation – Applications: Modeling of UPFC, IPC for power flow and transient stability studies.

**UNIT V COORDINATION OF FACTS CONTROLLERS 9**

FACTs Controller interactions – SVC–SVC interaction – Coordination of multiple controllers using linear control techniques – Control coordination using Genetic algorithm.

**L: 45; TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Mohan Mathur, R., Rajiv. K. Varma, "Thyristor – Based Facts Controllers for Electrical Transmission Systems", IEEE press and John Wiley & Sons, Inc., 2002.
2. Narani G. Hingorani and Laszlo Gyugyi, "Understanding FACTS concepts and Technology of flexible AC Transmission Systems", IEEE power Engineering society Sponsor, IEEE press, 2001.

**REFERENCES**

1. A.T.John, "Flexible AC Transmission System", Institution of Electrical and Electronic Engineers (IEEE), 1999.
2. Xiao–Ping Zhang, "Flexible AC Transmission Systems: Modelling and Control (Power Systems)", Springer; 2nd Edition, 2012.
3. Yong–Hua Song, and Allan Johns, "Flexible Ac Transmission Systems (FACTS)", IET, 1999.
4. Narain G. Hingorani, Laszlo Gyugyi, "Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems", Wiley–IEEE Press, 1st Edition, 1999.
5. K.R.Padiyar, "FACTS Controllers in Power Transmission and distribution", New age international Publishers 2007.

**15EE14E EHV AC POWER TRANSMISSION L T P C**
**3 0 0 3**

**COURSE OUTCOMES**

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

CO1: explain the role of EHVAC Transmission and Mechanical considerations. (K2)
CO2: calculate the line parameters for multiconductor lines. (K4)
CO3: estimate the voltage gradients of conductors. (K6)
CO4: discuss the concepts of corona and radio interference. (K2)
CO5: illustrate the effect of electrostatic field of EHV lines. (K3)

**UNIT I INTRODUCTION 9**

Role of EHVAC Transmission – Standard transmission voltages – Average values of line parameters – Power handling capacities and line losses – Mechanical considerations in line performance.

**UNIT II CALCULATION OF LINE PARAMETERS 9**

Properties of bundled conductors – Calculation of resistance, inductance and capacitance for multiconductor lines – Calculation of sequence inductances and capacitances – Line parameters for different modes of propagation.

**UNIT III VOLTAGE GRADIENTS OF CONDUCTORS 9**

Charge–potential relations for multi–conductor lines – Surface voltage gradient on conductors – Gradient factors and their use – Distribution of voltage gradient on sub conductors of bundle – Voltage gradients on conductors in the presence of ground wires on towers.

**UNIT IV CORONA EFFECTS 9**

$I^2R$ loss and corona loss – Corona loss formulae – Audible noise generation and characteristics – Limits for audible noise – Day–Night equivalent noise level – Corona pulse generation and properties – Limits for radio interference fields – Measurement of radio interference.

**UNIT V ELECTROSTATIC FIELD OF EHV LINES 9**

Electric shock and threshold currents – Calculation of electrostatic field of AC lines – Effect of high field on humans, animals, plants and vehicles – Electrostatic induction in un–energized circuit of a DC line – Induced voltages in insulated ground wires.

**L: 45; TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Rakosh Das Begamudre, “Extra High Voltage AC Transmission Engineering”, New Age International Pvt. Ltd., 2nd Edition, 2013.
2. Power Engineer’s Handbook, TNEB Engineers Association, Revised and Enlarged, 6th Edition, October 2002.

**REFERENCES**

1. Microtran Power System Analysis Corporation, “Microtran Reference Manual”, Vancouver Canada. (Website: www.microtran.com)
2. R.K. Rajput, “A Text Book of Power System Engineering”, Laxmi Publications, 2015.
3. Xiao–Ping Zhang, “Restructured Electric Power Systems”, Wiley Publications, 2010.
4. Shobhit Gupta, and Deepak Gupta, “EHV AC/DC Transmission”, genius publications, 2014.
5. A. Chakrabarti , D. P. Kothari and A. K. Mukhopadhyay, “Performance, Operation and Control of EHV Power Transmission System”, A H Wheeler Publishing Co Ltd, 1999.

**15EE15E HIGH VOLTAGE DC TRANSMISSION L T P C**
**3 0 0 3**

**COURSE OUTCOMES**

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

CO1: describe the DC power transmission technology. (K2)
CO2: analyze HVDC converters. (K4)
CO3: describe the various types, control and protection of MTDC systems. (K2)
CO4: analyze harmonics and filters. (K4)
CO5: discuss the simulation tools and Modeling of HVDC system. (K2)

**UNIT I HVDC POWER TRANSMISSION TECHNOLOGY 9**

Introduction – Comparison of AC and DC transmission – Application of DC transmission – Description of DC transmission system– Planning for HVDC transmission – Modern trends in DC transmission.

**UNIT II ANALYSIS OF HVDC CONVERTERS 9**

Pulse number – Choice of converter configuration – Simplified analysis of Graetz circuit– Converter bridge characteristics – Characteristics of a twelve pulse converter –Detailed analysis of converters – Line Commutated Converter.

**UNIT III MULTI TERMINAL DC SYSTEMS 9**

Introduction – Potential applications of MTDC systems – Types of MTDC systems – Control and Protection of MTDC systems – Current margin method – Voltage limiting control – Decentralized current balancing – Two ACR method – Study of MTDC systems.

**UNIT IV HARMONICS AND FILTERS 9**

Introduction – Generation of harmonics – Characteristics and non characteristics harmonics – Design of AC filters – Single tuned filters – High pass filters – Protection of filters – Design of DC filters – Carrier frequency and Radio Interference noise.

**UNIT V SIMULATION OF HVDC SYSTEMS 9**

Introduction to system simulation – Philosophy and tools – HVDC system simulation – Modeling of HVDC systems for digital dynamic simulation – Transient simulation of DC and AC systems.

**L: 45; TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Padiyar.K.R, “HVDC Power Transmission Systems: Technology and system Interactions”, New Age International (P) Limited, and Publishers, 2010.
2. Edward Wilson Kimbark, “Direct Current Transmission”, Vol. I, Wiley interscience, New York, London, Sydney, 1971.

**REFERENCES**

1. Colin Adamson and Hingorani N G, “High Voltage Direct Current Power Transmission”, Garraway Limited, London, 1963.
2. Arrillaga. J., “High Voltage Direct Current Transmission”, Peter Pregrinus, London, 1983.
3. Erich Uhlmann, “Power Transmission by Direct Current”, BS Publications, 2004.
4. Sood V.K., “HVDC and FACTS controllers – Applications of Static Converters in Power System”, Kluwer Academic Publishers, April 2004.
5. Rakosh Das Begamudre, “Extra High Voltage AC Transmission Engineering”, New Age Interantional (P) Ltd., New Delhi, 2013.

**15EE16E LINEAR AND NONLINEAR CONTROL SYSTEMS L T P C**

**3 0 0 3**

**COURSE OUTCOMES**

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

CO1: formulate and analyze the state model of system. (K5)

CO2: design state feedback and observer. (K5)

CO3: construct the phase trajectory for nonlinear system. (K5)

CO4: make use of describing function to analyze the nonlinear control system. (K3)
CO5: analyze the stability of the system using Lyapunov function. (K4)

**UNIT I FORMULATION AND SOLUTION OF STATE MODEL 9**

Basic concepts of state, State variables and state model – Linear continuous time systems – physical variable – Phase variable – Canonical variable – Transfer function from state model – Diagonalization – Solution of state equation – State variable for linear discrete time systems

**UNIT II DESIGN AND ANALYSIS OF STATE SPACE MODEL 9**

Concept of Controllability – Controllable phase variable form – Concept of observability – Observable phase variable form – Gilbert's test – Kalman's test – Pole placement by state feedback for Single input Single output system – State observer.

**UNIT III NONLINEAR SYSTEMS 9**

Behaviour of non linear system – Phase plane method – Stability of non linear system – Limit cycles – Phase trajectories – Analytical method – Graphical method

**UNIT IV DESCRIBING FUNCTION 9**

Basic concepts – Dead zone and saturation, relay with dead zone and hysteresis, ON /OFF controller with dead zone, backlash non linearities – Stability analysis using describing functions – Jump resonance.

**UNIT V LYAPUNOV STABILITY 9**

Lyapunov stability definition – Lyapunov stability theorem – Lyapunov functions for non linear system – Krasovskii method – Variable gradient method – Direct method of Lyapunov and linear systems.

**L: 45; TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. I.J. Nagrath and M.Gopal, "Control Systems Engineering", New Age International Publishers, 2010.
2. M. Gopal, "Digital Control and State variable method", Tata McGraw Hill Private Limited, 4th Edition, 2012.

**REFERENCES**

1. K.Ogatta, "Modern Control Engineering", Prentice Hall Private Limited, 2014.
2. Benjamin C. Kuo, "Automatic Control Systems", Prentice Hall Private Limited, 2010.
3. Hasan Khalil, "Nonlinear systems and control", Prentice Hall Private Limited, 2002.
4. M. Gopal, "Modern Control System Theory", New Age International, 2006.
5. M. Gopal, "Control Systems Principles and Design", Tata McGraw Hill Private Limited, 4th Edition, 2012.
6. J.E.Slotine &W.P.Li, "Applied non–linear control", Prentice Hall Private Limited, USA, 2012.
7. George J. Thaler, "Automatic Control Systems", Jaico Publishers, 1998.

**15EE17E LOGIC AND DISTRIBUTED CONTROL SYSTEM L T P C**
**3 0 0 3**

**COURSE OUTCOMES**

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

CO1:describe the PLC components and basic programming concept. (K2)
CO2:recognize the instruction used in PLC. (K2)
CO3:develop the program using PLC for industrial applications. (K3)
CO4:describe the functionality of SCADA (K2)
CO5:explain the basic concepts of DCS and its Interfacings. (K2)

**UNIT I PROGRAMMABLE LOGIC CONTROLLER 9**

Advantages of PLC over relay logic – Parts of PLC – Architecture – Principles of operation – PLC versus Computer – PLC Size and Application – PLC Hardware components – Different programming concept – Programming timers and counters.

**UNIT II INSTRUCTION IN PLC 9**

Instructions in PLC – Program control instructions – Data manipulation instructions – math instructions – sequencer and shift register instructions – Programming concept using Instructions.

**UNIT III APPLICATIONS OF PLC 9**

PLC Installation Practices – Editing and Troubleshooting – Data acquisitions system – Application of PLC – Case study of bottle filling system, traffic light control system – Industrial Application: Cement industry – Paint Industry – Power Plant.

**UNIT IV SUPERVISORY CONTROL AND DATA ACQUISITION 9**

Introduction to SCADA – SCADA Functional requirements and Components – General features, Functions and Applications, Benefits – Configurations of SCADA, RTU (Remote Terminal Units) Connections – SCADA Communication requirements – Structure of a SCADA Communications Protocol.

**UNIT V DISTRIBUTED CONTROL SYSTEM AND ITS INTERFACING 9**

DCS –Evolution of Architectures – Comparison – Local control unit – Process interfacing issues – Communication facilities – Operator interfaces – Low level and high level operator interfaces – Operator displays – Engineering interfaces – Low level and high level engineering interfaces – General purpose computers in DCS.

**L : 45; TOTAL : 45 PERIODS**

**TEXT BOOKS**

1. Petruzella, “Programmable Logic Controller”, Tata McGraw Hill Private Limited, 4th Edition, 2011.
2. Michael P. Lukas, “Distributed Control System”, Van Nostrand Reinhold Co., Canada, 2001.

**REFERENCES**

1. T. Hughes, “Programmable Logic Controllers”, ISA press, 2007.

2. Krishna Kant, “Computer based Industrial Control”, Prentice Hall Private Limited, New Delhi, 2014.
3. http://nptel.ac.in/courses/108106022
4. M. Chidambaram, “Computer Control of Processes”, Narosa Book Distributors Private Limited, 2002.

**15EE18E ADVANCED CONTROL THEORY L T P C**
**3 0 0 3**

**COURSE OUTCOMES**

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

CO1: explain discrete model of system. (K2)
CO2: classify digital compensator. (K2)
CO3: illustrate optimal control problems. K2)
CO4: interpret robust controller for simple application. (K2)
CO5: apply model reference adaptive control. (K3)

**UNIT I SAMPLED DATA SYSTEM 9**

Configuration of digital control scheme – Time domain models of discrete time systems – Transfer function models – Frequency response – Stability of sampled data system – Jury stability criterion – Sample and hold system – Sampled spectra and aliasing – Reconstruction of analog signal –Practical aspect of choice of sampling rate – Principle of discretisation – Impulse invariance – Step invariance – Bilinear transformation

**UNIT II DESIGN OF DIGITAL CONTROL ALGORITHMS 9**

Z plane specifications of control system design – Steady state accuracy – Transient accuracy – Nyquist stability criterion of Z plane – Disturbance rejection – Insensitivity and robustness – Digital compensator design using frequency response plot – Lead, Lag, Lag–Lead compensation – Z plane synthesis

**UNIT III OPTIMAL CONTROL 9**

Parameter optimization: Servomechanism – Optimal control problems: Transfer function and State variable approaches – State regulator problem – Infinite time regulator problem – Output regulator and Tracking problem – Parameter optimization : regulators.

**UNIT IV ROBUST CONTROL 9**

Robust control system and system sensitivity – Analysis of robustness – Systems with uncertain parameters – Design of robust control systems – PID controller – Design of robust PID controller – Design of robust internal model control system – Pseudo quantitative feedback system.

**UNIT V ADAPTIVE CONTROL 9**

Model reference adaptive control – MIT rule – MRAC using Lyapunov theory – First order systems – General higher order SISO systems – MRAC for a single link manipulator – Self tuning control.

**L: 45; TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. M.Gopal, "Digital Control & State Variable Methods", Tata McGraw Hill Private Limited, 4th Edition, 2012.
2. I.J. Nagrath and M.Gopal, "Control Systems Engineering", New Age International Publishers, 5th Edition 2012.
3. Richard C. Dorf, "Modern control systems", 12th Edition, Addison Wesley, 2014.

.

**REFERENCES**

1. K.Ogatta, "Discrete time control system", PHI, 2010.
2. B.C.Kuo," Digital Control Systems", SRL Publication, 2003.
3. M. Gopal, "Control Systems Principles and Design", Tata McGraw Hill Private Limited, 4rd Edition, 2012.
4. M.Gopal," Modern control system theory", New Age International Publishers, 2006.
5. Gene F.Franklin, J.David Powell and Abbasemami–Naeini, "Feedback Control of Dynamic Systems", 7th Edition, Pearson Education, 2015.

**15EE19E SOFT COMPUTING FOR ELECTRICAL ENGINEERING L T P C**
**3 0 0 3**

**COURSE OUTCOMES**

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

CO1: explain the components of fuzzy logic system. (K2)
CO2: distinguish various structures of ANN. (K2)
CO3: describe the basic concepts of genetic algorithms. (K2)
CO4: apply ANN and FLC to various electrical applications. (K3)
CO5: employ GA to power system optimization and control applications. (K3)

**UNIT I FUZZY LOGIC SYSTEM 9**

Introduction to crisp sets and fuzzy sets, basic fuzzy set operation and approximate reasoning – Fuzzification, inferencing and defuzzification methods – Fuzzy knowledge and rule bases – Fuzzy logic modelling

**UNIT II ARTIFICIAL NEURAL NETWORKS 9**

Basic concepts – Types of activation functions – McCulloch–Pitts neuron model – Adaline and Madaline, Applications – Architecture – Feed forward and Feedback – Multilayer Perceptron– Hopfield network – Self organizing network.

**UNIT III GENETIC ALGORITHM 9**

Basic concepts – Functional evaluation and constraint handling – Representation – Cross over – Mutation – Selection schemes – Stopping criteria.

**UNIT IV APPLICATIONS OF FLC AND ANN 9**

Implementation of fuzzy logic controller for motor drives – Identification and control of linear and nonlinear dynamic systems using Neural Network – ANN application to short term load forecasting .

**UNIT V APPLICATIONS OF GA 9**

GA application to power system optimization problem – Economic dispatch, load scheduling and unit commitment problems – System Identification and PID controller tuning.

.

**L: 45; TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Jacek.M.Zurada, "Introduction to Artificial Neural Systems", Jaico Publishing House,2006.
2. Kosko,B. "Neural Networks And Fuzzy Systems", Prentice Hall Private Limited, 2004.

**REFERENCES**

1. S.N.Sivanandam & S.N.Deepa, “Principles of Soft Computing”, Wiley India Private Limited, 2013.
2. Klir G.J. & Folger T.A. "Fuzzy sets, uncertainty and Information", Prentice Hall Private Limited, 2010.
3. Zimmerman H.J. "Fuzzy set theory–and its Applications" Kluwer Academic Publishers, 2014.
4. Driankov, Hellendroon, "Introduction to Fuzzy Control", Narosa Publishers, 2nd Edition, 2011.
5. Samir Roy, “Introduction to Soft Computing: Neuro – Fuzzy and Genetic Algorithms”, Pearson Education, 1st Edition, 2013.
6. Fakhreddine O. Karray, “Introduction to Soft Computing: Neuro – Fuzzy and Genetic Algorithms”, Pearson Education, 1st Edition, 2009.
7. Devendra K. Chaturvedi, “Soft Computing: Techniques and its Applications in Electrical Engineering”, Springer, 2008.

**15EE20E MEMS AND NEMS L T P C**
**3 0 0 3**

**COURSE OUTCOMES**

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

CO1: outline the design concepts of MEMS. (K1)
CO2: describe the processes in micromachining. (K2)
CO3: summarize the various types of sensors and actuators. (K2)
CO4: make use of MEMS concepts in various applications. (K3)
CO5: discuss the processes of NEMS and its applications. (K2)

**UNIT I INTRODUCTION TO MEMS 9**

Microelectromechanical systems – Micro sensors – Micro actuators – Single and Poly crystalline silicon – Silicon Piezoresistor –Polymers – SU8 photoresists – Scaling laws in miniaturization

**UNIT II MICROMACHINING 9**

Micro systems fabrication process – Problems with Bulk Micromachining and Surface Micromachining – Wafer Bonding – LIGA process.

**UNIT III SENSORS AND ACTUATORS 9**

Mechanical: Beam and Cantilever – Capacitive effect – MEMS Gyroscopes – Micromachined thermocouple probe – Peltier effect Heat pumps – Thermal flow sensors and MEMS relay – Shape Memory Alloys.

**UNIT IV RF MEMS and MOEMS 9**

RF based communication system – MEMS inductors –Varactors – Tuners – Filter – Resonator – MEMS Switches – Phase shifter – Principle of MOEMS – Micro mirrors – Light detectors

**UNIT V NEMS 9**

Nano electro mechanical systems – fabrication and process techniques – integration of nano systems and devices – applications – Single Electron Transistor – Carbon Nano tube Devices.

**L: 45; TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Tai Ran Hsu , “MEMS and Microsystems Design and Manufacture”, Tata Mc-Graw Hill Private Limited, 2007.
2. Nitaigour Premchand Mahalik, “MEMS” ,Tata McGraw Hill Private Limited, 2012.

**REFERENCES**

1. Nadim Maluf,” An introduction to Micro electro mechanical system design”, Artech House, 2000.
2. Mohamed Gad–el–Hak, editor,” The MEMS Handbook”, CRC press Baco Raton, 2006.
3. Stephen Santuria,” Microsystems Design”, Kluwer publishers, 2000.
4. Chang Liu, “Foundations of MEMS”, Pearson Education India Limited, 2012,
5. Sergey Edward Lyshevski, “MEMS and NEMS: Systems, Devices, and Structures” CRC Press, 2007
6. W.R.Fahrner, “Nanotechnology and Nanoelectronics: Materials, Devices, Measurement Techniques”, Springer, 2007.

**15EE21E DSP BASED SYSTEM DESIGN L T P C**

**3 0 0 3**

**COURSE OUTCOMES**

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

CO 1: classify the instruction sets of C2xx DSP Controller. (K2)
CO 2: discuss the various peripheral functions of DSP Controller. (K2)
CO 3: explain the Event Managers used in DSP Controller. (K2)
CO 4: demonstrate DSP Controllers based power electronics applications. (K3)
CO 5: determine the current trends in DSP system design. (K5)

**UNIT I INTRODUCTION 9**

TMS LC2407 DSP controller– Peripherals – Software tools – C2xx DSP Core and Code Generation – CPU and Instruction Set – Components of C2xx DSP Core – Mapping – Interface System Configuration–Memory – Programming using C2xx DSP Instruction Set.

**UNIT II PERIPHERALS 9**

General purpose Input/output (GPIO) Functionality – Multiplexing and Control Registers – Interrupt Hierarchy – Initializing and Servicing Interrupts in Software – A/D converter– PWM signal generation.

**UNIT III EVENT MANAGERS 9**

Event Manager (EV) – Interrupts – General Purpose (GP) Timers – Compare Units – Capture Units and Quadrature Encoded Pulse (QEP) Circuitry – General Event Manager Information

**UNIT IV DSP BASED POWER ELECTRONICS APPLICATIONS 9**

DC– DC Buck – Boost converters – Continuous and Discontinuous Conduction Mode – Interfacing DSP to Buck – Boost Converter – Interrupt Service Routine – Regulation Code Sequences – Space Vector PWM Technique – Principle of constant V/f control of induction motor – DSP implementation.

**UNIT V RECENT TRENDS IN DSP SYSTEM DESIGN 9**

FPGA – Features and families – Complementary Programmable Logic Device – DSP versus FPGA – VHDL programming – VHDL based controller design – Applications of FPGA.

**L: 45; TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Mitra, Sanjit Kumar, “Digital Signal Processing: a Computer Based Approach”, Tata McGraw Hill Private Limited, 2012.
2. Sen M Kuo, Woon .Seng. Gan, “Digital signal Processors–Architecture, implementation and applications”, Pearson Education, 2005.

**REFERENCES**

1. Avtar Singh and S. Srinivasan, “Digital Signal Processing”, Thomson Brooks, 2004.
2. Phil Lapsley, Bler, Sholam, E.A.Lee, “DSP Processor fundamentals”, IEEE Press, 1999.
3. Charles.D. Roth, “Digital System Design using VHDL”, 2008.
4. N. Mohan, T.M. Undeland, and W.P. Robbins, “Power Electronics: Circuits, Devices and Applications “, John Wiley & Sons, 2nd Edition, 1995.
5. Wolf Wayne, "FPGA Based System Design", Pearson Education, 2009.

**15EE22E MICROPROCESSORS, PC HARDWARE AND INTERFACING L T P C**
**3 0 0 3**

**COURSE OUTCOMES**

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

CO1: illustrate the Hardware organization of PC. (K3)
CO2: describe the Peripherals and drives interfaces. (K2)
CO3: appraise the Peripherals with the PC. (K4)
CO4: design a I/O system and port. (K5)
CO5: explain the register declaration and features of USB. (K2)

**UNIT I HARDWARE ORGANIZATION OF PC 9**

Hardware organization of IBM PC – Advanced microprocessors: Protected mode operation, Virtual memory, Multitasking – Special features of Pentium processors; Chipset chips – Memory organization and mapping.

**UNIT II INTERFACING 9**

System timer and RTC, System resources – Interrupts, DMA channels, I/O map. Peripherals: Drives – HDD, CD–ROM drive, IDE, SCSI interfaces. Video display systems – Video adapters, video standards, display controllers.

**UNIT III PERIPHERALS 9**

Peripherals: Keyboard and mouse, Printers, ROM BIOS services – Video, Keyboard, Disk, Printer, RTC, Serial I/O.

**UNIT IV I/O SYSTEM 9**

I/O Buses: 8–bit ISA, 16–bit ISA, EISA, PCI, buses – Pins and signals, Interfacing examples, PCMCIA and AGP

**UNIT V PARALLEL AND SERIES PROGRAMMING 9**

Parallel port – Register organization, pins and signals, handshaking and programming of SPP, EPP and ECP modes Serial port – Registers, Pins and signals, programming USB – Features.

**L: 45; TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. N.Mathivanan, “Microprocessors, PC Hardware and Interfacing”, PHI, 2003.
2. Bary B. Brey, “The INTEL Microprocessors 8086/8088, 80186/80188,80286, 80386, 80486, Pentium, and Pentium Pro processors”, V Ed., PHI, 2002.

**REFERENCES**

1. B.Govindarajulu, “IBM PC and Clones: Hardware, and Maintenance”, Tata McGraw Hill Private Limited, 2002.
2. S.J. Bigelow, “Troubleshooting, maintaining and repairing PCs”, Tata McGraw Hill Private Limited, 2011.
3. Scott Muller, “Upgrading and repairing PCs”, Prentice Hall Private Limited, 2015.
4. Douglas V. Hall ,“Experiments in Microprocessors and interfacing Programming and Hardware” Douglas V. Hall, 2nd Edition, 2010.
5. Walter A. Triebel, “The 8088 and 8086 Microprocessors: Programming, Interfacing, Software, Hardware, and Applications”, 4th Edition Aug. 2014.

**15EE23E ADVANCED MICROPROCESSOR AND MICROCONTROLLER L T P C**
**3 0 0 3**

**COURSE OUTCOMES**

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

CO1: explain the fundamental concepts of microprocessor architecture. (K2)
CO2: develop knowledge about high performance Pentium CISC architectures. (K5)
CO3: discuss about the ARM processors. (K2)
CO4: describe the concept of PIC microcontroller. (K2)
CO5: develop simple programming using arduino. (K5)

**UNIT I INTRODUCTION 9**

Generic Architecture – Instruction Set – Addressing modes – Memory hierarchy – register file – Cache – Virtual memory and paging – Segmentation – Pipelining – Instruction level parallelism – Reduced instruction set – RISC versus CISC.

**UNIT II PENTIUM CISC ARCHITECTURE 9**

CPU Architecture – Bus Operations – Pipelining – Branch prediction – Floating point unit – Operating Modes – Paging – Multitasking – Exception and Interrupts – Instruction set – Addressing modes.

**UNIT III ARM RISC ARCHITECTURE 9**

Organization of CPU – Bus architecture – Memory management unit – Instruction set – Thumb Instruction set – Addressing modes – Programming.

**UNIT IV PIC MICROCONTROLLER 9**

CPU Architecture – Instruction set – interrupts – Timers – I2C Interfacing – UART – A/D Converter – PWM and introduction to C–Compilers

**UNIT V INTRODUCTION TO ARDUINO 9**

Architecture – Instruction set – Registers and memory access – Digital I/O – timers, Debugging – Pulse width modulation (PWM) – Serial communication – Interrupts – Programming.

**L: 45; TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Daniel Tabak, ‘’Advanced Microprocessors”, Tata McGraw Hill Private Limited, 1995.
2. Steve Furber, ‘’ARM System–On–Chip Architecture“, Addision Wesley, 2001.
3. John .B.Peatman, “Design with PIC Microcontroller”, Prentice Hall Private Limited, 2007.

**REFERENCES**

1. James L. Antonakos, “The Pentium Microprocessor‘’, Pearson Education, 1997.
2. Gene .H.Miller.” Micro Computer Engineering”, Pearson Education, 2003.
3. James L.Antonakos, “An Introduction to the Intel family of Microprocessors‘’, Pearson Education 1999.
4. Barry.B.Breg, “The Intel Microprocessors Architecture, Programming and Interfacing”, 8th Edition, 2014.

5. Valvano, "Embedded Microcomputer Systems", Thomson Asia Private Limited, First Reprint, 2012.
6. Mike McRoberts, “Beginning arduino”, Apress; 2013.

**15EE24E REAL TIME OPERATING SYSTEMS L T P C**
**3 0 0 3**

**COURSE OUTCOMES**

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

CO 1: recall the processes of general Operating systems. (K1)
CO 2: describe the basics concepts of RTOS. (K2)
CO 3: explain the Real time models and scheduling. (K2)
CO 4: distinguish the various interprocess functions in RTOS. (K2)
CO 5: demonstrate the applications of RTOS in various domains. (K3)

**UNIT I REVIEW OF OPERATING SYSTEMS 9**

Basic Principles – Structures – System Calls – Files – Processes – Design and Implementation of processes – Communication between processes –Distributed Operating system – Distributed scheduling.

**UNIT II RTOS CONCEPTS 9**

Need for RTOS – Advantage and Disadvantage – Multitasking–Non preemptive Kernels – Preemptive Kernels – Round Robin Scheduling–Task Priorities – Mutual Exclusion – deadlock – inter task Communication – Message Mailboxes–Message Queues–Interrupts.

**UNIT III µC/OS II BASICS 9**

Features–Goal – Kernel Structures: Task– Task States–Task Scheduling– Idle Task – Statistics Task– Interrupts – Clock Tick– Initialization. Task Management: Creating Tasks– Task Stacks–Stack Checking– Suspending Task– System Time.

**UNIT IV RTOS INTERPROCESS FUNCTIONS 9**

Message Mailbox Management: Creating a Mailbox–Waiting for a Message box–Sending Message to a Mailbox. Message Queue Management: Creating Message Queue–Deleting a Message Queue–Waiting for a Message at a Queue–Sending Message to a Queue– Flushing a Queue– Semaphores in µC/OS II.

**UNIT V MEMORY MANAGEMENT AND RTOS APPLICATIONS 9**

Memory Management: Memory Control Blocks– Creating Partition– Obtaining a Memory Block function –Returning a Memory Block function – Applications: Image Processing – Voice over IP – Control Systems.

**L: 45; TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Raj Kamal, “Embedded Systems– Architecture, Programming and Design” Tata McGraw Hill Private Limited, 2015.

2. Herma K., “Real Time Systems – Design for distributed Embedded Applications”, Kluwer Academic, 2011.

**REFERENCES**

1. Charles Crowley, “Operating Systems–A Design Oriented approach” Tata McGraw Hill Private Limited, 1998.
2. C.M. Krishna, Kang, G.Shin, “Real Time Systems”, Tata McGraw Hill Private Limited, 1997.
3. Raymond J.A.Bhur, Donald L.Bailey, “An Introduction to Real Time Systems”, Prentice Hall Private Limited, 1999.
4. Mukesh Sighal and N G Shi “Advanced Concepts in Operating System”, Tata McGraw Hill Private Limited, 2011.
5. Jean J. Labrosse, “Micro C/OS–II: The Real Time Kernal”, CMP Books, 2nd Edition, 1998.

**15EE25E AUTOMOTIVE ELECTRICAL AND ELECTRONICS L T P C**
**3 0 0 3**

**COURSE OUTCOMES**

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

CO 1: describe the basics concepts of starting systems. (K2)
CO 2: explain the aspects of charging systems. (K2)
CO 3: distinguish the types of lighting system, batteries and accessories. (K2)
CO 4: explain the various process in automotive electronics. (K2)
CO 5: demonstrate the applications of sensors and activators. (K3)

**UNIT I STARTING SYSTEM 9**

Condition at starting, behavior of starter during starting, series motor and its characteristics, principle and construction of starter motor, working of different starter drive units, care and maintenances of starter motor, starter switches.

**UNIT II CHARGING SYSTEM 9**

Generation of direct current, shunt generator characteristics, armature reaction, third brush regulation, cutout. Voltage and current regulators, compensated voltage regulator, alternators principle and constructional aspects and bridge rectifiers, new developments.

**UNIT III LIGHTING SYSTEM, BATTERIES AND ACCESSORIES 9**

Principle and construction of lead acid battery, characteristics of battery, rating capacity and efficiency of batteries, various tests on batteries, maintenance and charging. Lighting system: insulated and earth return system, details of head light and side light, LED lighting system, head light dazzling and preventive methods – Horn: AC & DC horns, wind tone horn/air horns, electronic horn, reverse horn, Horn relay. Warning Buzzer. Windscreen wipers, windscreen washers, power windows, doors locks, Rear wind shield glass heating system. Rear view mirror adjusting, Day light regulating system, Central Locking system.

**UNIT IV AUTOMOTIVE ELECTRONICS 9**

Current trends in automotive electronic engine management system, electro- magnetic interference suppression, electromagnetic compatibility, ECU for Engine, electronic dashboard instruments, onboard diagnostic system (OBD), security and warning system. Electronic Fuel Injection and Ignition Systems: Introduction, feedback carburetor systems. Throttle body injection and multi- port or point fuel injection, fuel injection systems, Injection system controls. Advantages of electronic ignition systems: Types of solid state ignition systems and their principle of operation, Contact less electronic ignition system, and electronic spark timing control. Digital Engine Control System: Open loop and closed loop control systems – Engine cranking and warm up control – Acceleration Enrichment – Deceleration leaning and idle speed control. Distributor less ignition – Integrated engine control systems, Exhaust emission control engineering

**UNIT V SENSORS AND ACTIVATORS 9**

Types of sensors: sensor for speed, throttle position, exhaust oxygen level, manifold pressure, crankshaft position, coolant temperature, exhaust temperature, air mass flow for engine application. Solenoids, stepper motors, relay, Introduction to Microprocessor & Applications in Automobiles.

**L: 45; TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. A. L. Statini, “Automotive Electrical and Electronics”, Delmar Publications, 2013.
2. Tom denton, , “Automotive Electrical And Electronics Systems”, Allied Publishers, 2016.

**REFERENCES**

1. Young A.P. & Griffiths. L. “Automotive Electrical Equipment”, ELBS & New Press, 1999.
2. William B.Riddens “Understanding Automotive Electronics”, 5th Edition, Butter worth Heinemann Woburn, 2013.
3. Bechhold “Understanding Automotive Electronics”, SAE, 1998.
4. Crouse, W.H “Automobile Electrical Equipment”, Tata McGraw Hill Private Limited, New York, 3rd Edition, 1996.
5. Judge A.W “Modern Electrical Equipment of Automobiles”, Chapman & Hall, London, 1992.
6. Kholi.P.L “Automotive Electrical Equipment”, Tata McGraw Hill Private Limited, New Delhi, 1983.
7. Robert Bosch “Automotive Hand Book”, SAE, 2011.
8. Ganesan.V. “Internal Combustion Engines”, Tata McGraw Hill Private Limited, New Delhi, 2004.
9. Vinal.G.W., “Storage Batteries”, John Wiley & Sons Inc., New York, 1985.
10. Spreadbury. F.G., “Electrical ignition Equipment”, Constable & Co. Ltd., London 1962.
11. Tom Weather Jr and Cland C. Hunter, “Automotive Computers and Control System”, Prentice Hall Private Limited, New Jersey, 1984.
12. Robert N Brady, “Automotive Computers and digital Instrumentation reston Book”, Prentice Hall, Eagle Wood Cliffs, New Jersy,1988.

**15EE26E EMBEDDED AND REAL TIME SYSTEMS L T P C**
**3 0 0 3**

**COURSE OUTCOMES**

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

CO1: Explain the fundamental concept and design of embedded system.(K2)
CO2: Explain the various platforms used for embedded computing and the performance of embedded systems design. (K2)
CO3: Describe real time system and its characteristics. (K2)
CO4:Explain the basic properties of a real time operating system.(K1)
CO5: interpret the services of operating system.(K1)

**UNIT I INTRODUCTION TO EMBEDDED COMPUTING 9**

Definition: Embedded system, Intelligent system, Expert System – Embedded system - classification – Embedded system design process – Instruction sets Preliminaries – ARM Processor – CPU: Programming input andoutput – Supervisor mode, exception and traps. Embedded System design Example.

**UNIT II COMPUTING PLATFORM AND DESIGN ANALYSIS 9**

I/O devices – Component interfacing –Memory mapped I/O – I/O mapped I/O – Development and Debugging – Program design –Model of programs – Basic compilation techniques – Assembly and Linking, Analysis and optimization of execution time, power, energy, program size – Program validation and testing.

**UNIT III REAL TIME SYSTEMS 9**

Definition: Real time and real time systems – real time system Model - real time system characteristics – High reliability achievement ways in real time system - Hardware considerations for real time system – Examples for real time system .

**UNIT IV PROCESS AND OPERATING SYSTEMS 9**

Definition: Multi taskingand multi processing – Context Switching – Operating Systems Scheduling policies: Rate monotonic, EDF, Comparison example – Inter Process Communication mechanisms – Message Mailboxes – Message Queues – Evaluating operating system performance.

**UNIT V TASK MANAGEMENT AND MEMORY MANAGEMENT WITH MICRO C II OS 9**

Introduction to MICRO C OS II: Features, Services and variants. Task Management: Task creation, task stacks, stack checking, task priority, task suspending, task deletion program example for Multitasking. Memory management: Creating partition in memory, memory control block, obtaining and returning memory control block functions program example for memory management implementation.

**L: 45 TOTAL: 45 PERIODS**

**TEXT BOOKS**

1. Wayne Wolf, “Computers as Components -Principles of Embedded Computer System Design”, Morgan Kaufmann, 2nd Edition, 2008.

2. Philip A. Laplante “Real time systems design and analysis”, Wiley India Edition, 3rd Edition, 2006.

**REFERENCES**

1. Jean J. Labrosse, “Micro C/OS-II: The Real Time Kernal”, CMP Books, 2nd Edition 2002.
2. David E-Simon, “An Embedded Software Primer”, Pearson Education, 2007.
3. K.V.K.K.Prasad, “Embedded Real-Time Systems: Concepts, Design & Programming”, Dreamtech Press, 2005.
4. Tim Wilmshurst, “An Introduction to the Design of Small Scale Embedded Systems”, Pal grave Publisher, 2004.
5. Sriram V Iyer, Pankaj Gupta, “Embedded Real Time Systems Programming”, Tata Mc-Graw Hill, 2004.
6. Tammy Noergaard, “Embedded Systems Architecture”, Elsevier, 2006.

# B. E. – ELECTRICAL AND ELECTRONICS ENGINEERING

ONE CREDIT ELECTIVE COURSES

**15EE01L COMPUTATIONAL FLUID DYNAMICS FOR ELECTRICAL APPARATUS** **L T P C 1 0 0 1**

**COURSE OUTCOMES**

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

CO1: describe the necessity and application of CFD.

CO2: explain the approximation of the physical problem.

**COURSE CONTENT**

Introduction to Computational Fluid Dynamics (CFD) - Necessity, Applications; Numerical Simulation Process - Approximate Solution Techniques - Mathematical Modeling, Navier-Stroke and Euler Equation - Solution of Navier Stroke Equation - Grid Generation - Finite Difference Method - Finite Volume Method - Finite Element Method.

**L: 15 TOTAL: 15 PERIODS**

**REFERENCES**

1. John D Anderson, “Computational Fluid Dynamics – The Basics with Applications”, Tata McGraw Hill, 2010.
2. T.J. Chung, “Computational Fluid Dynamics”, Cambridge University Press, London, 2010.
3. H.K. Versteeg and W. Malalasekara, “An Introduction to Computational Fluid Dynamics - The Finite Volume Method”, Pearson, 2nd Edition, 2008.
4. Jiyuan Tu, Guan Heng Yeoh and Chaoqun Liu, “Computational Fluid Dynamics: A Practical Approach”, Butterworth-Heinemann, 2007.

**15EE02L DESIGN OF POWER CONVERTERS LABORATORY** **L T P C 0 0 2 1**

**COURSE OUTCOME**

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

CO1: design and construct the various types of power converters

**LIST OF EXPERIMENTS**

1. Single phase controlled rectifiers.
2. Three phase controlled rectifiers.
3. Step-down and step-up dc choppers.
4. Buck/boost converters.
5. Single phase voltage source inverter.
6. Three phase voltage source inverter.
7. Ac voltage controllers.
8. Two stage sequence control of ac voltage controller.
9. Step up cycloconverter.
10. Step down Cycloconverter.

**P: 30 TOTAL: 30 PERIODS**

**15EE03L ENERGY STORAGE SYSTEM L T P C**
**1 0 0 1**

**COURSE OUTCOMES**

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

CO1: understand the operational mechanisms of each energy storage system

CO2: characterize and analyze electrochemical energy storages

**COURSE CONTENT**

Energy storage overview - Thermodynamics - Rechargeable Batteries and their Fundamental Electrochemistry - Li-ion Battery Technology and Challenges - Cathode and Anode Materials - Electrolytes - Fuel cell / regenerative fuel cell - Super-capacitor - Reaction kinetics - Electrochemical characterization - Introduction to Super Conducting Magnetic Energy Storage (SMES) operation - Load Leveling - Frequency Regulation - Power Quality - Applications.

**L: 15 TOTAL: 15 PERIODS**

**REFERENCES**

1. Robert A. Huggins, "Energy Storage", Springer Science and Business Media, 2010.
2. Ryan O'Hayre, Suk-Won Cha, Whitney Colella and Fritz B. Prinz, "Fuel Cell Fundamentals", Wiley, 3rd Edition, 2016.
3. A.G. Ter-Gazarian, "Energy Storage for Power Systems", 2nd Edition, IET Publications, 2011.

**15EE04L LVDC WIRING L T P C**
**1 0 0 1**

**COURSE OUTCOMES**

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

CO1: describe the fundamental knowledge in electrical engineering

CO2: prepare the details of estimation for residential and commercial electrical installations

**COURSE CONTENT**

Electrical symbols - DC Source (solar panel) - Voltage levels in DC supply - Types of storage device - DC Appliances : CFL, LED bulbs/TV, Vacuum cleaners, Computers, Mobile chargers, DC Ceiling fans(muffin fans), DC Refrigerators - DC wirings(PoE) - Switches and relays (solid state DC circuit breakers ) - DC sockets - Safety practices – Advantages.

**L: 15 TOTAL: 15 PERIODS**

**REFERENCES**


1. S.L. Uppal, “Electrical Estimating and costing”, New Age International Pvt. Ltd., 2014.
2. J.B. Gupta, “Electrical Installation estimating and costing”, S. K. Kataria and Sons, New Delhi, 15th edition 2016.
3. Relevant IS Code for - Service Line Connection, Lying of Cable, Wiring Installation, National Building Code - Vol. 4.
4. https://www.allaboutcircuits.com/textbook/direct-current/
5. http://hackaday.com/2017/03/06/what-voltage-for-the-all-dc-house/
6. http://www.edn.com/electronics-blogs/dave-s-power-trips/4402704/How-do-we-get-to-a-DC-powered-home
7. http://chrisgammell.com/can-dc-power-an-entire-home/
8. http://www.backwoodssolar.com/when-to-use-dc-appliances
9. http://www.treehugger.com/sustainable-product-design/big-steps-in-building-change-our-wiring-to-12-volt-dc.html


**15EE05L** **DIGITAL SUBSTATION** **L T P C**
**1 0 0 1**

**COURSE OUTCOMES**

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

CO1: describe the architecture of a digital substation

CO2: explain the importance of intelligent electronic devices

**COURSE CONTENT**

Introduction to digital substation - Power system automation - Modern grid and substation automation - System architecture - Components of digital substation - IEC 61850 substation architecture - Intelligent Electronic devices - GOOSE - Station and process bus - GPS time clock - Merging units - Electronic fibre optic CT and VT - Substation communication and protocols - Working of a digital substation - Security threats - Advantages of digital substation.

**L: 15 TOTAL: 15 PERIODS**

**REFERENCES**


1. Evelio Padilla, “Substation Automation Systems: Design and Implementation”, Wiley, 2015.
2. Cobus Strauss, “Practical Electrical Network Automation and Communication Systems”, Elsevier, 1st Edition, 2003.
3. http://myelectrical.com/notes/entryid/245/how-a-digital-substation-works
4. store.gedigitalenergy.com/faq/documents/general/iec61850.pdf

**15EE06L ELECTRICAL SYSTEM FOR SMART BUILDING L T P C**
**1 0 0 1**

**COURSE OUTCOMES**

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

CO1: understand the basic features of intelligent buildings

CO2: understand the operating principle and characteristics of various service Systems / technologies

**COURSE CONTENT**

Introduction to Intelligent Buildings - Basic Concepts - Intelligent Building Automation - Introduction to Smart Materials - HVAC (Heating, Ventilation And Air-Conditioning) Systems - Electrical Installations - Lighting Systems - Security and safety systems - Intelligent vertical transportation systems - Communication Systems - Structured cabling systems - Electrical Power Quality In Buildings - EMI/EMC Issues - Grounding Problems - Overview of Home/Building Automation - Case studies.

**L: 15 TOTAL: 15 PERIODS**

**REFERENCES**

1. Derek Clements and Croome, “Intelligent Building Design, Management and Operations”, Thomas Telford Publishing, London, 2004.
2. Derek Clements and Croome, “Intelligent Buildings: An Introduction”, Routledge, 2014
3. Shengwei Wang**,** “Intelligent Buildings and Building Automation”, Spon Press, London, 2010.
4. P. Manolescue, “Integrating Security into Intelligent Buildings”, Cheltenharn, 2003.
5. Albert Ting – Pat So and Wai Lok Chan, “Intelligent Building Systems”, Kluwer Academic Publisher, U.S.A, 1999.
6. C. Ehrlich, “Intelligent Building Dictionary: Terminology for Smart, Integrated, Green Building Design, Construction, and Management” San Francisco, Calif: Hands-on-Guide, 2007.
7. www.ieindia.org,www.koetterfire.com,www.informit.com

**15EE07L POWER SYSTEM PROTECTION AND SUBSTATION AUTOMATION L T P C**
**1 0 0 1**

**COURSE OUTCOMES**

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

CO1: describe the protection schemes of electrical apparatus

CO2: explain the structure of substation automation system

**COURSE CONTENT**

Introduction to power system protection - Protection of generators and motors - Protection of transformers and reactors - Protection of transmission lines - Circuit breaker protection and monitoring - Introduction to substation integration and automation system - Functional architecture - Substation automation: Distributed structure, Centralized structure - Substation integration and automation technical issues.

**L: 15 TOTAL: 15 PERIODS**

**REFERENCES**

1. Badri Ram and D. N.Vishwakarma, “Power System Protection and Switchgear”, Tata McGraw Hill, 2nd Edition, 2011.
2. Cobus Strauss, “Practical Electrical Network Automation and Communication Systems”, Elsevier, 1st Edition, 2003.
3. Evelio Padilla, “Substation Automation Systems: Design and Implementation”, Wiley, 2015.

| **15EE08L** | **RENEWABLE ENERGY LABORATORY** | **L T P C** |
|---|---|---|
| | | **0 0 2 1** |

**COURSE OUTCOME**

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

CO1: Design the renewable energy system for given application by collecting the field data.

**LIST OF EXPERIMENTS**

1. Design and estimation of solar radiation transmission through glazing materials in solar collector.
2. Design the solar photovoltaic systems and predict the array yield, final yield and performance ratio of the systems.
3. Design the battery backup system for domestic application by investigating the charging and discharging characteristics of battery.
4. Design the Anaerobic digester for organic waste generated from community buildings through research of literature.
5. Design the small scale wind energy systems for a location by collecting metrological data.
6. Design and investigate the performance of solar water heating system for the residential building.

**P: 30 TOTAL: 30 PERIODS**

**15EE09L** **HVDC CIRCUIT BREAKERS** **L T P C**
**1 0 0 1**

**COURSE OUTCOMES**

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

CO1: understand the modern trends used in HVDC circuit breakers

CO2: explain the characteristics of HVDC circuit breakers

**COURSE CONTENT**

Introduction to HVDC Circuit Breakers - Construction - Principle – Comparison between HVAC and HVDC Circuit Breakers - IGBT Based Switching - Switching Energy - Interruption of DC Current - Type of HVDC Circuit Breakers - Capability and Characteristics of HVDC Circuit Breaker - Requirements of HVDC Circuit Breakers – Applications, Advantages and Disadvantages of HVDC Circuit Breakers.

**L: 15 TOTAL: 15 PERIODS**

**REFERENCES**

1. K.R. Padiyar, “HVDC Power Transmission Systems”, New age international publications, 3rd Edition, 2017
2. P. Kundur, “P.S. Stability and Control”, Tata McGraw Hill, 1994
3. C.L. Wadhwa, “Electrical Power Systems”, New age International Pvt. Ltd., 6th Edition, 2010

**15EE10L** **EARTHING DESIGN** **L T P C**
**1 0 0 1**

**COURSE OUTCOMES**

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

CO1: describe the earthing system design

CO2: explain the various types of earthing in substations

**COURSE CONTENT**

Factors Influencing the Choice of Earthed and Unearthed Systems - System Earthing - Substation Earthing/Grounding - Power Frequency Earthing - High Frequency Earthing - Touch and Step Potential - Surge Phenomenon and Suppression Techniques - Earthing In Substations - Earthing Associated With Overhead Power Lines- Calculation of Earth Fault Currents - Measurement of Earth Resistivity, Electrode Resistance, Earth Loop Impedance.

**L: 15 TOTAL: 15 PERIODS**

**REFERENCES**

1. Institute of Electrical and Electronics Engineers, IEEE Guide for Safety in AC Substation Grounding, IEEE standard 80 – 2000.
2. Maneesh Kumar and Gagandeep Singh, “Design of Grounding System for an Electrical Substation: An Overview”, International Journal of Scientific & Engineering Research, Vol. 5, No. 11, pp. 246-248November 2014.

**15EE11L ELECTRICAL STRESS ANALYSIS L T P C**
**1 0 0 1**

**COURSE OUTCOMES**

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

CO1: apply the theoretical concepts of stress analysis for various electrical apparatus

CO2: prepare and solve model in FEA simulation software

**COURSE CONTENT**

Introduction to electrical stress analysis - Derivation of Basic Differential Equations - Stress Analysis on Resistor - Inductor - Capacitor - Diodes - Circuit Breaker - Op-amp, Potentiometer, Power Supply - Relay-Switch - Transistor - Bushing - Induction motor - Insulator - Transformer - Various Stress control techniques on electrical apparatus - Derating analysis - Factors affecting the component life - Failure mode analysis - Reliability prediction tools - Standards followed in different fields.

**L: 15 TOTAL: 15 PERIODS**

**REFERENCES**


1. Matthew N.O. Sadiku, “Numerical Techniques in Electromagnetics”, Second Edition, CRC Press - Taylor & Francis, 3rd Edition, 2009.
2. Nicola Bianchi, “Electrical Machine Analysis Using Finite Elements”, CRC Press - Taylor & Francis, 2005
3. Sheppard J. Salon, “Finite Element Analysis of Electrical Machines”, Springer, 1995.
4. Titu I. Bajenescu and Marius I. Bazu, “Component Reliability for Electronic Systems”, Artech House, 2009.
5. http://www.sre.org/pubs/Mil-Hdbk-338B.pdf
6. http://www.ipc.org/3.0_industry/3.5_councils_associations/3.5.0_ipc/spvc/0607/ipc-9592-final-draft-0407.pdf


**15EE12L ALTERNATE INSULATING MEDIUM L T P C**
**1 0 0 1**

**COURSE OUTCOMES**

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

CO1: identify the various insulating materials

CO2: explain the structure of fluoroketone based gas mixture

**COURSE CONTENT**

Introduction to Insulating Medium - Overview of Solid, Liquid, Gas And Vacuum medium - Performance and Environmental Issues of Existing Dielectric Medium - Global warming potential (GWP) - Need For Alternate Insulating Medium - $SF_6$ - Advantages And Disadvantages - Identification Of New Gases - A Fluoroketone Based Gas Mixture - Properties - Dielectric Performance - Thermal Performance - Long-Term Behavior - Life-Cycle Assessment (LCA) - Benefits - Future Grid Carbon Footprint - alternate esteroids.

**L: 15 TOTAL: 15 PERIODS**

**REFERENCES**

1. P. Simka and N. Ranjan, "Dielectric Strength of $C_5$ Perfluoroketone," in 19th International Symposium on High Voltage Engineering, Pilsen, Czech Republic, 2015.
2. J. C. Devins, "Replacement gases for $SF_6$," IEEE Transactions on Dielectric Electrical Insulation, Vol. 15, pp. 81– 86, 1980.
3. ABB review 2016 in AirPlus™
4. Maik Hyrenbach, Tobias Hintzen, Pascal Muller and John Owens, "Alternative insulation gas for medium-voltage switchgear", 23rd International Conference on Electricity Distribution Lyon, June 2015.
5. J.D. Mantilla, N. Gariboldi, S. Grob and M. Claessens, "Investigation of the Insulation Performance of a New Gas Mixture with Extremely Low GWP", IEEE Electrical Insulation Conference, pp. 469-473, 2014.

**15EE13L COMMUNICATION TECHNOLOGIES FOR SMART GRIDS L T P C**
**1 0 0 1**

**COURSE OUTCOMES**

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

CO1: explain the communication channels and protocols for smart grid

CO2: describe the standards of smart grid communication

**COURSE CONTENT**

Introduction - Data communication -Communication channels - Communication/networking architecture - Smart Grid architecture - Internet based architecture - Power Line Communication architecture - Wireless Communication technologies - IEEE 802 series - Other issues in communication/networking - Challenges and research directions.

**L: 15 TOTAL: 15 PERIODS**

**REFERENCES**

1. Janaka Ekanayake, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, and Nick Jenkins, "Smart Grid Technology and Applications", A John Wiley and Sons Ltd. Publication, 1st Edition, 2012.
2. James Momoh, "Smart Grid: Fundamentals of Design and Analysis", A John Wiley and Sons Ltd. Publication, 2012.
3. Jingcheng Gao, Wei Liang, Yang Xiao and C. L. Philip Chen, "A survey of communication/ networking in Smart Grids", Future Generation Computer Systems, Vol. 28, No. 2, pp. 391-404, February 2012.

**15EE14L NON-CONVENTIONAL INSTRUMENT TRANSFORMER L T P C**
**1 0 0 1**

**COURSE OUTCOMES**

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

CO1: describe the structure and operation of non conventional instrument transformer (NCIT)

CO2: explain the measurements in real time applications by non conventional instrument transformer (NCIT)

**COURSE CONTENT**

Introduction to NCIT - Need of NCIT - Comparison of conventional Instrumentation transformer and NCIT - NCIT structure - Extended Merging Unit - NCIT operation - Measurements: HV laboratory - real operation states - NCIT in gas insulated switchgear - Advantages of NCIT.

**L: 15 TOTAL: 15 PERIODS**

**REFERENCES**

1. ABB Product Guide: Difference between Sensors and conventional Instrument Transformers.
2. Non-conventional instrument transformers: Advanced GIS substations with IEC 61850-9-2 LE process bus.
3. IEEE PES ELK-CP 050602_R0-5.ppt : Non-Conventional Instrument Transformers.
4. Holger Heine, Patrice Guenther and Farel Becker, “New Non Conventional Instrument Transformer (NCIT) – A future technology in Gas Insulated Switch Gear”, IEEE Conference on Transmission and Distribution and Exposition (T&D), May 2016.
5. Jure Mocnik, Janez Huma and Andrej Zemva, “A non-conventional instrument transformer”, Measurement, Elsevier, Vol. 46, No. 10, pp. 4114-4120, December 2013.

**15EE15L INDUSTRIAL CONTROLLERS LABORATORY L T P C**
**0 0 2 1**

**COURSE OUTCOMES**

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

CO1: articulate the PLC programming for Industrial processes

CO2: implement the performance of controller in DDC and DCS

**LIST OF EXPERIMENTS**

1. Design of Electronic On/Off controller with relay concept
2. Implementation of On Off controller using NI DAQ
3. Micro-processor based temperature control system

4. Batch process control by Programmable Logic Controller
5. PLC controlled level process
6. Reaction vessel control using Programmable Logic Controller
7. Traffic light control Using Programmable Logic Controller
8. Bottle filling system controlled by Programmable Logic Controller
9. Computer controlled Closed loop response of Temperature process
10. Computer controlled Closed loop response of pressure process
11. Monitor and Control of Temperature Process using SCADA with PLC
12. Implementation of Controller for Pressure and Temperature process in Distributed Control system
13. Automation of the Cement Plant, Sugar and Beverage Plant using Distributed Control system

**P: 30 TOTAL: 30 PERIODS**

| **15EE16L** | **SOFT COMPUTING FOR ELECTRICAL ENGINEERING LABORATORY** | **L T P C**<br>**0 0 2 1** |
|---|---|---|

**COURSE OUTCOMES**

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

CO1: implement various structures of ANN to system identification and control of linear and nonlinear systems

CO2: develop program with fuzzy relationship to control electrical drives

CO3: employ GA to power system optimization and control problems

**LIST OF EXPERIMENTS**

1. Implement Discrete Hopfield Network and Test for Input Pattern.
2. Implement Adaline with Bipolar Inputs and Outputs
3. Implement Back Propagation Network for a Given Input Pattern.
4. Implement Composition of Fuzzy and Crisp Relations.
5. Perform max-min composition of two matrices obtained from cartesian product.
6. System identification using neural network
7. Controlling linear and nonlinear dynamic systems using neural network
8. Short term load forecasting using neural network
9. Implement the fuzzy logic controller for motor drives
10. Economic dispatch problem using GA
11. Load scheduling problem using GA
12. Unit commitment problem using GA
13. PID controller tuning using GA
14. System identification using GA

**P: 30 TOTAL: 30 PERIODS**

**15EE17L ELECTRONICS FOR SAFETY CRITICAL SYSTEM L T P C**
**1 0 0 1**

**COURSE OUTCOMES**

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

CO1: describe the standards of safety critical system

CO2: explain the development of electronics and software tools with respect to safety critical system

**COURSE CONTENT**

Introduction to safety critical system - Need for safety critical systems - Integrity level and standard for safety critical system - Specification and Design - Verification - Commercial and Industrial Standards for Electrical Appliances - Grounding Techniques in Electrical / Electronics, ESD Protection, Need of Redundancy in Critical Applications to Avoid Risks - Single point failures- Elimination of Hazard / Risk Analysis - Basics of Reliability Analysis - Fault tree analysis - Failure mode effective analysis.

**L: 15 TOTAL: 15 PERIODS**

**REFERENCES**

1. An Introduction to Safety Critical Systems, www.qa-systems.com
2. G.R. Nisha, “A model driven approach for design and development of a safety critical system”, IEEE 2011 3rd International Conference on Electronics Computer Technology (ICECT) - Kanyakumari, India, 2011.
3. Ashok N. Srivastava and Johann Schumann, “Software Health Management: A Necessity for Safety Critical Systems”, Journal of Innovations in Systems and Software Engineering, Vol. 9, No. 4, pp. 219-233, 2013.
4. MIL STD 217 / 217 Plus, MIL STD 1629, for Reliability and FMEA / FMECA.

.

**15EE18L PCB DESIGN AND FABRICATION L T P C**
**0 0 2 1**

**COURSE OUTCOMES**

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

CO1: design and analyze the Printed Circuit Boards fabrication

CO2: develop the Printed Circuit Boards and discuss the factors affecting PCB performance

**COURSE CONTENT**

Introduction to PCB design - Basics of hardware and software - Types of PCB, terminologies, PCB Layers - Different tools and software used for PCB designing - Different circuit on PCB design software - Creating a new project Building parts and

symbols - Schematic of Different circuits - Creating multi-sheet flat designs - PCB layout and 3D Imaging - Introduction to Proteus and OrCAD Capture - Placement of components and Routing - Assigning reference designators - Design Rules checking - Adding inter sheet signal references - PCB stackup preparation-Characteristics impedance calculation-Signal Integrity analysis - Creating a Bill of Materials and Print layout - Gerber generation - PCB fabrication methods - Soldering Methods.

**P: 30 TOTAL: 30 PERIODS**

**REFERENCES**

1. Charles Hamilton, “A Guide to Printed Circuit Board Design” Elsevier, 2013.
2. Kraig Mitzner, “Complete PCB Design Using OrCAD Capture and PCB Editor” Newnes Publications, 2009.
3. Christopher T. Robertson, “Printed Circuit Board Designer's Reference” Prentice Hall Professional, 2004.
4. Eric Bogatin, “Signal integrity analysis simplified”, Prentice Hall Modern Semiconductor Design Series, 2012.
5. http://www.ece.ucsb.edu/Faculty/Johnson/ECE189/Mentor2007/
6. http://read.pudn.com/downloads120/ebook/509920/High-speed%20Digital%20Design%20-%20Johnson%20&%20Graham.pdf

**15EE19L** **EMBEDDED SYSTEM LABORATORY** **L T P C**
**0 0 2 1**

## COURSE OUTCOMES

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

CO1: interface GPIO, Timer, and ADC with external peripherals along with interrupt concept.

CO2: utilize serial communication protocols like UART, SPI and $I^2C$

**LIST OF EXPERIMENTS**

1. Program to interface on chip GPIO with external LED’s and switches
2. Program to control three different DC motors with different timings using delay routines and OnChip timers separately and compare both
3. Program to interface an Analog sensor with processor through OnChip ADC and display the measurement at external LCD.
4. Program to establish serial communication between two $I^2C$ compatible boards
5. Program to establish serial communication between two UART compatible boards
6. Program to establish serial communication between two SPI compatible boards

**P: 30 TOTAL: 30 PERIODS**

**15EE20L TECHNO COMMERCIAL PROJECT PROPOSAL L T P C**
**1 0 0 1**

**COURSE OUTCOMES**

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

CO1: determine the technical feasibility and financial viability of the project

CO2: assess the risk associated with the project and enumerate imminent actions that are required to be taken

**COURSE CONTENT**

Introduction - Gathering Background Information - Components of a Proposal - Executive Summary - Statement of Need - Project Description - Methods - Staffing/Administration - Evaluation - Sustainability - Budget - Support and Revenue Statement - Budget Narrative - Organizational Information and Conclusion - Case studies.

**L: 15 TOTAL: 15 PERIODS**

**REFERENCES**

1. Jane C. Geever, "The Foundation Center's Guide to Proposal Writing", New York: The Foundation Center, 6th Edition, 2012.
2. Ellen Karsh and Arlen Sue Fox, "The Only Grant-Writing Book You'll Ever Need", Basic Books, 4th Edition, 2014.
3. http://grantspace.org/

**15EE21L VIRTUAL INSTRUMENTATION L T P C**
**1 0 0 1**

**COURSE OUTCOMES**

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

CO1: design of electronic circuits using Virtual Instrumentation

CO2: develop the fundamental program for monitoring and control of process variable.

**COURSE CONTENT**

Concepts of Analog IO, Digital IO, Power supply, Counters, timers and PWM-Generation of signal using ELVIS **-** Design of RLC resonance circuit-Verification of logic gates- Design and implementation of adder and subtractor circuit **-** VI characteristics of Diode **-** VI characteristics of transistor amplifier-Analysis of Half wave rectifier with and without filter-Study of temperature measurement using ELVIS **-** Monitoring the displacement using LVDT-Vibration measurement using LVDT **-**Time response analysis of first order and second order process **-** Design of PID controller using ELVIS

**L: 15 TOTAL: 15 PERIODS**

**REFERENCES**

1. Rick Bitter, Taqi Mohiuddin ,Matt Nawrocki “Labview Advanced Programming Techniques” CRC press ,2 nd Edition ,2007
2. Gary Johnson, “LABVIEW Graphical Programming”, 2ndEdition, McGraw Hill, 2009.
3. S. Gupta, J.P. Gupta, “PC Interfacing for Data Acquisition and Process Control”, ISA, 2ndEdition, 2010.
4. Skolkoff, “Basic concepts of LABVIEW 4”, PHI, 1998

**15EE22L ELECTRICAL POWER CAPACITORS L T P C**
**1 0 0 1**

**COURSE OUTCOMES**

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

CO1: explain the general concepts and building blocks of capacitors. (K2)
CO2: summarize the various applications of capacitors. (K2)

**COURSE CONTENT**

Introduction: Capacitance – Basics of dielectric Materials – Dielectric Constant – Loss Angle – General Conceptions of Gaseous, Liquid and Solid Dielectrics – IS Standards – Solid Dielectrics, Composite Dielectrics, Electrolytes. Building Blocks of Capacitors: Condenser Tissue Paper – Polypropylene and Polyester Film – Aluminium Foil - Materials for Others Components – Discharge Resistors: Safety Consideration and Design – Housing of Capacitors – Impregnating Liquids – Manufacture of Paper and Plastic Film Capacitor. Application of Capacitors: DC and Energy Storage Capacitors –Series Capacitors for Power Quality Improvement –Harmonic Filters –Surge Protection Capacitors –Capacitors Voltage Transformers – Coupling Capacitors – Future capacitors.

**L: 15 TOTAL: 15 PERIODS**

**REFERENCES**

1. D.M.Tagore, “Electrical Power Capacitors – Design and Manufacturing”, Tata Mc-Graw Hill Publishing Company Ltd., 2002.
2. R.P. Deshpande, “Capacitors – Technology and Trends”, Tata Mc-Graw Hill Publishing Company Ltd., 2012.
3. T.Longland,T.W. Hunt and W.A.Brecknell, “Power Capacitors Handbook”, Butterworths Publishers, 1984.
4. Ramasamy Natarajan, “Power System Capacitors”, CRC Press, 2005.
5. R.E. Marbury, “Power Capacitors”, Tata Mc-Graw Hill Publishing Company Ltd., 1949.

**15EE23L INTERNET OF THINGS AND EMBEDDED SYSTEMS L T P C**
**1 0 0 1**

**COURSE OUTCOMES**

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

CO1: Explain the fundamentals of IoT and its applications.

CO2: Develop simple applications using ARM processor and IoT.

**COURSE CONTENT**

Introduction – History of IoT - Characteristic of IoT – Machine to Machine communication – Web of Things – IoT protocols – IoT Vs M2M – Architecture of IoT - Connecting IoT to cloud – Cloud Storage for IoT – Data Analytics for IoT. ARM Based Embedded System Design: Overview of IoT supported Hardware platform–ARM Cortex Processor – Programming —Various Real time applications of IoT and ARM Processor – Generating different patterns on LED's – Sensor interfacing - Smart Traffic system.

**L: 15 TOTAL: 15 PERIODS**

**REFERENCES**

1. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press, 2017.
2. Jonathan W. Valvano, "Embedded Systems and introduction to ARM cortex – M microcontrollers" 5th Edition, CreateSpace Independent Publishing Platform, 2012.
3. Arshdeep Bahga and Vijay Madisetti, "Internet of Things: A Hands-on Approach", Universities Press, 2014.
4. Dr.Yifeng Zhu, "Embedded systems with ARM cortex - M microcontrollers in assembly language and C". 2nd Edition, Man Press, 2015.

**15EE24L HIGH VOLTAGE TESTING TECHNIQUES L T P C**
**0 0 2 1**

**COURSE OUTCOMES**

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

CO1: perform the high voltage testing in insulating materials.

CO2: predict the behavior of different insulating material used in high voltage equipment.

**LIST OF EXPERIMENTS**

1. Study of high voltage testing objectives, classification, standards and specifications, correction factors.
2. Measurement of AC, DC and impulse breakdown voltage of insulating material
3. Partial discharge measurement with φ-q-n pattern
4. Measurement of flash over voltage for dry and wet 11kV outdoor insulator
5. Measurement of soil resistivity

6. Measurement of 50% critical impulse flashover voltages on the 11 kV insulator for positive / negative voltages.
7. Measurement of dielectric characteristics (Insulation Resistance, Absorption Index and Polarization Index) of insulating material
8. Investigate the effect of pollution severity on critical flashover voltage of 11 kV insulator.
9. Analyse the effect of dry band location of 11 kV insulator on electric field distribution using ANSYS.
10. Study on measurement of Radio interference voltage
11. Statistical Evaluation of Measured Results of breakdown phenomenon
    i) Direct determination of probability values on disruptive discharge voltage
    ii) Determination of the distribution function of a measured quantity
    iii) Determination of the confidence limits of the mean value of the breakdown discharge voltage
    iv) Determination of breakdown discharge voltages for given probability ranges
12. Study of multi stress ageing and life time analysis for different insulating medium

**P: 30 TOTAL: 30 PERIODS**

| 15EE25L | QUALITY PRACTICES FOR SAFETY CRITICAL INSTRUMENTATION SYSTEM | L T P C 1 0 0 1 |
|---|---|---|

**COURSE OUTCOMES**

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

CO1: To expose the students to requirement of standards and calibration techniques, safety and reliability mechanisms used in process industries.

CO2: To impart knowledge about EMI and EMC problems in industrial measurements.

CO3: To make the students to draw the specification of the industrial instruments and prepare the instrumentation project documents.

## Course Content:

Standards and Calibration: Introduction to standards and calibration of measuring instruments. Guidelines of enclosure design.

EMI and EMC: Introduction, interference coupling mechanism, basics of circuit layout and grounding, concepts of interfaces, filtering and shielding. co-axial & twisted pair cable; electronic grounding.

Safety: Introduction, electrical hazards, hazardous areas and classification, non-hazardous areas, enclosures-NEMA types, fuses and circuit breakers. Protection methods: Purging, explosion proofing and intrinsic safety.

Reliability: Bathtub curve; reliability for series parallel systems, Mean Time To Failure (MTTF), Mean Time To Repair (MTTR), Mean Time Between Failures (MTBF); availability, redundancy and stand by.

Specifications: Specification of instruments, preparation of project documentation, process flow sheet, instrument index sheet, instrument specifications sheet, panel drawing and specifications, instrument specifications. Project procedure, schedules, vendor drawing, tender documentation, selection of measurement method and control panels.

Reference Books:

1. Noltingk B.E., Instrumentation Reference Book, Butterworth Heinemann, 2nd Edition, 1995.

2. Liptak B.G, Process Measurement and Analysis, Chilton Book Company, Radnor, Pennsylvania, 4th Edition, 2003.

3. Andrew W.G, Applied Instrumentation in Process Industries – A survey, Vol I &Vol II, Gulf Publishing Company, Houston, 2001

4. Patranabis D., Principles of Industrial Instrumentation, Tata McGraw Hill Publishing Company Ltd, 3rd edition, 2010.

5. Lawrence D. Goettsche, Maintenance of Instruments and Systems, International society of automation, 2nd Edition, 2005.

6. Henry W.Ott, Electromagnetic Compatibility Engineering, A John Wiley & Sons, INC., Publication, 2009.

# B. E. – ELECTRICAL AND ELECTRONICS ENGINEERING

OPEN ELECTIVE COURSES

## Open Elective Course (OEC)

**Group - I** (Inter-disciplinary courses)

| 15ID01E | PRODUCT DESIGN AND DEVELOPMENT | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**COURSE OUTCOMES**

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

- CO1: analyze various global trends and identify the scope of a new product (K4)
- CO2: perform requirement analysis and convert the requirements into design specification (K4)
- CO3: translate conceptual idea into detailed design (K6)
- CO4: create prototype to demonstrate the product (K6)
- CO5: perform sustenance engineering to improve the longevity of the product(K6)

**UNIT I FUNDAMENTALS OF PRODUCT DEVELOPMENT 9**

Global Trends Analysis and Product decision: Types of various trends affecting product decision - Social Trends-Technical Trends- Economical Trends- Environmental Trends- Political/ Policy Trends- PESTLE Analysis.

Introduction to Product Development Methodologies and Management: Overview of Products and Services- Types of Product Development- Overview of Product Development methodologies - Product Life Cycle and PLM - Product Development Planning and Management .

**UNIT II REQUIREMENTS AND SYSTEM DESIGN 9**

Requirement Engineering: Types of Requirements- Requirement Engineering- Analysis -Traceability Matrix and Analysis- Requirement Management

System Design and Modeling: Introduction to System Modeling- Introduction to System Optimization- System Specification-Sub-System Design- Interface Design.

**UNIT III DESIGN AND TESTING 9**

Conceptualization - Industrial Design and User Interface Design - Introduction to Concept generation Techniques - Concept Screening and Evaluation - Concept Design - S/W Architecture - Hardware Schematics and simulation

Detailed Design: Component Design and Verification - High Level Design/Low Level Design of S/W Programs - S/W Testing-Hardware Schematic - Component design - Layout and Hardware Testing.

**UNIT IV IMPLEMENTATION AND INTEGRATION 9**

Prototyping: Types of Prototypes -Introduction to Rapid Prototyping and Rapid Manufacturing.

System Integration- Testing- Certification and Documentation: Introduction to Manufacturing/Purchase and Assembly of Systems- Integration of Mechanical, Embedded and S/W systems- Introduction to Product verification and validation processes - Product Testing standards, Certification and Documentation.

**UNIT V SUSTENANCE ENGINEERING AND BUSINESS DYNAMICS 9**

Sustenance - Maintenance and Repair - Enhancements

Product End of Life (EoL): Obsolescence Management-Configuration Management - EoL Disposal.

The Industry - Engineering Services Industry overview - Product development in Industry versus Academia

The IPD Essentials - Introduction to vertical specific product development processes - Product development Trade-offs - Intellectual Property Rights and Confidentiality- Security and configuration management

**L:45; TOTAL:45 PERIODS**

**TEXT BOOKS**

1. Anita Goyal, Karl T Ulrich, Steven D Eppinger, "Product Design and Development ", Tata McGraw-Hill Education, 4th Edition, 2009, ISBN-10-007-14679-9.
2. George E Dieter, Linda C Schmidt, "Engineering Design", McGraw-Hill International Edition,4th Edition, 2009, ISBN 978-007-127189-9

**REFERENCES**

1. Kevin Otto, Kristin Wood, "Product Design", Indian Reprint 2004, Pearson Education, ISBN 9788177588217
2. Yousef Haik, Shahin T M M, "Engineering Design Process", Cengage Learning,2nd Edition Reprint, 2010, ISBN 0495668141
3. Clive L Dym, Patrick Little, "Engineering Design: A Project-based Introduction", John Wiley & Sons, 3rd Edition, 2009, ISBN 978-0-470-22596-7
4. Kevin Otto & Kristin Wood, "Product Design Techniques in Reverse Engineering and New Product Development", Pearson Education (LPE), 2001.
5. James R Evens, William M Lindsay "The Management and control of Quality" Pub:son south-western(www.swlearning.com), 6th edition.
6. AmitavaMitra, "Fundamentals of Quality control and improvement" Pearson Education Asia, 2nd edition, 2002.
7. Montgomery D C, "Design and Analysis of experiments", John Wiley and Sons, 2003.
8. Phillip J Rose, "Taguchi techniques for quality engineering", McGraw Hill, 1996.
9. Reddy G B, "Intellectual Property Rights and the Law", Gogia Law Agency, 7th Edition Reprint, 2009.
10. Subbaram N R, "Demystifying Intellectual Property Rights", Lexisexis Butterworths Wadhwa, 1st Edition, 2009.

**15ID02E DISASTER MANAGEMENT L T P C**

**3 0 0 3**

**COURSE OUTCOMES**

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

CO1: classify the various types of disaster. (K2)

CO2: interpret various natural and manmade disasters. (K2)

CO3: choose a Hazard Assessment procedure. (K3)

CO4: construct the protection measures against Disaster. (K3)

CO5: apply Science and Technology in Disaster Management. (K3)

**UNIT I INTRODUCTION TO DISASTER 8**

Hazard, risk, vulnerability, disaster significance, nature, importance, dimensions and scope of disaster management - national disaster management frame work- financial arrangements- disaster- management cycle**.**

**UNIT II SOURCES OF DISASTER 10**

Natural disasters- significance, nature, types and effects - floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, heat and cold waves, climatic change - global warming - sea level rise - ozone depletion. Manmade disasters- nuclear , chemical, biological, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste water pollution, road accidents, rail accidents, air accidents and sea accidents.

**UNIT III DISASTER MITIGATION AND HAZARDS ASSESMENT 10**

Factors affecting damage – types, social status, habitation pattern, physiology and climate - Factors affecting mitigation measures - prediction – preparation - communication - area and accessibility - population - physiology and climate - Vulnerability Assessment and seismic strengthening of buildings - Vulnerability Assessment of Buildings procedure - Hazard Assessment-Visual Inspection and Study of Available Documents

**UNIT IV DISASTER MANAGEMENT 9**

Disaster management - efforts to mitigate natural disasters at national and global levels - international strategy for disaster reduction- Rescue ,relief And Rehabilitation, Role Of National And International Agencies In Disaster Management-National Disaster Policy Of India (Salient Features).

**UNIT V APPLICATIONS OF SCIENCE AND TECHNOLOGY AND CASE STUDIES 8**

Applications of Science and Technology (RS, GIS, GPS) - Early Warning And Prediction Systems- Earthquake, cyclone, landslides, fire accidents, accidents- case studies

**L: 45; TOTAL: 45 PERIODS**

**TEXTBOOKS**

1. S.K.Singh, S.C. Kundu, Shobha Singh A ,"Disaster management", William Publications, New Delhi, 1997.
2. Vinod K Sharma, "Disaster Management", IIPA, New Delhi, 1995

**REFERENCE**

1. Annual Report, 2009-10,Ministry of Home Affairs, GOI

| **15ID03E** | **ENERGY ENGINEERING** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| | | **3** | **0** | **0** | **3** |

**COURSE OUTCOMES**

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

CO1: explain the operation of Solar Thermal application and Solar Photovoltaic. (K2)

CO2: explain the operation of wind energy systems. (K2)

CO3: describe the concepts of various Bio-Energy Conversion techniques. (K2)
CO4: illustrate the concepts of other conventional and nonconventional power plants. (K2)
**CO5:** explain the concepts of hydrogen and fuel cell technology. (K2)

**UNIT I INTRODUCTION TO SOLAR ENERGY 9**

Sun - Earth Geometry, solar radiation, Solar Collectors - Application of solar thermal systems. Direct Electricity Conversion - Types of Solar cell - Solar Photovoltaic system and types.

**UNIT II WIND ENERGY 9**

Wind energy potential, Principle of wind energy conversion; Basic components, types and their constructional features; design considerations: wind data and site selection.

**UNIT III BIO-ENERGY 9**

Biomass: sources, characterization, principles of energy transfer technologies. Biogas: Feedstock, types of Biogas plant- parameters affecting biogas production.

**UNIT IV OTHER POWER PLANTS 9**

Layout of Hydel - thermal - Nuclear - Gas turbine - Diesel - MHD- Geo thermal - OTEC - Tidal Power Plants.

**UNIT V HYDROGEN AND FUEL CELLS 9**

Energy carrier: Types - Hydrogen: generation, storage, transport and utilization - thermal energy storage: Principle and utilization - Fuel cells: Technologies, types and applications.

**L:45; TOTAL:45 PERIODS**

**TEXT BOOKS**

1. Soteris Kalogirou, “Solar Energy Engineering: Processes and Systems”, Academic Press, 2014.
2. Godfrey Boyle, “Renewable Energy, Power for a Sustainable Future”, Oxford University Press, U.K, 3rd Edition, 2012.

**REFERENCES**

1. Mukund R Patel, “Wind and Solar Power Systems”, CRC Press, 2nd Edition, 2006.
2. Hart A B and Womack, G J, “Fuel Cells: Theory & Applications”,Prentice Hall, 1997.
3. EI-Wakil M M,“Power Plant Technology”, Tata McGraw-Hill, 2010.
4. Khandelwal K C and Mahdi S S, “Biogas Technology” - A Practical Handbook, Tata McGraw Hill, 1986.
5. Duffie J A and Beckman W A, “Solar Engineering of Thermal Processes”, Wiley, 4th Edition, 2013.
6. Chetan Singh Solanki, “Solar Photovoltaics Fundamentals, Technologies and Applications”, Prentice Hall of India, 3rd Edition, 2015.

**Group - II** (Trans disciplinary courses)

**15TD01E** **INDIAN BUSINESS LAWS** **L T P C**
**0 0 0 3**

**COURSE OUTCOMES**

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

CO 1: explain the elements of a valid contract.

CO 2: discuss main provisions relating to Sale of Goods Act and Negotiable Instruments Act.

CO 3: explain provisions relating to incorporation and functioning of company and partnership firm.

CO 4: understand the fundamentals of Consumer Protection Act and Foreign Exchange Management Act.

CO 5: understand the basic knowledge of Information Technology Act and RTI Act.

**UNIT I THE INDIAN CONTRACT ACT, 1872**

Definition of a Contract and its essentials - Formation of a valid Contract - Offer and Acceptance, Consideration - Capacity to Contract - Free consent - Legality of object - Discharge of a Contract by performance - Impossibility and Frustration - Breach, Damages for breach of a contract - Quasi contracts - Special Contracts - Contract of Indemnity and Guarantee - Contract of Bailment and Pledge - Contract of Agency.

**UNIT II THE SALE OF GOODS ACT, 1930**

Definition of a Contract of Sale - Conditions and Warranties - Passing of Property - Right of Unpaid Seller against the Goods - Remedies for Breach - The Negotiable Instrument Act, 1881

Definition and characteristics - Kinds of negotiable instruments - Promissory Note - Bill of Exchange and Cheques - Holder and Holder in due course - Negotiation, Presentment, Discharge from Liability - Noting and Protest – Presumption - Crossing of Cheques - Bouncing of Cheques.

**UNIT III THE COMPANIES ACT, 1956**

Nature and Definition of a Company - Registration and Incorporation - Memorandum of Association - Articles of Association – Prospectus - Kinds of Companies - Directors: Their powers and duties – Meetings - Winding up - The Indian Partnership Act, 1932 - Definition of Partnership and its essentials - Rights and Duties of Partners: Types of Partners - Minor as a partner - Doctrine of Implied Authority - Registration of Firms - Dissolution of firms - Limited Liability Partnership Act, 2000.

**UNIT IV THE CONSUMER PROTECTION ACT, 1986**

Aims and Objects of the Act - Redressal Machinery and Procedure for complaints under the Act – Remedies – Appeals - Enforcement of orders and Penalties - Foreign Exchange Management Act 2000 - Definition and Main Provisions.

**UNIT V THE INFORMATION TECHNOLOGY ACT**

Definition, Digital Signature - Electronic Governance – Attribution - Acknowledgment and Dispatch of Electronic Records - Sense Electronic Records and Sense Digital Signatures - Regulation of Certifying Authorities Digital Signature Certificates - Duties of Subscribers - Penalties and Offences - The Right to Information Act, 2005 - Right to know - Salient Features of the Act - Obligation of Public Authority - Designation of Public Information Officer - Request for obtaining information - Duties of a PIO - Exemption from Disclosure of Information - Partial Disclosure of Information - Information Commissions - Powers of Information Commissions - Appellate Authorities – Penalties - Jurisdiction of Courts.

**TEXT BOOKS**

1. Kuchhal M.C, "Business and Industrial Laws", 3rd Edition, JBA Publishers, New Delhi, 2013.
2. Gulshan S.S, "Merchantile Law", 3rd Edition, JBA Publishers, New Delhi, 2007.

**REFERENCES**

1. Mulla D.F, "The Sale of Goods Act and the Indian Partnership Act", 10th Edition, LexisNexis Ltd., India, 2012.
2. Dabas J, "Negotiable Instruments Act", 2nd Edition, JBA Publishers, New Delhi, 2013.
3. Avtar S, "The Principles of Mercantile Law", 9th Edition, Eastern Book Company, India, 2011.

**15TD02E LEADERSHIP AND PERSONALITY DEVELOPMENT L T P C**
**0 0 0 3**

**COURSE OUTCOMES**

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

CO 1: identify the various leadership skills.
CO 2: understand group dynamics and factors influencing the team performance.
CO 3: describe the personality dimensions based on personality theories.
CO 4: explain personality determinants and personality types.
CO 5: apply effective training program for personality development.

**UNIT I INTRODUCTION**

Leadership – Meaning, Concepts and Myths about Leadership, Components of Leadership- Leader, Followers and Situations - Leadership Skills – Basic Leadership Skills - Building Technical Competency - Advanced Leadership Skills - Team Building for Work Teams - Building High Performance Teams.

**UNIT II TEAMS AND LEADERSHIP**

Assessing Leadership & Measuring Its Effects - Group- Nature, Size, Roles, Norms, Cohesion, and Stages of Group Development - Teams and their Leadership – Effective Team Characteristics and Team Building - Ginnetts Team Effectiveness Leadership Model.

**UNIT III PERSONALITY**

Personality - Meaning, Concept, Personality Patterns, Symbols of Self, Moulding the Personality Pattern, Persistence & Change - Personality & Personal Effectiveness - Psychometric Theories – Cattele and Big Five - Psychodynamic Theories - Carl Jung and MBTI - Transactional Analysi - Johari – Window - Personal Effectiveness.

**UNIT IV PERSONALITY DETERMINANTS**

Personality Determinants – Heredity and Environment – Types of personality.

**UNIT V PERSONALITY TRAINING**

Concept, Role, Need, Importance and types of personality Training - Understanding Process of Learning - Developing an Integrated Approach of Learning in Training Programme - Training Needs Assessment.

**TEXT BOOKS**

1. Yukl G, “Leadership in Organisations”, 8th Edition, Pearson Education Ltd., England, 2013.
2. Lall M, Sharma S, “Personal Growth Training & Development”, Kindle Edition, USA, 2009.

**REFERENCES**

1. Janakiraman B, “Training and Development”, Wiley Dream tech, Biztantra, 2005.
2. Pareek U, “Understanding Organizational Behaviour”, 2nd Edition, Oxford University Press, USA, 2007.

**15TD03E INTERNATIONAL BUSINESS MANAGEMENT L T P C**
**0 0 0 3**

**COURSE OUTCOMES**

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

CO 1: understand the global business environment.
CO 2: explain the impact of economic, legal, cultural, geographical and political factors on international business.
CO 3: discuss the issues and problems of Multinational Enterprises.
CO 4: discuss the role of various international financial institutions.
CO 5: discuss about important aspects of WTO and GATT agreement.

**UNIT I INTERNATIONAL BUSINESS ENVIRONMENT**

International Business Environment - Globalization - Forces, Meaning, Dimensions and Stages in Globalization - Trading Environment of International Trade - Tariff and Non-tariff Barriers - Trade Blocks.

**UNIT II RISK ANALYSIS AND PRACTICES**

Country Risk Analysis - Political, Social and Economic - Cultural and Ethical practices - Responsibilities of International Business - Economic crisis in foreign countries.

**UNIT III MULTINATIONAL ENTERPRISES**

Managing Multinational Enterprises - Problems and Potential - Multinational Service Organizations - Indian companies becoming multinationals - Potential, Need and Problems.

**UNIT IV INTERNATIONAL FINANCIAL MANAGEMENT**

Introduction to International Financial Management - Balance of Trade and Balance of Payment - International Monetary Fund, Asian Development Bank and World Bank - Financial Markets and Instruments - Introduction to Export and Import Finance - Methods of Payment in International Trade.

**UNIT V INTERNATAIONAL AGREEMENT**

General Agreement on Trade and Tariffs, (GATT) - World Trade Organization - Seattle and Doha Round of Talks - Dispute Settlement Mechanism under WTO - Problems of Patent Laws - International Convention on Competitiveness - Global Sourcing and its Impact on Indian Industry - Globalization and Internal Reform Process.

**TEXT BOOKS**

1. Bhalla V.K, Shivaramu S, "International Business Environment", 9th Edition, Anmol Publications Pvt. Ltd., Delhi, 2005.
2. Apte P.G, "International Financial Management", 5th Edition, Tata McGraw Hill, India, 2008.
3. Cherulinam F, "International Business", 5th Edition, Prentice Hall of India, New Delhi, 2010.

**REFERENCES**

1. Rao, Rangachari, "International Business", Himalaya Publishing House, New Delhi, 2010.
2. Hill C, "International Business", 10th Edition, Tata McGraw Hill Education, New Delhi, 2014.
3. Daniels J.D, "International Business Environment", 15th Edition, Prentice Hall of India, New Delhi, 2014.

**15TD04E BASICS OF MARKETING L T P C**
**0 0 0 3**

**COURSE OUTCOMES**

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

CO 1: describe the basic concepts of marketing.
CO 2: discuss the significance of consumer behavior and market segmentation.
CO 3: discuss brand, trade mark, after- sales service and product life cycle concepts.

CO 4: formulate strategies for pricing and channels of distribution.
CO 5: analyze and selection of best promotional technique.

**UNIT I INTRODUCTION**

Nature and Scope of Marketing - Importance of Marketing – Concepts: Traditional and Modern - Selling Vs. Marketing - Marketing Mix - Marketing Environment.

**UNIT II CONSUMER BEHAVIOR AND MARKET SEGMENTATION**

Nature, Scope and Significance of Consumer Behavior - Market Segmentation - Concept and Importance - Bases for Market Segmentation.

**UNIT III PRODUCT PLANNING**

Concept of Product - Consumer and Industrial Goods - Product Planning and Development - Packaging - Role and Functions - Brand Name and Trade Mark - After-Sales Service - Product Life Cycle Concept.

**UNIT IV PRICING AND PHYSICAL DISTRIBUTION**

Price - Importance of Price in the Marketing Mix - Factors Affecting Price of a Product/Service - Discounts and Rebates - Distribution Channels - Concept and Role - Types of Distribution Channels - Factors Affecting Choice of a Distribution Channel - Retailer and Wholesaler - Distributions Channels and Physical Distribution.

**UNIT V PROMOTION**

Definition - Methods of Promotion - Optimum Promotion Mix - Advertising Media - Their Relative Merits and Limitations - Characteristics of an Effective Advertisement - Personal Selling - Selling as a Career - Classification of a Successful Sales Person - Functions of Salesman.

**TEXT BOOKS**

1. Etzel M.J, Walker B.J, Stanton W.J, “Fundamentals of Marketing”, 13th Edition, McGraw Hill, New York, 2004.
2. Tanner J, Raymond M, “Principles of Marketing”, University of Minnesota Libraries Publishing, New York, 2015.

**REFERENCES**

1. Rajan Nair N, Varma M.M, “Marketing Management”, 2nd Edition, S.Chand & Sons, New Delhi, 2005.
2. Ramaswamy V.S, Namakumari S, “Marketing Management", 3rd Edition, Macmillan India Limited, London, 2002.

**15TD05E RETAILING AND DISTRIBUTION MANAGEMENT L T P C**
**0 0 0 3**

**COURSE OUTCOMES**

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

CO 1: explain the concepts of retailing and distribution management.
CO 2: analyze and solve retailers' problems to make decisions in retail organizations.
CO 3: plan and formulate strategy for retail management process.
CO 4: discuss about various distribution technology and stores management.
CO 5: analyze the issues and challenges in Logistic Management

**UNIT I INTRODUCTION**

Meaning and Nature of Distribution and Retail Industry - Future of Retailing and Distribution in India - Distribution Channels – Concept, Role and Types - Factors Affecting Choice of Distribution Channel.

**UNIT II TYPES OF RETAILING**

Stores Classified by Owners - Stores Classified by Merchandising Categories - Wheel Of Retailing - Traditional Retail Formats Vs. Modern Retail Formats in India - Store and Non-Store Based Formats - Cash and Carry Business - Retailing Models – Franchiser Franchisee, Directly Owned - Wheel of Retailing and Retailing Life Cycle – Issues in Retailing.

**UNIT III MANAGEMENT OF RETAILING OPERATIONS**

Meaning - Functions of Retail Management - Strategic Retail Management Process - Retail Planning - Importance and Process - Developing Retailing Strategies.

**UNIT IV TECHNOLOGY IN DISTRIBUTION**

Bar-Coding – RFID – Electronic Payment Systems - Store Administration - Floor Space Management – Managing Store Inventories and Display Action Plans - Pricing Strategies and Location Strategies.

**UNIT V LOGISTICS OF RETAIL MANAGEMENT**

Components and Functions; Distribution Related Issues and Challenges - Gaining Competitive Advantage through Logistics Management.

**TEXT BOOKS**

1. Agrawal D. K., “Distribution & Logistics Management: A Strategic Marketing Approach”, Macmillan Publishers India Limited, New Delhi, 2007.
2. Berman B, Evans J.R, “Retail Management – A Strategic approach”, 12th Edition, Pearson Education Ltd., England, 2013.
3. Cox R, Brittan P, “Retailing an introduction, Financial Times Management”, 5th Edition, Pearson Education Limited, England, 2004.

**REFERENCES**

1. Rushton A, Croucher P, Baker P, “The Handbook of Logistics & Distribution Management”, Kogan Page Limited, London, 2006.

2. Coughlan A.T, Anderson E, Stern L.W, El-Ansary A.I, "Marketing Channels", 7th Edition, Prentice Hall, New Jersey, 2006.
3. Sinha P. K, Uniyal D.P, "Managing Retailing", Oxford University Press, India, 2007.

**15TD06E** **INTERNATIONAL ECONOMICS** **L T P C**
**0 0 0 3**

**COURSE OUTCOMES**

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

CO 1: discuss the impact of globalization.
CO 2: identify and analyze different theoretical models of international economics in light of 'real world' situations.
CO 3: examine the consequences of trade policies.
CO 4: explain the importance of international financial markets.
CO 5: discuss the important aspects of international banking.

**UNIT I INTRODUCTION**

Background of International Business Economics - Globalization and International Business – The Emergence of Global Institutions – Drivers of Globalizations - The Globalization Debate.

**UNIT II THE INTERNATIONAL TRADE THEORY**

The Law of Comparative Advantage – The Demand and Supply, Offer Curves - The Terms of Trade – Factor Endowments and the Heckscher – Ohlin Theory – Implications of Trade Theories - Economics of Scale - Imperfect Competition.

**UNIT III INTERNATIONAL TRADE POLICY**

Trade Restrictions - Tariffs, Non –Tariff Trade Barriers - Tariff Vs. Quota - The New Protectionism – Economic Integration - Custom Unions and Free Trade Areas - Major Regional Trade Agreements - Foreign Exchange Market – Types of Foreign Exchange Transactions – Reading Foreign Exchange Quotations – Forward and Futures Market – Foreign - Currency Options – Exchange Rate Determination – Arbitrage – Speculation and Exchange - Market Stability.

**UNIT IV WORLD FINANCIAL ENVIRONMENT**

Global Foreign Exchange Markets – Economic Theories of Exchange - Rate Determination - International Regime for FDI and MNC - Consequences of Economic Globalization.

**UNIT V INTERNATIONAL BANKING**

Reserves, Debt and Risk - Nature of International Reserves – Demand for International Reserves – Supply of International Reserves – Gold Exchange Standard – Special Drawing Rights – International Lending Risk – The Problem of International Debt – Financial Crisis and The International Monetary Fund – Eurocurrency Market.

**TEXT BOOKS**

1. Krugman P.R, Obstfeld M, "International Economics Theory and Policy", 8th Edition, Prentice Hall, Boston, 2008.
2. Carbaugh R.J, "International Economics", 15th Edition, South Western College publication, USA, 2014.

**REFERENCES**

1. Daniels J, Radebaugh L, Sullivan D, Salwan P, "International Business", 12th Edition, Pearson Education, New Delhi, 2010.
2. Suranovic S, "International Economics: Theory and Policy", Flat World Knowledge, USA, 2010.

**15TD07E** **INDIAN ECONOMY** **L T P C**
**0 0 0 3**

**COURSE OUTCOMES**

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

CO 1: discuss the current economic development in India
CO 2: describe the key indicators of estimation of national income
CO 3: explain elementary concepts of economic planning and development in India
CO 4: discuss the concept of public finance and preparation of budget
CO 5: discuss the influence of infrastructure growth on economic development

**UNIT I ECONOMIC DEVELOPMENT**

Meaning - Measurement of Economic Development - Characteristic of underdeveloped and developed economies - Causes for Indian economic underdevelopment - Major issues in development - Strategies for economic development Import substitution and Export oriented strategies - Determinants of economic development.

**UNIT II NATIONAL INCOME**

The National Income and its estimates in India - Limitations of National income estimation - Trends in National income of India: Growth and Structure - Inter-state variations in National income - Income distribution - Measurement of poverty in India.

**UNIT III ECONOMIC PLANNING**

Planning and economic development in India - Planning models in India (Elementary concepts) - Capital formation - Growth of Public and Private sector in India – Industrial policies an assessment - Capital formation and domestic saving.

**UNIT IV INDIAN PUBLIC FINANCE**

Budgetary policies of the central government - Composition and trends in public revenue and expenditure - Expenditure control and government consumption expenditure - concepts of Budgetary deficits and implications - state budget.

**UNIT V INFRASTRUCTURE AND ECONOMIC DEVELOPMENT**

Power and energy - Transport system in India's economic development - Communication system in India - Urban infrastructure - Science and technology - Private investment in infrastructure - Outlook and prospects.

**TEXT BOOKS**

1. Dutt R, Sundaram K.P.M, "Indian Economy", S.Chand and Co., New Delhi, 2006.
2. Agarwal A.N, Agarwal M.K, "Indian Economy: Problems of Development and Planning", 41st Edition, New Age International Ltd., New Delhi, 2016.

**REFERENCES**

1. Arvind P, "India:The Emerging Giant", Oxford University Press, USA, 2008.
2. Government of India, Economic Survey, (2010 -11 to 2014 -15).

**15TD08E RURAL ECONOMICS L T P C**

**0 0 0 3**

**COURSE OUTCOMES**

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

CO 1: discuss the role and importance of agriculture in economic development of India.

CO 2: describe the impact of agricultural forming in rural employment, wage policy, technological change and green revolution.

CO 3: analyze the relationship between rural and urban society.

CO 4: recognize the formation and system of rural social institutions.

CO 5: compare the social changes in the rural society after modernization and globalization.

**UNIT I INTRODUCTION**

Nature and Scope of Rural Economy - Importance of Agriculture in Economic Development of India - Nature of Land Problems - Evolution of Policy – Land Tenure System - Land Reform Measures.

**UNIT II AGRICULTURE AND FARMING**

Agricultural Holdings - Fragmentation and Sub-Division of Holdings, Cooperative Farming- Rural Labour Problems - Nature of Rural Unemployment - Employment and Wage Policy - Sources of Technological Change and Green Revolution.

**UNIT III RURAL SOCIETY**

Rural Society Structure and Change - Village and its Social Organization - Indian Village and its Types - Rural-Urban Continuum and Rural-Urban Relationships.

**UNIT IV RURAL SOCIAL INSTITUTIONS**

Rural Social Institutions - Family, Property, Caste, Class, Agrarian Structure - Indebtedness and Poverty - Jajmani System - Religion, Village, Panchayat Raj and Community Development Programmes – Problems.

**UNIT V SOCIAL CHANGES**

Social Change in Rural India-Impact of Westernization - Secularization, Urbanisation, Industrialisation, Migration, Transportation, Modernization of Indian Rural Society - Post Modernization and Globalization and Indian Villages.

**TEXT BOOKS**

1. Carver T.N, "The Principles of Rural Economics", Ginn and company, USA, 1911.
2. Desai A.R, "Rural Sociology in India", 5th Edition, Popular Prakashan Ltd., Mumbai, 2011.

**REFERENCES**

1. Dube S.C., "India's changing villages", Psychology Press, UK, 2003.
2. Datt R, Sundharam K.P.M, Datt G, Mahajan A, "Indian Economy", 72nd Edition, S.Chand & Co., New Delhi, 2016.
3. Chaudhari, C.M., "Rural Economics", Sublime Publication, Jaipur, 2009.

**15TD09E INTERNATIONAL TRADE L T P C**
**0 0 0 3**

**COURSE OUTCOMES**

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

CO 1: discuss the importance of international trade in developing countries.
CO 2: describe the impact of Trade agreements in international Business environment.
CO 3: explain the role of foreign exchange and their impact on trade and investment flows.
CO 4: discuss the benefits of Multinational Corporation in Internal Trade
CO 5: analyze the key role of globalisation in Indian economy.

**UNIT I INTRODUCTION**

International Marketing - Trends in International Trade - Reasons - Global Sourcing and Production Sharing - International Orientations - Internationalization Stages and Orientations - Growing Economic Power of Developing Countries – International Business Decision.

**UNIT II INTERNATIONAL BUSINESS ENVIRONMENT**

Trading Environment - Commodity Agreements – State Trading - Trading Blocks and Growing Intra-Regional Trade - Regional Groupings – SAARC, BRICS, ECM, ASEAN - Trade Liberalization - The Uruguay Round-Evaluation – UNCTAD – GATT – WTO.

**UNIT III INTERNATIONAL FINANCIAL ENVIRONMENT**

International Money and Capital Markets - Foreign Investment Flows – Pattern, Structure and Effects - Movements in Foreign Exchange and Interest Rates and their Impact on Trade and Investment Flows - Exchange Rate Mechanism and Arrangement.

**UNIT IV MULTINATIONAL CORPORATIONS**

Definition - Organizational Structures - Dominance of MNC's - Recent Trends - Code of Conduct - Multinationals in India - Issue in Investment, Technology Transfer, Pricing and Regulations - International Collaborations and Strategic Alliances

**UNIT V INDIA IN THE GLOBAL SETTING**

India an Emerging Market - India in the Global Trade - Liberalization and Integration with Global Economy - Factors Favouring and Resisting Globalization - Trade Policy and Regulation in India - Trade Strategies - Export-Import Policy - Regulation and Promotion of Foreign Trade in India.

**TEXT BOOKS**

1. Daniels J.D, Radebaugh L.H, Sullivan D.P, "International Business: Environment and Operations", 12th Edition, Prentice Hall, USA, 2009.
2. Ricky W.G, Michael W.P, "International Business: A Managerial Perspective", Prentice Hall, USA, 2009.

**REFERENCES**

1. Bhattacharya B, Varshney R.L, "International Marketing Management", 25th Revised Edition, S. Chand & Sons, New Delhi, 2015.
2. Verma M.L, "International Trade", Common wealth Publisher, New Delhi, 2010.

**15TD10E GLOBAL CHALLENGES AND ISSUES L T P C**
**0 0 0 3**

**COURSE OUTCOMES**

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

CO 1: understand the various global issues.
CO 2: demonstrate a reasonable understanding of environmental debates and issues.
CO 3: explain the developmental issues relating to food, health and energy.
CO 4: demonstrate the economical issues in international trade.
CO 5: describe the civilization issues relating to human rights and social justice.

**UNIT I SECURITY ISSUES**

Nuclear Issues - Global and South Asian Context - Small Weapons Proliferation and Internal Arms Race - Chemical and Biological Weapons – Terrorism - Causes, Consequences And Trends - Cyber Terrorism – Counter Terrorism.

**UNIT II ENVIRONMENTAL ISSUES**

Global Warming and Climate Change - Threats to Bio-Sphere and Space - Pollutions, De-Forestation, Solid, Chemical and Nuclear Wastes and their Management - Preserving the Green Cover and Wild Life.

**UNIT III DEVELOPMENTAL ISSUES**

Food Security - Poverty and Hunger - Energy Security - Supply and Demand - Traditional and Alternative Sources of Energy – ITER - Health Security – Health for all - Development Vs. Environment - Sustainable Development.

**UNIT IV ECONOMIC ISSUES ON INTERNATIONAL TRADE**

International Trade - GATT, WTO - Regional Associations - ECM, ASEAN, OPEC, BRICS - Financial Crisis - ASEAN, Mexico and Greece - Global Issues in Trade and Commerce.

**UNIT V CIVILIZATION ISSUES**

Human Rights - Issues Relating to Freedom of Speech and Expression - Right to Self Determination - Preservation of Cultures and Cultural Diversities - Rights of Women and Children - Dividends of Globalization and Social Justice – Good Governance.

**TEXT BOOKS**

1. Payne R, "Global Issues", 4th Edition, Pearson Education Ltd., New York, 2013.
2. Owens P, Baylis J, Smith S, "The Globalization of World Politics", 3rd Edition, Oxford University Press, USA, 2013.

**REFERENCE**

1. Chirco J.A, "Globalization: Prospects and Problems", Sage Publications, New Delhi, 2013.

**15TD11E INDIAN CULTURE AND HERITAGE L T P C**
**0 0 0 3**

**COURSE OUTCOMES**

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

CO1: describe Indian culture, civilization and its features.
CO2: demonstrate stone age, Indian races and their contribution in pre-historic culture.
CO3: explain historical development of Indian culture.
CO4: explain the significance, conditions and development of Vedic culture.
CO5: analyze the advent of Islam and European culture.

**UNIT I INTRODUCTION**

Introduction to Culture - Meaning and Scope - Culture and Civilization - General Characteristics Features of Indian Culture - Geographical Impact on Indian Culture.

**UNIT II PRE-HISTORIC CULTURE**

Dravidian Culture - Old Stone Age - New Stone Age - Metal Age - Indian Races and their Contribution to Indian Culture.

**UNIT III HISTORICAL DEVELOPMENT OF INDIAN CULTURE**

Indus Valley Culture - City Planning - Social and Religious Conditions - Vedic and Later Vedic Cultures - Dharmasastras and Caste Systems - Comparison of Indus and Vedic

Culture - Importance of Indus Valley and Vedic Cultures.

**UNIT IV CULTURE IN SANGAM AGE AND POST SANGAM AGE**

Sangam Literature - Society - Political and Economical Conditions - Trade - Religion and Fine Arts.

**UNIT V ADVENT OF ISLAM AND EUROPEAN CULTURE**

Impact on Indian Culture and Heritage – Reform Movements - Brahma Samaj, Ariya Samaj, Self Respect Movement – Post Colonial Development.

**TEXT BOOKS**

1. Luniya B.N, “Evolution of Indian Culture”, Lakshmi Narain Agarwal Publishers, Agra, 1986.
2. Jeyapalan N, “History of Indian culture”, Atlantic publishers, New Delhi, 2001.
3. Sharma H.C, “Indian Culture and Heritage”, Neha Publishers & Distributors, New Delhi, 2012.

**REFERENCES**

1. John G.A, “Dictionary of Indian Philosophy (Sanskrit-English)”, University of Madras, Madras, 1998.
2. Misra R.S, “Studies in philosophy and Religion”, Bharathiya Vidya Prakasans, Varanasi, 1991.
3. Misra S.K, “Culture and Rationality”, Sage publications India Pvt. Ltd., New Delhi, 1988.
4. Suda J.P, “Religious in India”, Sterling Publishers Pvt. Ltd., New Delhi, 1978.

**15TD12E INDIAN HISTORY L T P C**
**0 0 0 3**

**COURSE OUTCOMES**

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

CO1: illustrate the basics of Indian cultural heritage.
CO2: describe interaction between Ancient Indian cultural heritage and Islamic culture.
CO3: demonstrate Innovation by rulers of medieval period in the area of Administration, and their contact with the Europeans.
CO4: analyse modern Indian movements, Economic history and Impact of the British rule on India.
CO5: demonstrate the concepts of Indian National Movement and the history of freedom struggle in India.

**UNIT I ANCIENTY INDIAN CULTURE**

Ancient Indian Cultural Heritage - Social, Political, Legal and in the Area of Religion and Philosophy.

**UNIT II LAW RELATING TO CULTURE**

Law Givers and Dispute Resolution Systems in Ancient India (Administration of Justice in Ancient India - Pre-Islamic Period) - Law Relating to Culture - The Advent of Islam - Interaction between Ancient Indian Cultural Heritage and Islamic Culture - The Emergence of Synthetic Indian Culture.

**UNIT III ADMINISTRATION IN ANCIENT INDIA**

Innovation by Rulers of Medieval Period in the Area of General and Revenue Administration - District Administration - Court Systems - Indian Contact with the Europeans.

**UNIT IV SOCIO-ECONOMIC HISTORY**

Socio-Religious Reform Movements in Modern India and its Legal Culture - Economic History of India During British Period - Impact of the British Rule on India – Education.

**UNIT V EUROPEAN CULTURE IMPACT**

Impact of European Culture and Liberal Thought on India – The Indian National Movement - The History of Freedom Struggle in India upto 1947.

**TEXT BOOKS**

1. Sreenivasa M.H.V, “History of India Part I and II”, JBA Publishers, New Delhi, 2015.
2. Agarwal R.C, Bhatnagar M, “Constitutional Development and National Movement of India”, S. Chand Publishers, New Delhi, 2005.

**REFERENCES**

1. Altekar S, “State and Government in Ancient India”, Motilal Banarsidass Publishers, New Delhi, 2002.
2. Majumdur R.C, “History and Culture of the Indian People”, Vol. 2, The Age of Imperial Unity, Bharatiya Vidya Bhavan, New Delhi, 2001

**15TD13E SUSTAINABLE DEVELOPMENT AND PRACTICES L T P C**
**0 0 0 3**

**COURSE OUTCOMES**

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

CO 1: recognize the sustainable development and the way to achieve the sustainable development.
CO 2: outline the concept, factors governing the sustainability and their linkages.
CO 3: explain the environmental impact assessment and environmental audit.
CO 4: describe the environmental planning and managing the resources.
CO 5: acquire the knowledge about the environmental problems and their solutions.

**UNIT I SUSTAINABLE DEVELOPMENT**

Need for Sustainability - Nine Ways to Achieve Sustainability - Economics as the Dismal Science - Population, Resources and Environment.

**UNIT II CHALLENGES OF SUSTAINABLE DEVELOPMENT**

Concept of Sustainability - Factors Governing Sustainable Development - Linkages among Sustainable Development, Determinants of Sustainable Development - Case Studies on Sustainable Development.

**UNIT III ENVIRONMENT IMPACT ASSESSMENT AND AUDIT**

Concepts-process-evaluation methodology-EIA and EMS integration-setting up of audit programme - typical audit process - carrying out the audit-benefits of environmental auditing-environmental audit programmes in India.

**UNIT IV ENVIRONMENTAL PLANNING**

Introduction - Perspective of Environmental Planning - land resource development planning - Planning and managing the natural resources - landscape ecological planning - information and decision of environmental planning - Land use policy in India.

**UNIT V ENVIRONMENTAL EDUCATION**

Knowledge about the environment - Knowledge about the environment and population growth -Knowledge about the solution and environmental problems - Environmental education (EE) – Strategies for EE – Models for future Environmental Education Systems.

**TEXT BOOKS**

1. Rogers P, Jalal K.F, Boyd J.A, “An Introduction to Sustainable Development”, Earth scan Publications Ltd., UK, 2006.
2. Santra S.C,” Environmental Science”, 3rd Edition, New Central Book Agency (P) Ltd., London, 2013.

**REFERENCES**

1. Stavins R.N. “Economics of the Environment: Selected Readings”, 5th Edition, W.W. Norton and Company, New York, 2005.
2. Sachs J.D, “The Age of Sustainable Development”, Columbia University Press, New York, 2015.

**15TD14E WOMEN IN INDIAN SOCIETY L T P C**

**0 0 0 3**

**COURSE OUTCOMES**

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

CO1: Demonstrate historical perspective about women in Indian society.
CO2: Explain social problems of women.
CO3: Understand the legislation for women protection in India.
CO4: Demonstrate the involvement of women literacy, career and politics.
CO5: Analyse the role of NGO’s in women empowerment.

**UNIT I INTRODUCTION**

A Historical Perspective - Early Vedic, Colonial and Modern Periods - Position of Women in Contemporary India.

**UNIT II SOCIAL ISSUES**

Issues of Girl Child - Female Infanticide and Foeticide, Sex Ratio, Child Marriage, Dowry and Property Rights - Women's Health and Birth Control - Reproduction - Violence against Women - Domestic Violence - Female Headed Households - Women in the Unorganized Sector of Employment - Women's Work- Status and Problems - Problems of Dalit Women.

**UNIT III PROTECTIVE LEGISLATION FOR WOMEN**

Protective Legislation for Women in the Indian Constitution - Anti Dowry, SITA, PNDT, And Prevention Sexual Harassment At Workplace (Visaka Case) - Domestic Violence (Prevention) Act.

**UNIT IV WOMEN AND EDUCATION**

Formal and Non-Formal Literacy - Post Literacy - Vocational Training - Dual Career Modernization – Women and Politics - Political Status - Global Movements and Indian Movements.

**UNIT V ROLE OF NGO'S IN WOMEN EMPOWERMENT**

Gender Economy - All India Women's Conference (AIWC) – Women's India Association (WIA) - National Council of Women in India (NCWIE) - Indian Association of Women's Studies – Women Development Cells - Self Help Groups.

**TEXT BOOKS**

1. Majumdar M, "Social Status of Women in India", Wisdom Press, New Delhi, 2012.
2. Harish R, Harishankar V.B, "Re-Defining Feminisms", Rawat Publications, Jaipur, 2011.

**REFERENCES**

1. Rathod P.B, "An Introduction to Women's Studies", ABD Publishers, Jaipur, 2010.
2. Ray R, "Hand Book of Gender", Oxford University Press, New Delhi, 2012.

**15TD15E INDIAN CONSTITUTION L T P C**
**0 0 0 3**

**COURSE OUTCOMES**

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

CO1: describe the basic understanding of the Indian Constitution.
CO2: understand the structure and functions of parliament.
CO3: demonstrate the organization and working of the Judiciary.
CO4: understand the structure and functions of state legislature.
CO5: understand the 73$^{rd}$ and 74$^{th}$ Constitutional Amendments.

**UNIT I INDIAN CONSTITUTION**

Salient Features - Preamble - Fundamental Rights – Directive Principles of State Policy - Fundamental Duties.

**UNIT II PARLIAMENTARY SYSTEM**

Powers and Functions of President and Prime Minister - Council of Ministers - The Legislature Structure and Functions of Lok Sabha and Rajya Sabha – Speaker.

**UNIT III THE JUDICIARY**

Organisation and Composition of Judiciary - Powers and Functions of the Supreme Court - Judicial Review – High Courts.

**UNIT IV STATE GOVERNMENTS**

Powers and Functions of Governor and Chief Minister – Council of Ministers - State Legislature.

**UNIT V LOCAL GOVERNMENTS**

73rd and 74th Constitutional Amendments – Federalism - Center – State Relations.

**TEXT BOOKS**

1. Basu D.D," Introduction to Indian Constitution", Prentice Hall of India, New Delhi, 2015.
2. Gupta D.C, "Indian Government and Politics", Vikas Publishing House, New Delhi, 2010.

**REFERENCES**

1. Pylee M.V, "Introduction to the Constitution of India", Vikas Publishing House, NewDelhi, 2011.
2. Kashyap S, "Our Constitution", National Book Trust, New Delhi, 2010.

**15TD16E BIO MECHANICS IN SPORTS L T P C**
**0 0 0 3**

**COURSE OUTCOMES**

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

CO1**:** discuss the basics of biomechanics in sports & movement technique accurately.
CO2**:** discuss the basics of linear kinematics and its applications in the field of sports.
CO3: demonstrate the linear kinematics in the field of sports.
CO4**:** discuss the basics of angular kinematics and its applications in the field of sports.
CO5: demonstrate the angular kinematics in the field of sports.

**UNIT I INTRODUCTION**

Meaning, Aim and Objectives, Importance of Biomechanics in Sports - Types of Motion Linear, Angular, Curvilinear and Circular Motion.

**UNIT II LINEAR KINEMATICS**

Speed, Velocity, Acceleration, Motion, Projectile Motion – Application of Linear Kinematics in The Field of Physical Education and Sports.

**UNIT III ANGULAR KINEMATICS**

Angular Speed - Angular Velocity - Angular Acceleration - Relationship between Linear and Angular Motion – Application of Angular Kinematics in the Field of Physical Education and Sports.

**UNIT IV LINEAR KINETICS**

Mass, Weight, Force, Pressure, Work, Power, Energy, Impulse, Momentum, Impact, Friction, Newton's Law of Motion - Law of Inertia and Types of Inertia.

**UNIT V ANGULAR KINETICS**

Levers, Equilibrium and Centre of Gravity – Friction and its Types, Centrifugal and Centripetal Force Bio Mechanical Principles Involved in Designing Sports Equipments.

**TEXT BOOKS**

1. Singh S.K, "Biomechanics in Sports", Neha Publishers & Distributors, New Delhi, 2009.
2. McGinnis P.M, "Biomechanics of Sports and Exercise", 2nd Edition, Human Kinetics Publishers, USA, 2004.

**REFERENCES**

1. Saxena A, "Biomechanics in Sports", Neha Publishers & Distributors, New Delhi, 2011.
2. Heyward V.H, Gibson A.L, "Advanced Fitness Assessment and Exercise Prescription", 7th Edition, Human Kinetics, USA, 2014.