Dr. MAHALINGAM COLLEGE OF ENGINEERING AND TECHNOLOGY

Enlightening Technical Minds

An Autonomous Institution Since 2011.
Approved by AICTE / Affiliated to Anna University.
Accredited by NAAC with 'A++' Grade.
Tier-1* - Accredited by NBA.
Part of NIA Educational Institution

# Curriculum and Syllabi

## B.E. Electronics and Instrumentation Engineering

## Semesters I to VIII

## Regulations 2019

(2021 Batch Onwards)

# Dr. Mahalingam College of Engineering and Technology
# Department of Electronics and Instrumentation Engineering

## Vision

To develop globally competent instrumentation engineers and entrepreneurs with societal, environmental and human values.

## Mission

- **Supportive Learning Environment**: Provide suitable learning environment to the graduates with innovative learning resources and adequate infrastructure.
- **Engineering Skills:** Enhance electronic, instrumentation and automation skills of the engineering graduates to fulfil the industrial requirements.
- **Sustainable and Eco-Friendly**: Create awareness among the graduates for sustainable, eco-friendly products and safety standards.
- **Ethical and Professional Responsibi**lity: Enrich continuous learning, communicative, collaborative and administrative skills of the engineering graduates to become ethical, social responsible engineers and entrepreneurs

## Programme: B.E. Electronics and Instrumentation Engineering

**Programme Educational Objectives (PEOs) - Regulations 2019**

B.E. Electronics and Instrumentation Engineering graduates will:

**PEO1.** Technical Knowledge Actively apply technical and professional skills in engineering practices towards the progress of the organization in competitive and dynamic environment.

**PEO2.** Higher studies and Research own their professional and personal development by continuous learning and apply the learning at work to create new knowledge

**PEO3.** Professional and Ethical knowledge conduct themselves in a responsible, professional and ethical manner supporting sustainable economic development which enhances the quality of life.

**Programme Outcomes (POs) - Regulations 2019**

On successful completion of B.E. Electronics and Instrumentation Engineering programme, graduating students/graduates will be able to:

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

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

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

**PO4. Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions for complex problems.

**PO5. Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

**PO6. The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

**PO7. Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

**PO8. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

**PO9. Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multi-disciplinary settings

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

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

**PO12. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

**Programme Specific Outcomes (PSOs) - Regulations 2019**

On successful completion of B.E. Electronics and Instrumentation Engineering programme, graduating students/graduates will be able to:

**PSO1. Instrument Analysis:** Analyze and monitor the characteristics of electronic measuring instruments to ensure performance, safety and quality of the processes

**PSO2. Controller Selection:** Select the suitable instruments, control schemes and controllers as per the requirements.

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**Programme: B.E Electronics and Instrumentation Engineering**
**2019 Regulations (2021 batch onwards)**
**Curriculum for Semesters I to VIII**

| Course Code | Course Title | Duration | Credits | Marks |
|---|---|---|---|---|
| 19SHMG6101 | Induction Program | 3 Weeks | - | 100 |

**Semester I**

| Course Code | Course Title | Hours/Week L | T | P | Credits | Marks | Common to Programmes |
|---|---|---|---|---|---|---|---|
| 19MABC1101 | Matrices and Calculus | 3 | 1 | 0 | 4 | 100 | AU,CE,EC, EE,EI,ME |
| 19ENHG2101 | Communication Skills – I | 2 | 0 | 2 | 3 | 100 | All |
| 19CHBC2001 | Chemistry for Electrical Sciences | 3 | 0 | 2 | 4 | 100 | EC,EE &EI |
| 19EISN2101 | Fundamentals of Instrumentation Engineering | 3 | 0 | 2 | 4 | 100 | - |
| 19MESC2001 | Introduction to Engineering | 2 | 0 | 2 | 3 | 100 | AU,EC,EE,EI, ME,CE |
| 19PSHG6001 | Wellness for Students | 0 | 0 | 2 | 1 | 100 | All |
| **Total** | | **13** | **1** | **10** | **19** | **600** | |

**Semester II**

| Course Code | Course Title | Hours/Week L | T | P | Credits | Marks | Common to Programmes |
|---|---|---|---|---|---|---|---|
| 19ENHG2201 | Communication Skills - II | 2 | 0 | 2 | 3 | 100 | All |
| 19MABC1201 | Ordinary Differential Equations and Complex Variables | 3 | 1 | 0 | 4 | 100 | AU,CE,EC,EE, EI,ME |
| 19PHBC2001 | Physics for Electrical Sciences | 3 | 0 | 2 | 4 | 100 | EC,EE,EI |
| 19EISN1201 | Electric Circuit Analysis | 3 | 1 | 0 | 4 | 100 | - |
| 19CSSC2001 | C Programming | 3 | 0 | 2 | 4 | 100 | AU,CE,EC,EE EI,ME |
| 19MESC4001 | Engineering Drawing | 1 | 0 | 3 | 2.5 | 100 | AU,ME,EC,EI, CS,IT,AD,SC |
| 19CHMG6201 | Environmental Sciences | 1 | 0 | 0 | - | 100 | All |
| 19PSHG6003 | தமிழர்மரபு / Heritage of Tamils** | 1 | 0 | 0 | 1 | 100 | All |
| **Total** | | **17** | **2** | **9** | **22.5** | **800** | |

** Applicable only for 2022 Batch

**Semester III**

| Course Code | Course Title | Hours/Week | | | Credits | Marks | Common to Programmes |
|---|---|---|---|---|---|---|---|
| | | L | T | P | | | |
| 19MABC1302 | Numerical Methods and Linear Algebra | 3 | 1 | 0 | 4 | 100 | EC,EE,EI |
| 19EICN1301 | Electron Devices and Circuits | 3 | 0 | 0 | 3 | 100 | - |
| 19EICN1302 | Electrical Machines and Measurements | 3 | 0 | 0 | 3 | 100 | - |
| 19EECC2301 | Digital Electronics | 3 | 0 | 2 | 4 | 100 | EE,EI |
| 19EICN2301 | Sensors and Transducers | 3 | 0 | 2 | 4 | 100 | - |
| 19EICN3301 | Electron Devices and Circuits Laboratory | 0 | 0 | 3 | 1.5 | 100 | - |
| 19EICN3302 | Electrical Machines and Measurements Laboratory | 0 | 0 | 3 | 1.5 | 100 | - |
| XXXXXXXXX | One Credit Course | 0 | 0 | 2 | 1 | 100 | - |
| 19PSHG6004 | தமிழரும்தொழில்நுட்பமும் / Tamils and Technology** | 2 | 0 | 0 | 1 | 100 | All |
| **Total** | | **17** | **1** | **12** | **23** | **900** | |

**Semester IV**

| Course Code | Course Title | Hours/Week | | | Credits | Marks | Common to Programmes |
|---|---|---|---|---|---|---|---|
| | | L | T | P | | | |
| 19MABG1401 | Probability and Statistics | 3 | 1 | 0 | 4 | 100 | All |
| 19EICN1401 | Linear Integrated Circuits | 3 | 0 | 0 | 3 | 100 | - |
| 19EICN1402 | Signals and Systems | 3 | 1 | 0 | 4 | 100 | - |
| 19EICN2401 | Industrial Instrumentation | 3 | 0 | 2 | 4 | 100 | - |
| 19CSSC2401 | Data Structures and Algorithms | 2 | 0 | 2 | 3 | 100 | EE,EI |
| 19EICN3401 | Signal Conditioning Laboratory | 0 | 0 | 4 | 2 | 100 | - |
| XXXXXXXXX | One Credit Course | 0 | 0 | 2 | 1 | 100 | - |
| 19PSHG6002 | Universal Human Values-2: Understanding Harmony | 2 | 1 | 0 | 3 | 100 | All |
| 19EIPN6401 | Mini-Project | 0 | 0 | 4 | 2 | 100 | - |
| **Total** | | **16** | **3** | **14** | **26** | **900** | **-** |

| Course Code | Course Title | Duration | Credits | Marks |
|---|---|---|---|---|
| XXXXX | Internship or Skill Development* | 2 Weeks | 1 | 100 |

*Refer to clause: 4.8 in UG academic regulations 2019

** Applicable only for 2022 Batch

**Semester V**

| Course Code | Course Title | Hours/Week | | | Credits | Marks | Common to Programmes |
|---|---|---|---|---|---|---|---|
| | | L | T | P | | | |
| 19EICN1501 | Control System | 3 | 1 | 0 | 4 | 100 | - |
| 19EICN1502 | Microprocessor and Microcontroller | 3 | 0 | 0 | 3 | 100 | - |
| 19CSSN2502 | Object Oriented Programming | 3 | 0 | 2 | 4 | 100 | - |
| XXXXXXXXX | Professional Elective – I | 3 | 0 | 0 | 3 | 100 | - |
| XXXXXXXXX | Professional Elective – II | 3 | 0 | 0 | 3 | 100 | - |
| XXXXXXXXX | Open Elective – I | 3 | 0 | 0 | 3 | 100 | - |
| 19EICN3501 | Microprocessor and Microcontroller Laboratory | 0 | 0 | 3 | 1.5 | 100 | - |
| 19EICN3502 | Control System Laboratory | 0 | 0 | 3 | 1.5 | 100 | - |
| 19PSHG6501 | Employability Skills 1: Teamness and Interpersonal Skills | 0 | 0 | 2 | 1 | 100 | All |
| **Total** | | **18** | **1** | **10** | **24** | **900** | **-** |

**Semester VI**

| Course Code | Course Title | Hours/Week | | | Credits | Marks | Common to Programmes |
|---|---|---|---|---|---|---|---|
| | | L | T | P | | | |
| 19EICN1601 | Process Control | 3 | 0 | 0 | 3 | 100 | - |
| 19EICN1602 | Embedded System Design | 3 | 0 | 0 | 3 | 100 | - |
| XXXXXXXXX | Professional Elective – III | 3 | 0 | 0 | 3 | 100 | - |
| XXXXXXXXX | Professional Elective – IV | 3 | 0 | 0 | 3 | 100 | - |
| XXXXXXXXX | Open Elective – II | 3 | 0 | 0 | 3 | 100 | - |
| 19EICN3601 | Process Control Laboratory | 0 | 0 | 3 | 1.5 | 100 | - |
| 19EICN3602 | Embedded and IoT Laboratory | 0 | 0 | 3 | 1.5 | 100 | |
| 19EIPN6601 | Innovative and Creative Project | 0 | 0 | 4 | 2 | 100 | - |
| 19PSHG6601 | Employability Skills 2: Campus to Corporate | 0 | 0 | 2 | 1 | 100 | All |
| **Total** | | **15** | **0** | **12** | **21** | **900** | **-** |

| Course Code | Course Title | Duration | Credits | Marks |
|---|---|---|---|---|
| XXX | Internship or Skill Development* | 2 or 4 Weeks | 1 | 100 |

*Refer to clause: 4.8 in UG academic regulations 2019

### Semester VII

| Course Code | Course Title | Hours/Week | | | Credits | Marks | Common to Programmes |
|---|---|---|---|---|---|---|---|
| | | L | T | P | | | |
| 19EICN1701 | Introduction to Machine Learning | 3 | 0 | 0 | 3 | 100 | - |
| 19EICN1702 | Industrial Automation System | 3 | 0 | 0 | 3 | 100 | - |
| XXXXXXXXX | Professional Elective – V | 3 | 0 | 0 | 3 | 100 | - |
| XXXXXXXXX | Professional Elective – VI | 3 | 0 | 0 | 3 | 100 | - |
| XXXXXXXXX | Open Elective – III | 3 | 0 | 0 | 3 | 100 | - |
| 19EICN3701 | Industrial Automation Laboratory | 0 | 0 | 3 | 1.5 | 100 | |
| **Total** | | **15** | **0** | **3** | **16.5** | **600** | **-** |

### Semester VIII

| Course Code | Course Title | Hours/Week | | | Credits | Marks | Common to Programmes |
|---|---|---|---|---|---|---|---|
| | | L | T | P | | | |
| 19EIPN6801 | Project | 0 | 0 | 16 | 8 | 200 | - |
| **Total** | | **0** | **0** | **16** | **8** | **200** | **-** |

| Course Code | Course Title | Duration | Credits | Marks |
|---|---|---|---|---|
| XXXXX | Internship or Skill Development* | 8 or 16 weeks | 4 | 100 |

*Refer to clause: 4.8 in UG academic regulations 2019

| Semester | I | II | III | IV | V | VI | VII | VIII | Total Credits |
|---|---|---|---|---|---|---|---|---|---|
| **Credits** | 19 | 22.5 | 23 | 27 | 24 | 22 | 16.5 | 12 | **166** |

**Total Credits (2021 Batch onwards): 166**

## Vertical wise Electives

| Sensors and Instrumentation Electives | | | | | | | |
|---|---|---|---|---|---|---|---|
| Course Code | Course Title | Hours/Week | | | Credits | Marks | Common to Programmes |
| | | L | T | P | | | |
| 19EIEN1007 | Fiber optics and Laser Instrumentation | 3 | 0 | 0 | 3 | 100 | - |
| 19EIEN1009 | Bio Medical Instrumentation | 3 | 0 | 0 | 3 | 100 | - |
| 19EIEN1010 | Analytical Instrumentation | 3 | 0 | 0 | 3 | 100 | - |
| 19EIEN1012 | Agricultural Instrumentation | 3 | 0 | 0 | 3 | 100 | - |
| 19EIEN1013 | Instrumentation System Design | 3 | 0 | 0 | 3 | 100 | - |
| 19EIEN1025 | Instrumentation Testing | 3 | 0 | 0 | 3 | 100 | - |
| 19EIEN1026 | Smart Sensor Instrumentation | 3 | 0 | 0 | 3 | 100 | - |
| 19EIEN1027 | Wireless Sensor Networks | 3 | 0 | 0 | 3 | 100 | - |

| Control and Automation Electives | | | | | | | |
|---|---|---|---|---|---|---|---|
| Course Code | Course Title | Hours/Week | | | Credits | Marks | Common to Programmes |
| | | L | T | P | | | |
| 19EIEN1018 | Fluid Power System | 3 | 0 | 0 | 3 | 100 | - |
| 19EIEN1020 | Power Plant Instrumentation | 3 | 0 | 0 | 3 | 100 | - |
| 19EIEN1022 | Industrial safety and standards | 3 | 0 | 0 | 3 | 100 | - |
| 19EIEN1028 | Virtual Instrumentation | 3 | 0 | 0 | 3 | 100 | - |
| 19EIEN1029 | Industrial Drives and Control | 3 | 0 | 0 | 3 | 100 | - |
| 19EIEN1030 | PLC Programming | 3 | 0 | 0 | 3 | 100 | - |
| 19EIEN1031 | Advanced Process Control | 3 | 0 | 0 | 3 | 100 | - |
| 19EIEN1032 | Hydraulics and Pneumatics | 3 | 0 | 0 | 3 | 100 | - |

| Embedded Systems & VLSI Electives | | | | | | | |
|---|---|---|---|---|---|---|---|
| Course Code | Course Title | Hours/Week | | | Credits | Marks | Common to Programmes |
| | | L | T | P | | | |
| 19EEEC1002 | Embedded Control of Power Electronics | 3 | 0 | 0 | 3 | 100 | EE,EI |
| 19EEEC1022 | Advanced Microprocessors | 3 | 0 | 0 | 3 | 100 | EE,EI |
| 19EEEC1028 | CMOS Analog IC Design | 3 | 0 | 0 | 3 | 100 | EE,EI |
| 19EEEC1030 | Testing of VLSI Circuits | 3 | 0 | 0 | 3 | 100 | EE,EI |
| 19EEEC1031 | ASIC Design | 3 | 0 | 0 | 3 | 100 | EE,EI |
| 19EEEC1064 | Embedded C Programming | 3 | 0 | 0 | 3 | 100 | EE,EI |
| 19EEEC1065 | Embedded Systems for Automotive Applications | 3 | 0 | 0 | 3 | 100 | EE,EI |
| 19EEEC1066 | IoT for Smart Systems | 3 | 0 | 0 | 3 | 100 | EE,EI |

| Electric Vehicle Technology Electives | | | | | | | |
|---|---|---|---|---|---|---|---|
| Course Code | Course Title | Hours/Week | | | Credits | Marks | Common to Programmes |
| | | L | T | P | | | |
| 19EEEC1047 | Smart Grid Interface for EV | 3 | 0 | 0 | 3 | 100 | EE,EI |
| 19EEEC1049 | Advanced sensors for electric Vehicle | 3 | 0 | 0 | 3 | 100 | EE,EI |
| 19EEEC1051 | Automotive Electrical & Electronic Systems | 3 | 0 | 0 | 3 | 100 | EE,EI |
| 19EEEC1067 | Testing of Electric Vehicles | 3 | 0 | 0 | 3 | 100 | EE,EI |
| 19EEEC1068 | Design of Electric Vehicle Charging System | 3 | 0 | 0 | 3 | 100 | EE,EI |
| 19EEEC1069 | Electric Vehicle Architecture | 3 | 0 | 0 | 3 | 100 | EE,EI |
| 19EEEC1070 | Design of Motor and Power Converters for Electric Vehicles | 3 | 0 | 0 | 3 | 100 | EE,EI |
| 19EEEC1071 | Intelligent Control of Electric Vehicles. | 3 | 0 | 0 | 3 | 100 | EE,EI |

| Internet of Things Electives | | | | | | | |
|---|---|---|---|---|---|---|---|
| Course Code | Course Title | Hours/Week | | | Credits | Marks | Common to Programmes |
| | | L | T | P | | | |
| 19EIEN1023 | Industrial Internet of Things | 3 | 0 | 0 | 3 | 100 | - |
| 19EIEN1033 | Sensor for IoT Application | 3 | 0 | 0 | 3 | 100 | - |
| 19EIEN1034 | IoT for Industry Automation | 3 | 0 | 0 | 3 | 100 | - |
| 19EIEN1035 | Data Analytics for IoT | 3 | 0 | 0 | 3 | 100 | - |
| 19EIEN1036 | IoT for Smart Agriculture | 3 | 0 | 0 | 3 | 100 | - |
| 19EIEN1037 | IoT Security | 3 | 0 | 0 | 3 | 100 | - |
| 19EIEN1038 | IoT for Smart Cities | 3 | 0 | 0 | 3 | 100 | - |
| 19EIEN1039 | IoT and Edge Computing | 3 | 0 | 0 | 3 | 100 | - |

## Diversified Electives

| Course Code | Course Title | Hours/Week | | | Credits | Marks | Common to Programmes |
|---|---|---|---|---|---|---|---|
| | | L | T | P | | | |
| 19EIEN1001 | Industrial Data Communication Networks | 3 | 0 | 0 | 3 | 100 | - |
| 19EIEN1002 | Digital Signal Processing | 3 | 0 | 0 | 3 | 100 | - |
| 19EIEN1003 | VLSI Design | 3 | 0 | 0 | 3 | 100 | - |
| 19EIEN1004 | Automotive Electronics | 3 | 0 | 0 | 3 | 100 | - |
| 19EIEN1005 | Image and Video Processing | 3 | 0 | 0 | 3 | 100 | - |
| 19EIEN1006 | Modern Electronic Instrumentation | 3 | 0 | 0 | 3 | 100 | - |
| 19EIEN1008 | Smart and Wireless Instrumentation | 3 | 0 | 0 | 3 | 100 | - |
| 19EIEN1011 | Automobile and Aircraft Instrumentation | 3 | 0 | 0 | 3 | 100 | - |
| 19EIEN1014 | Thermal and Fluid Mechanics | 3 | 0 | 0 | 3 | 100 | - |
| 19EIEN1015 | Power Electronics and Drives | 3 | 0 | 0 | 3 | 100 | - |
| 19EIEN1016 | Non-Linear Control System | 3 | 0 | 0 | 3 | 100 | - |
| 19EIEN1017 | Digital Control Engineering | 3 | 0 | 0 | 3 | 100 | - |
| 19EIEC1001 | Robotics and Automation | 3 | 0 | 0 | 3 | 100 | EE,EI |
| 19EIEN1021 | Instrumentation in Process Industries | 3 | 0 | 0 | 3 | 100 | - |
| 19CSEC1001 | Programming using JAVA | 3 | 0 | 0 | 3 | 100 | EC,EE,EI |
| 19CSEC1002 | Data Mining And Analytics | 3 | 0 | 0 | 3 | 100 | EC,EE,EI |
| 19CSEC1003 | Software Testing | 3 | 0 | 0 | 3 | 100 | EC,EE,EI |
| 19CSEC1004 | Database Management System Concepts | 3 | 0 | 0 | 3 | 100 | EC,EE,EI |
| 19CSEN1001 | Introduction to Python Programming | 3 | 0 | 0 | 3 | 100 | - |
| 19EEEC1004 | Disaster Management | 3 | 0 | 0 | 3 | 100 | EE,EC,EI |
| 19MEEC1014 | Engineering Economics and Cost Analysis | 3 | 0 | 0 | 3 | 100 | AU,EC,EE, ME,EI |
| 19MEEC1015 | Principles of Management | 3 | 0 | 0 | 3 | 100 | EC,EE,ME, EI |
| 19EIEN1024 | Introduction to Total Quality Management | 3 | 0 | 0 | 3 | 100 | - |
| 19SCEC2001 | Cyber Security | 2 | 0 | 2 | 3 | 100 | All |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 19MEEC1025 | Fundamentals of Entrepreneurship | 3 | 0 | 0 | 3 | 100 | All |
| 19MEEC1026 | Design Thinking and Innovation | 3 | 0 | 0 | 3 | 100 | All |
| 19ITEN1029 | Intellectual Property Rights | 3 | 0 | 0 | 3 | 100 | All |

**Open Electives**

| Course Code | Course Title | Hours/Week | | | Credits | Marks |
|---|---|---|---|---|---|---|
| | | L | T | P | | |
| 19EIOC1001 | Industrial Measurement Systems | 3 | 0 | 0 | 3 | 100 |
| 19EIOC1002 | Electronics System Design | 3 | 0 | 0 | 3 | 100 |
| 19EIOC1003 | Industrial Internet of Things | 3 | 0 | 0 | 3 | 100 |
| 19EIOC1004 | Smart Sensor Technology | 3 | 0 | 0 | 3 | 100 |
| 19EIOC1005 | Factory Automation | 3 | 0 | 0 | 3 | 100 |
| 19EIOC1006 | Internet of Medical Things | 3 | 0 | 0 | 3 | 100 |
| 19EIOC1007 | Virtual Instrumentation | 3 | 0 | 0 | 3 | 100 |

| | | |
|---|---|---|
| **Course Code:19SHMG6101** | **Course Title: Induction Program (common to all B.E/B.Tech Programmes)** | |
| **Course Category: Mandatory Non-Credit Course** | | **Course Level: Introductory** |
| **Duration: 3 Weeks** | | **Max. Marks:100** |

**Pre-requisites**

- Nil

**Course Objectives:**

The course is intended to:

1. Explain various sources available to meet the needs of self, such as personal items and learning resources
2. Explain various career opportunities, opportunity for growth of self and avenues available in the campus
3. Explain the opportunity available for professional development
4. Build universal human values and bonding amongst all the inmates of the campus and society

**List of Activities:**

1. History of Institution and Management: Overview on NIA Education Institutions-Growth of MCET – Examination Process-OBE Practices – Code of Conduct – Centre of Excellence
2. Lectures by Eminent People, Motivational Talk – Alumni, Employer
3. Familiarization to Dept./Branch: HoD Interaction – Senior Interaction – Department Association
4. Universal Human Value Modules: Module 1, Module 2,Module 3 and Module 4
5. Orientation on Professional Skill Courses
6. Proficiency Modules – Mathematics, English, Physics and Chemistry
7. Introduction to various Chapters, Cell, Clubs and its events
8. Creative Arts: Painting, Music and Dance
9. Physical Activity: Games and Sports, Yoga and Gardening
10. Group Visits: Visit to Local areas and Campus Tour

| Course Outcomes | Cognitive Level |
| --- | --- |
| At the end of this course, students will be able to: | |
| CO1: Explain various sources available to meet the needs of self, such as personal items and learning resources through visit to local areas and campus | Understand |
| CO2: Explain various career opportunities and avenues available in the campus through orientation sessions | Understand |
| CO3: Explain the opportunity available for professional development through professional skills, curricular, co-curricular and extracurricular activities | Understand |
| CO4: Build universal human values and bonding amongst all the inmates of the campus and society for having a better life | Apply |

**Course Articulation Matrix**

| CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| CO1 | 1 | - | - | - | - | - | - | 2 | 1 | 2 | - | - | - | - |
| CO2 | 1 | - | - | - | - | - | - | 2 | 1 | 2 | - | - | - | - |
| CO3 | 1 | - | - | - | - | - | - | 2 | 1 | 2 | - | - | - | - |
| CO4 | 2 | - | - | - | - | - | - | 2 | 1 | 2 | - | - | - | - |

High-3; Medium-2;Low-1

**Semester – I**

<table>
<tr><td>Course Code:19MABC1101</td><td colspan="3">Course Title: Matrices and Calculus<br>(Common to AU,ME,CE,EE,EC and EI)</td></tr>
<tr><td colspan="2">Course Category: Basic Science</td><td colspan="2">Course Level: Introductory</td></tr>
<tr><td>L:T:P(Hours/Week)<br>3: 1: 0</td><td>Credits:4</td><td>Total Contact Hours:60</td><td>Max Marks:100</td></tr>
</table>

**Pre-requisites**

- NIL

**Course Objectives**

The course is intended to:

1. Determine the canonical form of a Quadratic form using Orthogonal transformation
2. Use different testing methods to check the convergence of infinite series
3. Apply differential and integral calculus to determine the evaluate of a curve and improper integrals
4. Apply partial derivatives to find extreme values of functions of two variables
5. Apply multiple integrals to find area of plane curves and volume of solids

**Unit I Matrices 9+3 Hours**

Rank of a matrix - System of linear equations – Symmetric - Skew symmetric and orthogonal matrices-(Definitions and examples only) - Eigenvalues and Eigenvectors - Diagonalization of symmetric matrices through orthogonal transformation – Cayley-Hamilton Theorem - Transformation of quadratic forms to canonical forms through orthogonal transformation.

**Unit II Sequences and Series 9+3 Hours**

Sequences - Definition and Examples - Series- Tests for convergence- Power series - series for exponential, trigonometric and logarithm functions - Comparison Test – Integral Test - Cauchy's root test - D Alembert's ratio test - Alternating series- Leibnitz's test.

**Unit III Differential and Integral Calculus 9+3 Hours**

Curvature – Radius of curvature - Evolutes and Involutes - Evaluation of definite and improper integrals - Beta and Gamma functions and their properties.

**Unit IV Multivariable Differentiation 9+3 Hours**

Limit – continuity - Mean value theorems and partial derivatives-Taylor's series and Maclaurin's series – Jacobian – Maxima, Minima and saddle points - Method of Lagrange's multipliers.

**Unit V Multivariable Integration 9+3 Hours**

Multiple Integration: Double integrals - Change of order of integration in double integrals - Change of variables (cartesian to polar, cartesian to spherical and cartesian to cylindrical) - Triple integrals - Applications: areas and volumes.

| **Course Outcomes** | **Cognitive Level** |
|---|---|
| At the end of this course, students will be able to: | |
| CO1: Determine the canonical form of a Quadratic form using Orthogonal transformation | Apply |
| CO2: Use different testing methods to check the convergence of infinite series | Apply |
| CO3: Determine the evolute of a curve and evaluate improper integrals using beta gamma functions | Apply |
| CO4: Apply partial derivatives to find extreme values of functions of two variables | Apply |
| CO5: Apply multiple integrals to find area of plane curves and volume of solids | Apply |

**Text Book(s):**


T1. Erwinkreyzig, Advanced Engineering Mathematics, 9th edition, John Wiley& Sons, 2006.

T2. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, NewDelhi, 2008.

T3. Ramana B.V., higher Engineering Mathematics, Tata McGraw-Hill, New Delhi, 11th Reprint, 2010.


**Reference Book(s):**


R1. G.B.Thomas and R.L Finney, Calculus and Analytic Geometry, 9thedition, Pearson, Reprint, 2002.

R2. N.P.Bali and Manish Goyel, A text book of Engineering Mathematics, Laxmi Publication, Reprint, 2008.

R3. B.S.Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.


**Web References:**

1. https://onlinecourses.nptel.ac.in/noc16_ma05
2. https://nptel.ac.in/courses/122101003/2
3. https://nptel.ac.in/syllabus/111104092/

**Course Articulation Matrix**

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

High-3; Medium-2;Low-1

<table>
<tr><td colspan="2">Course Code: 19ENHG2101</td><td colspan="2">Course Title: Communication Skills – I<br>(Common to all B.E/B.Tech Programmes)</td></tr>
<tr><td colspan="2">Course Category: Humanities</td><td colspan="2">Course Level: Introductory</td></tr>
<tr><td>L:T:P(Hours/Week)<br>2: 0: 2</td><td>Credits:3</td><td>Total Contact Hours:60</td><td>Max Marks:100</td></tr>
</table>

**Pre-requisites**

- The student should have undergone English as his/her first or second language in school.

**Course Objectives**

The course is intended to:

1. Listen and understand monologues and dialogues of a native speaker on par with B1 of CEFR level
2. Speak in simple sentences to convey their opinions and ideas on par with B1 of CEFR level
3. Read and infer a given text on par with B1 of CEFR level
4. Draft basic formal written communication on par with B1 of CEFR level

**Unit I Listening 15 Hours**

Importance of active listening – Physical condition needed for active listening-Identifying relevant points while taking notes.- Framing questions at different linguistic contexts - Listening for specific details of concrete monologues and dialogues – Listening to organize ideas - Developing ideas – Listening to compose paragraphs – Paraphrasing the aural input.

**Unit II Speaking 15 Hours**

Importance of note making to practice speaking - Traditional note making, developing Mind map - Collecting points from various sources - Identifying relevant ideas needed for the speech -Using mind-map to organize thought processing - Prioritizing the ideas - Types of sentences -Frequently used words (Institution, home and leisure) - Mother Tongue Influence - Expressing the thoughts in simple sentences - Tenses & Voices (Active & Passive) - Postures, gestures and eye contact - Intonation and Sentence stress - Express one's thoughts coherently.

**Unit III Reading 15 Hours**

Reading strategies - Skimming -Scanning - Interpretation of visual data - Factual texts on subjects of relevance - Inferring texts – Reading to write a review – Checking the accuracy of reading while presenting the interpreted data – Reading to comprehend.

**Unit IV Writing 15 Hours**

WritingSimple and short sentences **-** Writing E-mail, Memo, Note and Message - Letter Writing - Importance of punctuations -- Identifying the main points - Organising the main ideas - Writing a draft.

**List of Tasks:**

1. BEC Preliminary Listening Test-I & Speaking Test-1.
2. BEC Preliminary Listening Test-2 & Speaking Test-2.
3. BEC Preliminary Listening Test-3 & Speaking Test-3.
4. BEC Preliminary Listening Test-4 & Speaking Test-4.
5. BEC Preliminary Listening Test-5 & Speaking Test-5.
6. BEC Preliminary Listening Test-6 & Speaking Test-6.

| **Course Outcomes** | **Cognitive Level** |
|---|---|
| At the end of this course, students will be able to: | |
| CO1: Listen actively and paraphrase simple messages and specific details of concrete monologues and dialogues | Apply |
| CO2: Express one's views coherently in a simple manner | Apply |
| CO3: Read and comprehend factual texts on subjects of relevance | Understand |
| CO4: Write texts bearing direct meanings for different contexts maintaining an appropriate style | Apply |

**Text Book(s):**

T1.Whitby Norman, Business Benchmark Pre-intermediate to Intermediate Students' Book CUP Publications, 2ndEdition, 2014

T2.Wood Ian, Williams Anne, Cowper Anna, Pass Cambridge BEC Preliminary, Cengage Learning,2ndEdition, 2015.

T3.Learners Book prepared by the Faculty members of Department of English.

**Reference Book(s):**

R1.BEC-Preliminary - Cambridge Handbook for Language Teachers, 2ndEdition, CUP 2000.

R2.Hewings Martin - Advanced Grammar in use - Upper-intermediate Proficiency, CUP, 3rd Edition, 2013.

**Web References:**

1. http://www.grammarinenglish.com -Jan 23,2018
2. https://www.northshore.edu/support_centre /pdf/listen-notes.pdf
3. http://www.examenglish.com/BEC/BEC_Vantage.html- Jan 23, 2018

### Course Articulation Matrix

| CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | - | - | - | - | - | - | - | 2 | 3 | 3 | - | 2 | - | - |
| CO2 | - | - | - | - | - | - | - | 2 | 3 | 3 | - | 2 | - | - |
| CO3 | - | - | - | - | - | - | - | 1 | - | 3 | - | 2 | - | - |
| CO4 | - | - | - | - | - | - | - | 1 | - | 3 | - | 2 | - | - |

High-3; Medium-2; Low-1

<table>
<tr><td colspan="2">Course Code:19CHBC2001</td><td colspan="2">Course Title: Chemistry for Electrical Sciences<br>(Common to EC,EE and EI)</td></tr>
<tr><td colspan="2">Course Category: Basic Science</td><td colspan="2">Course Level: Introductory</td></tr>
<tr><td>L:T:P(Hours/Week)<br>3: 0: 2</td><td>Credits:4</td><td>Total Contact Hours:75</td><td>Max Marks:100</td></tr>
</table>

**Pre-requisites**

- Higher Secondary Chemistry I and II

**Course Objectives**

The course is intended to:

1. Explain the principles of electrochemistry and batteries
2. Explain the mechanism of corrosion and corrosion control
3. Explain the concepts of spectroscopic techniques
4. Describe the basics of biofuels and fuel cells
5. Describe synthesis, properties and applications of nano-materials

**Unit I Electrochemistry and Batteries 9 Hours**

Cells – Types of cells– galvanic and electrolytic cells – emf and its measurement – Nernst equation – Batteries – types and Characteristics, Construction, working and applications - Alkaline battery, Lead –Acid battery, Nickel-Cadmium battery, Lithium ion battery

**Unit II Corrosion and its Control 9 Hours**

Corrosion – dry and wet corrosion – mechanism of electrochemical corrosion – galvanic corrosion and concentration cell corrosion, Factors influencing corrosion. Corrosion Control methods – Cathodic protection methods, Metallic coating – Galvanizing, Tinning – Chrome plating and Electroless plating of Nickel

**Unit III Spectroscopic Techniques 9 Hours**

Spectroscopy- Electromagnetic spectrum, Absorption and Emission spectroscopy – Relationship between absorbance and concentration – Derivation of Beer-Lambert's law (problems). UV – Visible Spectroscopy, Atomic Absorption Spectroscopy, Flame photometry – Principle, Instrumentation and applications.

**Unit IV Biofuels and Fuel Cells 9 Hours**

Biomass – Biogas – Constituents, manufacture and uses. General outline of fermentation process – manufacture of ethyl alcohol by fermentation process. Combustion – Calorific values – Gross and bet calorific value – problems based on calorific value. Fuel cells – Construction working and applications of Hydrogen Oxygen fuel cells, methanol oxygen fuel cells, solid oxide fuel cells

**Unit V Synthesis and Applications of Nano Materials 9 Hours**

Introduction – Difference between bulk and Nano materials – size dependent properties. Nano scale materials –particles, clusters, rods and tubes. Synthesis of Nanomaterials: Sol-gel process, Electro deposition, Hydrothermal methods. Applications of Nano materials in Electronics, Energy science and medicines. Risk and future perspectives of nano materials.

**List of Experiments 30 Hours**

1. Estimation of iron in water by spectrophotometry.
2. Estimation of $Fe^{2+}$ by potentiometric titration.
3. Determination of corrosion rate by weight loss method.
4. Measurement of emf of electrochemical cell – Poggendorff's method.
5. Determination strength of acid by pHmetry.
6. Determination of strength of strong acid by conductance measurement

| **Course Outcomes** | **Cognitive Level** |
|---|---|
| At the end of this course, students will be able to: | |
| CO1: Explain batteries based on their characteristics, construction, working principle and applications | Understand |
| CO2:Explain the mechanism of corrosion and its control techniques | Understand |
| CO3: Use Beer- Lambert's law and other spectroscopic methods for chemical analysis | Apply |
| CO4: Calculate energy potential of fuel cells and calorific value of biofuels | Apply |
| CO5:Describe synthesis, properties and applications of nano-materials | Understand |

**Text Book(s):**


T1. P. C. Jain and Monica Jain, "Engineering Chemistry", 17th Edition.,DhanpatRai Pub, Co., New Delhi, 2018.

T2. Wiley Engineering Chemistry, 2nd Edition, Wiley India Pvt. Ltd. New Delhi, 2011.


**Reference Book(s):**


R1. Larry Brown and Tom Holme, Chemistry for Engineering Students, 3rd Edition, Cengage Learning, 2010.

R2. S. S. Dara, S. S. Umare "A text book of Engineering Chemistry" 12th Edition S. Chand & Co. Ltd., New Delhi, 2014.

R3. Charles P. Poole, Jr., Frank J. Owens "Introduction to Nanotechnology" Wiley India Pvt. Ltd. New Delhi, 2003.


**Web References:**

1. http://nptel.ac.in/courses/122101001/downloads/lec.23.pdf

2. https://nptel.ac.in/courses/104106075/Week1/MODULE%201.pdf
3. https://nptel.ac.in/courses/103102015/

**Course Articulation Matrix**

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

High-3; Medium-2;Low-1

| Course Code:19EISN2101 | Course Title: Fundamentals of Instrumentation Engineering | | |
|---|---|---|---|
| Course Category: Engineering Sciences | | Course Level: Introductory | |
| L:T:P(Hours/Week)<br>3 : 0: 2 | Credits:4 | Total Contact Hours:75 | Max Marks:100 |

**Pre-requisites**

- Nil

**Course Objectives**

The course is intended for the learners to:

1. Explain the basics of electrical quantities and electrical devices
2. Describe the Electronics components
3. Elucidate the units and standards for measurement
4. Explain the Instrumentation system
5. Explain the basic control structure

**Unit I BASICS OF ELECTRICAL COMPONENTS AND CIRCUITS 9 Hours**

Definition of electrical quantities: Charge, Resistivity, Conductivity, Resistance, inductance, capacitance, Voltage, current, Power, Power factor, Energy - AC & DC circuits – Relays and types – Contactors - Solenoids

**Unit II BASICS OF ELECTRONIC COMPONENTS AND CIRCUITS 9 Hours**

Semiconductors – Energy band – Diodes – LED – LDR – Solar cell – Zener diode as voltage regulator – Rectifiers – AC ripple filters - Transistors as Amplifier and switch.

**Unit III FUNDAMENTALS OF MEASUREMENTS 9 Hours**

S.I Units and Standards –IEEE and ISA Standards – Unit conversion – Instrument signal levels: Current, voltage and pressure - Calibration – Types of errors – Recorders - Indicators – MC & MI Instruments

**Unit IV BASICS OF INSTRUMENTATION SYSTEM 9 Hours**

Block diagram of Instrumentation systems - Sensors and Transducers - Classification of Transducers – Signal conditioning circuits – Analog signal to digital conversion – Digital processing unit – Digital to Analog signal Conversion

**Unit V APPLICATIONS OF CONTROL AND INSTRUMENTATION 9 Hours**

Block diagram of open loop and closed loop system - Open loop system: Electronic weighing scale: Block diagram – Sensing system – Processor – Display System – Closed loop system: Temperature control system: Closed loop structure – Sensing system – controller – Heater driving system – Temperature display.

**List of Experiments:** **30 Hours**

1.Serial and parallel circuit (Resistance connection)

2.Electrical wiring (Two switch or simple house wiring)

3.Power supply (AC-DC)

4.Soldering electronic components (Dot PCB board soldering)

5.Testing and calibration Measuring instruments (Function generator, CRO, etc)

6.RTD based Temperature measurement (Simple potential divider circuit)

| **Course Outcomes** | **Cognitive Level** |
|---|---|
| At the end of this course, students will be able to: | |
| CO1: Explicate the electrical components and device operation | Understand |
| CO2: Elucidate the electronic components for device development | Understand |
| CO3: Summarize the units and standards for measurement | Understand |
| CO4: Illuminate the structure of Instrumentation system | Understand |
| CO5: Describe the operation of open and feedback system | Understand |

**Text Book(s):**

T1.William H. HaytJr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", McGraw Hill publishers, 8$^{th}$edition, New Delhi, 2013.

T2.Charles K. Alexander, Mathew N.O. Sadiku, "Fundamentals of Electric Circuits", 2$^{nd}$ Edition, McGraw Hill, 2013.

T3.William Bolton, "Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering", 5$^{th}$ Edition, PHI, 2013.

**Reference Book(s):**

R1.Chakrabarti A, "Circuits Theory (Analysis and synthesis), DhanpathRai& Sons, New Delhi, 1999.

R2.Jegatheesan, R., "Analysis of Electric Circuits," McGraw Hill, 2015.

R3.Joseph A. Edminister, MahmoodNahri, "Electric circuits", Schaum's series, McGraw- Hill, New Delhi, 2010.

R4.M E Van Valkenburg, "Network Analysis",Prentice-Hall of India Pvt Ltd, New Delhi, 2015.

R5.Sedra and Smith, Microelectronic Circuits, Oxford University Press, 2004.

**Web References:**

1. https://nptel.ac.in/courses/117103063/
2. https://nptel.ac.in/courses/112103174/3
3. https://nptel.ac.in/courses/101108056/module7/lecture13.pdf

**Course Articulation Matrix**

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

High-3; Medium-2; Low-1

<table>
<tr><td>Course Code:19MESC2001</td><td colspan="3">Course Title: Introduction to Engineering<br>(Common to AU,ME,EC,EE,CE and EI)</td></tr>
<tr><td colspan="2">Course Category: Engineering Science</td><td colspan="2">Course Level: Introductory</td></tr>
<tr><td>L:T:P(Hours/Week)<br>2: 0: 2</td><td>Credits:3</td><td>Total Contact Hours:60</td><td>Max Marks:100</td></tr>
</table>

**Pre-requisites**

- Nil

**Course Objectives**

**The course is intended to:**

1. Explain the career opportunities in engineering.
2. Explain how to acquire engineering competencies.
3. Explain how to remain, relevant and versatile as an engineer.
4. Observe engineering products and processes.
5. Take ownership for learning and development.
6. Identify and rectify unsafe conditions and acts.

**Unit I Career Opportunities in Engineering 5 Hours**

Technicians, engineers and scientists, history of engineering. 17 sustainable development goals set by UNO, concept of small e to big E. career choices for an engineer, types of industries, academia and research as career choices, entrepreneurship as a career choice, various departments in engineering industries, roles available in engineering industries. innate skills, learnt skills (competencies), graduate attributes, roles of engineers and the corresponding competencies, career opportunities in engineering in terms of roles & competencies

**Unit II Developing Specific Skills and Competencies 5 Hours**

OBE Model, PEOs and POs, technical POs, professional POs, mapping with Graduate attributes, Classification of courses, resources available in the campus and e-resources, resources and facilities available to acquire specific competencies, on-campus and off-campus activities, the methods by which students can systematically involve in activities, significance of professional skill courses, plan for utilizing the resources and facilities to develop specific competencies.

**Unit III Staying Relevant Through Continuous Improvement / Environmental Versatility 7 Hours**

Rate of change, technology life cycle (TLC), features of a dynamic and complex environment in which students operate or will operate, impact of globalization & technical advancements, importance of remaining, relevant and versatile in a dynamic and complex environment with the help of technology life cycle, activities/process to remain relevant and versatile, environmental scanning, Life- long learning.

**Unit IV** **Observe Every Product and Process With an Engineering Perspective and Inquisitiveness** **4 Hours**

Product -Need, purpose - primary and secondary function, various stages of manufacturing and its processes. Product - assembly of several simple engineering devices/systems. Product-Parts, principles and laws (mechanical, electrical and electronics), functional relationship between the parts, role of programming in engineering products. Significance of materials and their advancements in improvements in product.

**Unit V** **Learning and Development Leveraging The Resources and Infrastructure** **6 Hours**

Process Of Learning, Situated Learning with Examples, Own Learning (Not Copying), Differences between Real Life and Simulated Environment, the Sprit Of Experimentation, Various Learning Enablers, Measure the performance against the plan.

**Unit VI** **Unsafe Conditions and Acts and Following Environment Friendly Practices** **3 Hours**

Safety-definition, importance of personal safety. Statistics of road accidents. Unsafe condition and unsafe act- definition, cause and effects, identification of the unsafe conditions and acts in home/hostel, labs, class rooms, public places. Importance of environment friendly practices.

| **Course Outcomes** <br> **At the end of this course, students will be able to:** | **Cognitive Level** |
|---|---|
| CO1: Explain the career opportunities in engineering in terms of roles & competencies | Understand |
| CO2: Explain how a student can acquire the competencies | Understand |
| CO3: Explain how to remain, relevant and versatile in a dynamic and complex environment | Understand |
| CO4: Observe every product and processes with an engineering perspective and inquisitiveness | Apply |
| CO5: Choose to take ownership for his/her learning and development leveraging the resources and infrastructure | Understand |
| CO6: Identify and rectify unsafe conditions and acts and follow environment friendly practices | Understand |

**Text Book(s):**

T1.Worksheets and Handouts prepared by MCET team.

**Reference Book(s):**

R1. L. A Bloomfield, "How things work: The physics of everyday life", Wiley, 5th Edition, 2013.

R2. C. Mason, "How things work," Usborne Publishing Ltd 2009.

R3. D.K. Publishing, "How things work encyclopedia", 2010.

R4. J. E. Gordon, "The New Science of Strong Materials or Why You Don't Fall through the Floor" Princeton University Press; With a New introduction by Philip Ball,2018.

R5. R.P. Feynman," Six Easy Pieces: Essentials of Physics Explained by Its Most Brilliant Teacher", Basic Books; 4th Edition 2011.

**Web References:**

1. https://en.wikibooks.org/General_Engineering_Introduction/Engineering_Science
2. https://science.howstuffworks.com/engineering-channel.html

**List of RiaLab Exercises** **30 Hours**

1. Career opportunities with roles and responsibilities

2. Observe every product and processes with an engineering perspective and inquisitiveness

a) Primary and Secondary functions of products and their equivalents

b) Primary and Secondary functions of parts of the products, their manufacturing processes and materials

c) Structural and functional relations of the product

3. Safe and unsafe acts and conditions in day-to-day life and professional practices.

4. Skills for Hobby project (At least TWO)

a) Soldering and de-soldering practices

b) Circuit and component testing using multi-meter & CRO

c) Battery operated circuit connections and testing

d) Simple switching circuits using relays and transistors

e) Adhesives used in part assembly

**Course Articulation Matrix**

| CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 1 | - | - | - | 2 | 2 | 1 | 3 | 1 | - | 1 | - | - |
| CO2 | 2 | 1 | - | - | - | 2 | 2 | 1 | 3 | 1 | - | 1 | - | - |
| CO3 | 2 | 1 | - | - | - | 2 | 2 | 1 | 3 | 1 | - | 1 | - | - |
| CO4 | 3 | 2 | 1 | 1 | - | 2 | 2 | 1 | 3 | 1 | - | 1 | - | - |
| CO5 | 2 | 1 | - | - | - | 2 | 2 | 1 | 3 | 1 | - | 1 | - | - |
| CO6 | 2 | 1 | - | - | - | 2 | 2 | 1 | 3 | 1 | - | 1 | - | - |

High-3; Medium-2; Low-1

| Course Code:19PSHG6001 | Course Title: Wellness for Students (Common to all B.E/B. Tech Programmes) | | |
|---|---|---|---|
| Core/Elective: Core | | Course Level: Introductory | |
| L:T:P(Hours/Week) 0: 0: 2 | Credits:1 | Total Contact Hours:30 | Max Marks:100 |

**Pre-requisites**

- Nil

**Course Objectives**

The course is intended to:

1. Set SMART goals for academic, career and life
2. Apply time management techniques
3. Articulate the importance of wellness for success in life
4. Understand the dimensions of wellbeing and relevant practices

**Unit I GOAL SETTING**

Understanding Vision and mission statements - Writing personal mission statements – ‘Focus’ as a way of life of most successful people. Clarifying personal values, interests and orientations – Awareness of opportunities ahead – Personal SWOT analysis - Principles driving goal setting: Principle of response and stimuli, Circle of influence and circle of concern, What you see depends on the role you assume. Potential obstacles to setting and reaching your goals - Five steps to goals setting: SMART goals, Inclusive goals, Positive stretch, Pain vs gain, Gun-point commitment.

**Unit II TIME MANAGEMENT - TOOLS AND TECHNIQUES**

Importance of planning and working to time. Pareto 80-20 principle of prioritization – Time quadrants as a way to prioritize weekly tasks – The glass jar principle - Handling time wasters – Assertiveness, the art of saying ‘NO’ – Managing procrastination

**Unit III PRACTICES FOR PHYSICAL WELLNESS**

Concept of wellness – impact of absence of wellness - Wellness as important component to achieve success. Wellbeing as per WHO - Dimensions of Wellbeing: Physical, Mental, Social, Spiritual – indicators and assessment methods

Simplified Physical Exercises. Fitness as a subset of Wellness – health related physical fitness - skill related physical fitness. Joint movements, Warm up exercises, simple asanas, WCSC simplified exercises.

**Unit IV PRACTICES FOR MENTAL WELLNESS:**

Meditation: Mind and its functions - mind wave frequency – Simple basic meditation – WCSC meditation and introspection tables. Greatness of friendship and social welfare – individual, family and world peace – blessings and benefits.

Food & sleep for wellness: balanced diet - good food habits for better health (anatomic therapy) – hazards of junk food - food and the gunas.

**Unit V PUTTING INTO PRACTICE**

Practicals: Using the weekly journal – Executing and achieving short term goals – Periodic reviews.

| **Course Outcomes:** | **Cognitive/ Affective** |
|---|---|
| At the end of this course, students will be able to: | |
| CO1: Set well-articulated goals for academics, career, and personal aspirations | Apply |
| CO2: Apply time management techniques to complete planned tasks on time | Apply |
| CO3: Explain the concept of wellness and its importance to be successful in career and life | Apply |
| CO4: Explain the dimensions of wellness and practices that can promote wellness | Apply |
| CO5: Demonstrate the practices that can promote wellness | Valuing |

**Text Book(s):**

T1. Reading material, workbook and journal prepared by PS team of the college.

**Reference Book(s):**

R1. Stephen R Covey, “First things first”, Simon & Schuster U.K, Aug 1997.

R2. Sean Covey, “Seven habits of highly effective teenagers”, Simon & Schuster U.K, 2004.

R3. Vethathiri Maharishi Institute for Spiritual and Intuitional Education, Aliyar, “Value education for harmonious life (Manavalakalai Yoga)”, Vethathiri Publications, Erode, I Ed. (2010).

R4. Dr. R. Nagarathna, Dr.H.R. Nagendra, “Integrated approach of yoga therapy for positive health”, Swami Vivekananda Yoga Prakashana, Bangalore, 2008 Ed.

R5. Tony Buzan, Harper Collins, The Power of Physical Intelligence (English).

## Course Articulation Matrix

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | - | - | - | - | - | - | - | 1 | 1 | - | - | - |
| CO2 | - | - | - | - | - | - | 1 | 1 | 1 | - | - | - |
| CO3 | - | - | - | - | - | 1 | 1 | 1 | 1 | - | - | 1 |
| CO4 | - | - | - | - | - | 1 | 1 | - | 1 | - | - | - |
| CO5 | - | - | - | - | - | 1 | 1 | - | 1 | - | - | 1 |

High-3; Medium-2; Low-1

**Semester – II**

<table>
<tr><td colspan="2">Course Code: 19ENHG2201</td><td colspan="2">Course Title: Communication Skills – II<br>(Common to all B.E/B.Tech Programmes)</td></tr>
<tr><td colspan="2">Course Category: Humanities</td><td colspan="2">Course Level: Introductory</td></tr>
<tr><td>L:T:P(Hours/Week)<br>2: 0: 2</td><td>Credits:3</td><td>Total Contact Hours:60</td><td>Max Marks:100</td></tr>
</table>

**Pre-requisites**

- Communication Skills - I

**Course Objectives**

The course is intended to:

1. Listen and understand monologues and dialogues of a native speaker on par with B2 of CEFR level.
2. Speak in simple sentences to convey their opinion and ideas on par with B2 of CEFR level.
3. Read and infer a given text on par with B2 of CEFR level.
4. Draft basic formal written communication on par with B2 of CEFR level.

**Unit I LISTENING 15 Hours**

Importance and purpose of extensive listening and intensive listening -Body Language –Listening tasks on complex and abstract themes- Correlating Ideas related to listening input – importance of empathetic- listening for main ideas – Paraphrasing- Listening to native speakers English – Compound and Complex sentences - Developing ideas – Listening to compose paragraphs.

**Unit II SPEAKING 15 Hours**

Jotting down ideas collected from listening to speak – organising the ideas – Expressing one's view coherently – Understanding grammatical elements (Noun – Pronoun Antecedent) – Expressing ideas assertively – Answering questions during presentations – Understanding the use of discourse markers – word stress and sentence stress – voice modulation and pauses – Highlighting significant points – interpretation of visual data – Using verbal cues - Preparing simple hand - outs.

**Unit III READING 15 Hours**

Reading strategies – Skimming & Scanning – Inferring meaning- Barriers to reading – sub vocalisation, Eye fixation, Regression – Speed Reading Techniques - Reading different types of texts and their contexts with speed – Note making – Reading a review – Paraphrasing – Reading to comprehend.

**Unit IV WRITING 15 Hours**

Reported speech & Concord (Subject - verb Agreement) - Report writing - Different kinds of Report - Structure of the report - Writing Proposal - Plagiarism – References – Appendices – Techniques for Report writing – Registers.

**LIST OF TASKS:**

1. BEC Vantage Listening Test- I & Speaking Test-1.
2. BEC Vantage Listening Test-2 & Speaking Test-2.
3. BEC Vantage Listening Test-3 & Speaking Test-3.
4. BEC Vantage Listening Test-4 & Speaking Test-4.
5. BEC Vantage Listening Test-5 & Speaking Test-5.
6. BEC Vantage Listening Test-6 & Speaking Test-6.

| **Course Outcomes**<br>At the end of this course, students will be able to: | **Cognitive Level** |
|---|---|
| CO1: Listen actively and empathetically, and paraphrase discussions and presentations on complex and abstract themes and topics | Apply |
| CO2: Express one's views coherently, fluently and confidently highlighting the significant points with supporting details | Apply |
| CO3: Read and comprehend different types of texts and their contexts reasonably at moderate speed | Understand |
| CO4: Write detailed reports on variety of subjects synthesizing information gathered during listening & reading citing appropriate references | Apply |

**Text Book(s):**

T1. Whitby Norman, Business Benchmark Upper Intermediate Students' Book CUP Publications, 2nd Edition, 2014.

T2. Learners Book prepared by the Faculty members of Department of English.

**Reference Book(s):**

R1. Cambridge BEC Vantage - Practice Tests, Self-study Edition, Cambridge University Press, 2002.

R2. Hewings Martin - Advanced Grammar in use - Upper-intermediate Proficiency, CUP, 3rd Edition, 2013.

**Web References:**

1. http://www.grammarinenglish.com -Jan 23, 2018
2. https://www.northshore.edu/support_centre /pdf/listen-notes.pdf
3. http://www.examenglish.com/BEC/BEC_Vantage.html - Jan 23, 2018

## Course Articulation Matrix

| CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 1 | 1 | - | - | - | 2 | 3 | 3 | - | 2 | - | - |
| **CO2** | 3 | 2 | 1 | 1 | - | - | - | 2 | 3 | 3 | - | 2 | - | - |
| **CO3** | 2 | 1 | - | - | - | - | - | 1 | - | 3 | - | 2 | - | - |
| **CO4** | 3 | 2 | 1 | 1 | - | - | - | 1 | - | 3 | - | 2 | - | - |

High-3; Medium-2; Low-1

<table>
<tr><td colspan="2">Course Code:19MABC1201</td><td colspan="3">Course Title: Ordinary Differential Equations and Complex Variables<br>(Common to AU,ME,CE,EE,EC and EI)</td></tr>
<tr><td colspan="3">Course Category: Basic Science</td><td colspan="2">Course Level: Introductory</td></tr>
<tr><td>L:T:P(Hours/Week)<br>3: 1: 0</td><td colspan="2">Credits:4</td><td>Total Contact Hours:60</td><td>Max Marks:100</td></tr>
</table>

**Pre-requisites**

- Matrices and Calculus

**Course Objectives**

The course is intended to:

1. Explain the concepts of vector differentiation and integration
2. Determine the solution of second and higher order ordinary differential equations
3. Construct analytic functions
4. Use the concept of complex integration to evaluate definite integrals
5. Apply Laplace transform techniques to solve ordinary differential equations

**Unit I VECTOR CALCULUS 9+3 Hours**

Gradient – Divergence – Curl – Line integrals – Surface integrals – Volume integrals – Theorems of Green, Gaussand Stokes (without proof)and their applications.

**Unit II COMPLEX VARIABLES (DIFFERENTIATION) 9+3Hours**

Cauchy-Riemann equations – Analytic functions – Properties – Harmonic functions – Finding harmonic conjugate – Conformal mapping (w=z+a, w= az, w=1/z) – Mobius transformation and their properties.

**Unit III COMPLEX VARIABLES (INTEGRATION) 9+3 Hours**

Contour integrals – Cauchy Integral formula (without proof) – Cauchy Integral theorem – Taylor's series – Singularities of analytic functions – Laurent's series–Residues – Cauchy Residue theorem(without proof) – Evaluation of real definite integrals around unit circle and semi-circle (Excluding poles on the real axis).

**Unit IV ORDINARY DIFFERENTIAL EQUATIONS OF HIGHER ORDERS 9+3 Hours**

Second and higher order linear differential equations with constant coefficients – Second order linear differential equations with variable coefficients (Cauchy - Euler equation–Legendre's equation) – Method of variation of parameters – Solution of first order simultaneous linear ordinary differential equations

**Unit V LAPLACE TRANSFORM 9+3 Hours**

Laplace Transform – Properties of Laplace Transform – Laplace transform of integrals – Laplace transform of periodic functions -Inverse Laplace transforms - Convolution theorem – Solution of ordinary differential equations by Laplace Transform method– Applications on engineering problems.

| Course Outcomes | Cognitive Level |
|---|---|
| At the end of this course, students will be able to: | |
| CO1: Explain the concepts of vector differentiation and integration. | Apply |
| CO2: Use the concept of complex variables to construct analytic functions | Apply |
| CO3: Use the concept of complex integration to evaluate definite integrals | Apply |
| CO4: Determine the solution of second and higher order ordinary differential equations | Apply |
| CO5: Apply Laplace transform techniques to solve ordinary differential equations | Apply |

**Text Book(s):**


T1. Erwinkreyzig, Advanced Engineering Mathematics, 9th edition, John Wiley& Sons, 2006.

T2. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, NewDelhi, 2008.

T3. Ramana B.V., higher Engineering Mathematics, Tata McGraw-Hill, New Delhi, 11thReprint, 2010.


**Reference Book(s):**


R1. G.B.Thomas and R.L Finney, Calculus and Analytic Geometry, 9th edition, Pearson, Reprint, 2002.

R2. N.P.Bali and Manish Goyel, A text book of Engineering Mathematics, Laxmi Publication, Reprint, 2008.

R3. B.S.Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.


**Web References:**

1. https://onlinecourses.nptel.ac.in/noc16_ma05
2. https://nptel.ac.in/courses/122101003/2
3. https://nptel.ac.in/courses/111105035/22

## Course Articulation Matrix

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

High-3; Medium-2;Low-1

| Course Code:19PHBC2001 | Course Title: Physics for Electrical Sciences (common to EC,EE and EI) | | |
|---|---|---|---|
| Course Category: Basic Sciences | | Course Level: INTRODUCTORY | |
| L:T:P(Hours/Week) 3: 0: 2 | Credits:4 | Total Contact Hours:75 | Max Marks:100 |

**Pre-requisites**

- Nil

**Course Objectives**

**The course is intended to:**

1. Explain the concepts of static electric field
2. Explain the concepts of static magnetic field
3. Explain the behavior of materials in electric and magnetic fields
4. Explain electric and magnetic fields using Maxwell's equation
5. Explain the phenomenon of Electromagnetic wave propagation

**Unit I ELECTROSTATICS 9 Hours**

Definition of electric charge-Coulomb's Law – Electric field intensity – Field intensity due to point and line charges – Electric flux density -Gauss's law- Application of Gauss's law: Due to a line charge and a plane sheet of charge – Electric potential-Equipotential surfaces-Potential gradient.

**Unit II MAGNETOSTATICS 9 Hours**

Definition of magnetic flux- magnetic field intensity-Lorentz Law of force- Biot –savart Law, Ampere's Law- Application of Ampere's Law: Magnetic induction due to a long linear conductor and solenoid - Magnetic field due to straight conductors- circular loop – Magnetic flux density (B) - Magnetic potential.

**Unit III ELECTRIC AND MAGNETIC FIELDS IN MATERIALS 9 Hours**

Dielectrics: An atomic view - Dielectric Polarization- Dielectrics and Gauss's law- Dielectric Strength- Energy stored in a dielectric medium - Capacity of a condenser - Capacitance - coaxial, Spherical capacitor- Poisson and Laplace Equation.

Magnetic susceptibility and permeability- properties of dia, para and ferro magnetic materials- hysteresis loop.

**Unit IV ELECTROMAGNETIC INDUCTION 9 Hours**

Faraday's law – Lenz's law – Time varying magnetic field - self Inductance - self Inductance of a solenoid- Mutual inductance- Mutual inductance of two solenoids. Charge conservation law - continuity equation- displacement current- Maxwell's equations.

**Unit V ELECTROMAGNETIC WAVES 9 Hours**

Maxwell's equations – Electromagnetic waves in free space - Poynting vector - Propagation of electromagnetic waves in dielectrics – Phase velocity- Propagation of electromagnetic waves through conducting media- penetration or skin depth.

**List of Experiments:** **30 Hours**

1. Verification of Ohms' law.
2. Test the Faraday's hypothesis of magnetic field induction.
3. Determination of specific resistance of the given material using Carey foster's bridge.
4. Determination of Dielectric constant of a given material.
5. Determination of inductance using Maxwell's bridge.
6. Determination of wavelength of the given light source using spectrometer.

| **Course Outcomes** | **Cognitive Level** |
|---|---|
| At the end of this course, students will be able to: | |
| CO1: Explain the laws and concepts of static electric field | Understand |
| CO2: Explain the laws and concepts of static magnetic field | Understand |
| CO3: Explain the behavior of materials in electric and magnetic fields | Understand |
| CO4: Explain time varying electric and magnetic fields using Maxwell's equation | Understand |
| CO5: Explain the phenomenon of Electromagnetic wave propagation in different media | Understand |

**Text Book(s):**


T1. R.K.Gaur and S.L.Gupta, "Engineering Physics", DhanpatRai publications, New Delhi, 8$^{th}$ Edition, 2011.

T2. M.N.Avadhanulu and P.G.Kshirsagar, "Text Book of Engineering Physics", S. Chand & Company Ltd., New Delhi, 2014.

T3. W. H. Hayt and John A. Buck, "Engineering Electromagnetics", Tata McGraw Hill, New Delhi. 6$^{th}$Edition, 2014.


**Reference Book(s):**


R1. David Griffiths, "Introduction to Electrodynamics", 4th Edition, Pearson Education, 2013

R2. D. Halliday., R. Resnick and J. Walker, "Fundamentals of Physics", Wiley Publications, 2008.

R3. K. A. Gangadhar and P. M. Ramanathan, "Electromagnetic Field Theory", Khanna Publishers, New Delhi, 5$^{th}$Edition, 2013.

R4. Mathew. N. O. Sadiku, " Elements of Electromagnetics", 4th Edition, Oxford University Press, 2009

R5. John D. Kraus and Daniel A. Fleisch, "Electromagnetic with Applications", Tata McGraw Hill, New Delhi. 5$^{th}$Edition, 2010.


**Web References:**

1. http://openems.de/start/index.php
2. http://nptel.iitm.ac.in

**Course Articulation Matrix**

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

High-3; Medium-2; Low-1

| Course Code:19EISN1201 | Course Title: Electric Circuit Analysis | | |
|---|---|---|---|
| **Course Category: Engineering Science** | | **Course Level: Introductory** | |
| **L:T:P(Hours/Week) 3:1: 0** | **Credits:4** | **Total Contact Hours:60** | **Max Marks:100** |

**Pre-requisites**

- Nil

**Course Objectives**

The course is intended to:

1. Analyze DC circuits
2. Analyze AC circuits
3. Analyze resonance and coupled circuits
4. Analyze three phase circuits
5. Determine transient response of the circuit

**Unit I D.C. CIRCUIT ANALYSIS 9+ 3 Hours**

Ohm's law – Ideal voltage and current sources – Independent sources – Dependent sources– Circuit elements – Kirchhoff's Laws – Voltage and Current division in series and parallel circuits, Network reduction – Mesh and Nodal analysis with voltage and current sources – Circuit theorems:- Superposition, Thevenin's, Norton's Reciprocity and Maximum Power Transfer – Source transformation – Y-Δ transformation .

**Unit II A.C. CIRCUIT FUNDAMENTALS AND ANALYSIS 9 + 3 Hours**

Sinusoidal voltage and current – RMS value – Form factor – Phasor representation of sinusoidal of voltages –Current and voltage relationship in R, L, and C circuits – Impedance and admittance, power factor concepts in RC, RL and RLC circuits – Impedance combinations– Real power, reactive power, complex power, apparent power – Analysis of simple series and parallel circuits.

**Unit III RESONANCE AND COUPLED CIRCUITS 9 + 3 Hours**

Resonance in parallel and series circuits – Half power frequencies – Bandwidth and Q factor of Resonant circuits – Mutual Inductance – Dot convention – Coefficient of coupling – Sinusoidal steady state analysis of network with coupled inductance.

**Unit IV THREE- PHASE CIRCUIT ANALYSIS 9 + 3 Hours**

Three-phase balanced and unbalanced voltage sources – Three - phase balance and unbalanced loads – Line voltage and phase voltage – Phasor diagram and Power in three- phase circuit – Three - phase circuit analysis with star and delta balanced and unbalanced loads – Phasor diagram – Power and power factor measurement in three-phase circuits.

**Unit V TRANSIENT ANALYSIS AND TWO PORT NETWORKS 9 + 3 Hours**

Source free RC and RL Circuit responses – Step response of RC and RL circuits – source free RLC series and parallel circuit responses – Step responses of RLC series and parallel circuits– Responses of RC, RL and RLC series circuits to sinusoidal excitation. **Two Port Networks:** One-port and two-port networks, driving point impedance and admittance, open and short circuit parameters. Interconnection of Two port networks T and $\pi$ representations.

| **Course Outcomes** | **Cognitive Level** |
|---|---|
| At the end of this course, students will be able to: | |
| CO1: Analyze DC circuits using circuit reduction techniques and network theorems. | Analyze |
| CO2: Analyze AC circuits using circuit reduction techniques and network theorems. | Analyze |
| CO3: Determine circuit parameters in resonance ad coupled circuits. | Analyze |
| CO4: Analyze three phase circuit behavior with balanced and unbalanced three phase loads. | Analyze |
| CO5: Determine transient and steady state response of RL, RC and RLC circuit with step input and sinusoidal input. | Analyze |

**Text Book(s):**


T1. Edminister, J.A. and Nahvi, M., “Electric Circuits”, 4th Edition, Schaum’s Outline series, McGraw-Hill, 2002.

T2. Husain, A., “Networks and Systems”, Khanna Publishers, 2000.


**Reference Book(s):**


R1. Charles K. Alexander, Mathew N.O. Sadiku, “Fundamentals of Electric Circuits”, 2nd Edition, McGraw Hill, 2013.

R2. Joseph A. Edminister, MahmoodNahri, “Electric circuits”, Schaum’s series, McGraw- Hill, New Delhi, 2010.

R3. Boylsted, R.L., “Essentials of Circuit Analysis”, Prentice Hall, 2003.

R4. Hayt, Jr.W.H., Kemmerly, J.E., and Durbin, S.M., “Engineering Circuit Analysis”, TataMcGraw-Hill, 2002.

**Web References:**

1.https://nptel.ac.in/courses/108102097/3
2.https://nptel.ac.in/courses/108102042/
3. https://nptel.ac.in/downloads/108105053/

**Course Articulation Matrix**

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

High-3; Medium-2;Low-1

| Course Code:19CSSC2001 | Course Title: C Programming (Common to AU,CE,ME,EE,EC and EI) | | |
|---|---|---|---|
| Course Category: Engineering Sciences | | Course Level: Introductory | |
| L:T:P(Hours/Week) 3: 0: 2 | Credits:4 | Total Contact Hours:75 | Max Marks:100 |

**Pre-requisites**

- Nil

**Course Objectives**

The course is intended to:

1. Explain about computer organization and problem solving techniques
2. Write programs using appropriate programming constructs
3. Develop programs using arrays, functions & strings
4. Implement programs using pointers, structures& unions
5. Write programs using files & preprocessor directives

**Unit I INTRODUCTION 7 Hours**

Generation and Classification of Computers –Basic Organization of a Computer – Software development life cycle – Problem Solving Techniques :Algorithm,Pseudocode and Flow Chart.

**Unit II C PROGRAMMING BASICS 10 Hours**

Introduction to C programming – Structure of a C program – Keywords – Identifiers-Constants–Variables –Data Types– Operators and Expressions –Formatted & Unformatted I/O functions–Decision statements –Loop control statements.

**Unit III ARRAYS, FUNCTIONS AND STRINGS 10 Hours**

Arrays: Characteristics –One-dimensional and Two-dimensional arrays – Functions: Declaration & Definition of function –Built in function – User defined function –Types of functions –Call by value &reference– Strings: Formatting strings–String handling functions.

**Unit IV POINTERS, STRUCTURES & UNION 9Hours**

Pointers: Features and Types of pointers – Arithmetic operations with pointers–Pointers and Arrays –Structures: Features– Operations on Structures–Array of structures – Unions.

**Unit V FILES & PRE-PROCESSOR DIRECTIVES 9 Hours**

Introduction to Files –Stream and File Types–File operations (Open, close, read, write) – Command line arguments–Pre-processor Directives: Macro Expansion, File Inclusion, Conditional Compilation.

**List of Exercises 30 Hours**

1. Programs to process data types, operators and expression evaluation(any 1)
   a. To find area of rectangle/circle/square
   b. To find the simple interest and compound interest
2. Programs using decision and looping statements(any 2)
   a. To find the maximum number among 3 given numbers
   b. To check whether given year is leap year or not
   c. To display the Fibonacci series

    d. To find the factorial of a number
3. Programs using Arrays
    a. To search for particular number among N numbers(1D array)
    b. To compute matrix addition (2 D array)
4. Programs using Functions and Strings(any 2)
    a. To swap two numbers using call by reference
    b. To find the cube of a number
    c. To manipulate strings using string functions
    d. To check whether the string is palindrome or not
5. Programs using Pointer, Structure & Union
    a. To perform arithmetic operations using pointers
    b. To display the information of N students using Structure
    c. To display the employee details using Union
6. Programs using Files (any 1)
    a. To read the contents of a text file
    b. To copy the contents from one file into another

| **Course Outcomes** | **Cognitive Level** |
|---|---|
| At the end of this course, students will be able to: | |
| CO1: Explain about computer organization and problem solving techniques | Understand |
| CO2: Write programs for the given scenario using appropriate programming constructs | Apply |
| CO3: Develop programs using arrays, functions & strings for the givenscenario | Apply |
| CO4: Implement programs for given application using pointers, structures& unions | Apply |
| CO5: Write programs using files & preprocessor directives for simple problems | Apply |

**Text Book(s):**

T1.Ashok N.Kamthane, Amit.N.Kamthane, “Programming in C”, 3rdEdition, Pearson Education, 2015.

**Reference Book(s):**

R1.Ajay Mittal, “Programming in C-A Practical Approach ”,3rdEdition, Pearson Education, 2010.

R2.YashavantP.Kanetkar, “Let Us C”, 16thEdition, BPB Publications,2018.

R3.PradipDey, ManasGhosh, “Computer Fundamentals and Programming in C”, 2ndEdition, Oxford University Press,2013.

**Web References:**

1. http://www.cprogramming.com/
2. http://www.c4learn.com/

**Course Articulation Matrix**

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

High-3; Medium-2; Low-1

<table>
<tr><td colspan="1">Course Code: 19MESC4001</td><td colspan="3">Course Title: Engineering Drawing<br>(Common to AU, ME, CS, IT, EC,AD,SC and EI)</td></tr>
<tr><td colspan="2">Course Category: Engineering Science</td><td colspan="2">Course Level: Introductory</td></tr>
<tr><td>L:T:P(Hours/Week)<br>1: 0: 3</td><td>Credits: 2.5</td><td>Total Contact Hours: 60</td><td>Max Marks:100</td></tr>
</table>

**Pre-requisites**

- NIL

**Course Objectives**

The course is intended to:

1. Develop skills for communication of concepts and ideas.
2. Expose them to existing national standards related to technical drawings.

**Unit I ORTHOGRAPHIC PROJECTION 12 Hours**

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning. Projection of points, Projection of straight lines located in the first quadrant. Determination of true lengths and true inclinations. Visualization principles –conversion of pictorial into orthographic views.

**Unit II PROJECTION OF SOLIDS 12 Hours**

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

**Unit III PROJECTION OF SECTIONED SOLIDS 12 Hours**

Sectioning of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by cutting planes inclined to one reference plane and perpendicular to the other – Orthographic views of sections of simple solids.

**Unit IV DEVELOPMENT OF SURFACES 12 Hours**

Development of lateral surfaces of simple and truncated solids – Prisms, pyramids, cylinders and cones.

**Unit V ISOMETRIC PROJECTION 12 Hours**

Principles of isometric projection – Isometric scale – Isometric projections of simple solids and truncated solids.

| Course Outcomes<br>At the end of this course, students will be able to: | Cognitive Level |
|---|---|
| CO1: Sketch the orthographic projections of the given pictorial view of the object using first angle projection. | Apply |
| CO2: Sketch the projections of simple solids such as prism, pyramid, cylinder and cone using rotating object method. | Apply |
| CO3: Sketch the projections of simple sectioned solids with all necessary dimensions meeting the standards. | Apply |
| CO4: Sketch the lateral surface of simple solids using straight line and radial line development methods. | Apply |
| CO5: Sketch the isometric view of simple solids and truncated solids using principles of isometric projection. | Apply |

**Text Book(s):**


T1. Cencil Jensen, Jay D.Helsel and Dennis R. Short, " Engineering Drawing and Design", Tata McGraw Hill India, New Delhi, 7th Edition, 2017.

T2. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, Gujarat, 53rd Edition, 2015.

T3. K. V. Natrajan, "A Text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 48th Edition, 2018.


**Reference Book(s):**


R1. BasantAgarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill India, New Delhi, 2nd Edition, 2013.

R3. John K.C., "Engineering Graphics", PHI Learning, Delhi, 1st Edition, 2009.

R4. Dhananjay A. Jolhe, "Engineering Drawing with an introduction to AutoCAD" TataMcGraw India, New Delhi, 3rd Edition, 2008.


**<u>Publications of Bureau of Indian Standards</u>**

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

**Web References:**

1. http://nptel.ac.in/courses/112103019/
2. https://en.wikipedia.org/wiki/Engineering_drawing

## Course Articulation Matrix

| CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | 2 | 2 | - | - | 2 | 3 | 2 | - | 2 | 2 | 2 |
| **CO2** | 3 | 2 | 2 | 2 | 2 | - | - | 2 | 3 | 2 | - | 2 | 2 | 2 |
| **CO3** | 3 | 2 | 2 | 2 | 2 | - | - | 2 | 3 | 2 | - | 2 | 2 | 2 |
| **CO4** | 3 | 2 | 2 | 2 | 2 | - | - | 2 | 3 | 2 | - | 2 | 2 | 2 |
| **CO5** | 3 | 2 | 2 | 2 | 2 | - | - | 2 | 3 | 2 | - | 2 | 2 | 2 |

High-3; Medium-2; Low-1

| Course Code:19CHMG6201 | Course Title: Environmental Sciences (Common to all B.E/B.Tech Programmes) | |
|---|---|---|
| **Course Category: Mandatory Non-Credit Course** | **Course Level: Introductory** | |
| **L:T:P(Hours/Week) 1: 0: 0** | **Total Contact Hours:15** | **Max. Marks: 100** |

**Pre-requisites**

- NIL

**Course Objectives**

The course is intended to:

1. Create awareness for conservation and equitable use of natural resources.
2. Explain the measures of prevention of pollution and disaster management.
3. State the importance of environmental legislation in India.
4. Expose the general environmental issues relevant to human health.
5. Explain the innovative measures for day to day environmental issues.

**Unit I NATURAL RESOURCES 2 Hours**

Role of individual in conservation of natural resources; Equitable use of resources for sustainable lifestyles.

**Unit II ENVIRONMENTAL POLLUTION AND DISASTER MANAGEMENT 2 Hours**

Role of an individual in prevention of pollution; Disaster management : floods, earthquake, cyclone and landslides.

**Unit III ENVIRONMENTAL ETHICS AND LEGISLATIONS 2 Hours**

Environmental ethics : Environment Protection Act; Air Act; Water Act ; Wildlife Protection Act; Forest Conservation Act; Issues involved in enforcement of environmental legislation.

**Unit IV ENVIRONMENTAL ISSUES AND PUBLIC AWARNESS 2 Hours**

Public awareness - Environment and human health

**Unit V ENVIRONMENTAL ACTIVITIES 7 Hours**

**(a) Awareness Activities:**

i) Small group meetings about water management, promotion of recycle use, generation of less waste, avoiding electricity waste

ii) Slogan making event

iii) Poster making event

**(b) Actual Activities:**

i) Plantation

ii) Cleanliness drive

iii) Drive for segregation of waste

iv) To know about the different varieties of plants

v) Shutting down the fans and ACs of the campus for an hour or so

| Course Outcomes | Cognitive Level |
|---|---|
| At the end of this course, students will be able to: | |
| CO1: Describe the measures for conservation and equitable use of natural resources | Understand |
| CO2: Describe the measures for pollution prevention and disaster management | Understand |
| CO3: Brief the importance of environmental legislation in India . | Understand |
| CO4: Explain the general environmental issues in relevant to human health | Understand |
| CO5: Demonstrate innovative measures for day to day environmental issues | Understand |

**Text Book(s):**


T1. Benny Joseph, "Environmental Studies", Tata McGraw Hill, New Delhi, 2006.

T2. Mackenzie Davis and Susan Masten, "Principles of environmental engineering and science", Mc-Graw Hill, 3rd Edition, 2014.


**Reference Book(s):**


R1. Trivedi R.K. "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards", Vol.I and II, Enviro Media.

R2. Cunningham, W.P.Cooper,T.H. Gorhani, "Environmental Encyclopedia", Jaico Publishing House, Mumbai, 2001.


**Course Articulation Matrix**

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

High-3; Medium-2; Low-1

| | | | |
|---|---|---|---|
| **Course Code: 19PSHG6003** | **Course Title:HERITAGE OF TAMILS (Common to all B.E/B.TechProgrammes)** | | |
| **Course Category: Humanities** | | **Course Level: Introductory** | |
| **L:T:P (Hours/Week) 1: 0 :0** | **Credit: 1** | **Total Contact Hours: 15** | **Max Marks:100** |

**Pre–requisites**

- NIL

**Course Objectives**

The course is intended to:

1. Understand the Heritage of Tamils in terms of Language and Literature, Rock Art Paintings to Modern Art – Sculpture, Folk and Martial Arts, Thinai Concept.
2. Understand the Contribution of Tamils to Indian National Movement and IndianCulture.

**HERITAGE OF TAMILS**

**UNIT I LANGUAGE AND LITERATURE 3**

Language Families in India - Dravidian Languages – Tamil as a Classical Language – Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

**UNIT II HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE 3**

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

**UNIT III FOLK AND MARTIAL ARTS** **3**

Therukoothu, Karagattam, VilluPattu, KaniyanKoothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

**UNIT IV THINAI CONCEPT OF TAMILS** **3**

Flora and Fauna of Tamils &Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

**UNIT V CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIANCULTURE** **3**

Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

**TOTAL : 15 PERIODS**

| **Course Outcomes**<br>At the end of this course, students will be able to: | **Cognitive Level** |
|---|---|
| CO.1 Understand the Heritage of Tamils in terms of Language and Literature, Rock Art Paintings to Modern Art – Sculpture, Folk and Martial Arts, Thinai Concept. | Understand |
| CO.2 Understand the Contribution of Tamils to Indian National Movement and IndianCulture. | Understand |

## TEXT - CUM REFERENCE BOOKS


1 தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே.பிள்ளை
(வெளியீடு. தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி – வைகை நதிக்கரையில் சங்க கால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by:
Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.


## Course Articulation Matrix

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - |
| CO2 | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - |

High–3; Medium–2; Low–1

| Course Code: 19PSHG6003 | Course Title:HERITAGE OF TAMILS (Common to all B.E/B.TechProgrammes) | | |
|---|---|---|---|
| Course Category: Humanities | | Course Level: Introductory | |
| L:T:P (Hours/Week) 1: 0 :0 | Credit: 1 | Total Contact Hours: 15 | Max Marks:100 |

**Pre–requisites**

- NIL

**Course Objectives**

மாணவர்கள் இப்பாடத்தை கற்றலின் மூலம்

CO.1 மொழி மற்றும் இலக்கியம், பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை , நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள் , திணைக் கோட்பாடுகள் மூலம் தமிழர் மரபை அறிந்து கொள்ள இயலும்.

CO.2இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பை அறிந்து கொள்ள இயலும்.

## தமிழர் மரபு

**அலகு 1 – மொழி மற்றும் இலக்கியம்** 3

இந்திய மொழிக் குடும்பங்கள் – திராவிட மொழிகள் – தமிழ் ஒரு செம்மொழி – தமிழ் செவ்விலக்கியங்கள் – சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை – சங்க இலக்கியத்தில் பகிர்தல் அறம் – திருக்குறளில் மேலாண்மைக் கருத்துக்கள் – தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் – பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் – சிற்றிலக்கியங்கள் – தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி –தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

**அலகு 2 – மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை** 3

நடுகல் முதல் நவீன சிற்பங்கள் வரை – ஐம்பொன் சிலைகள் – பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் – தேர் செய்யும் கலை – சுடுமண் சிற்பங்கள் – நாட்டுப்புறத் தெய்வங்கள் – குமரிமுனையில் திருவள்ளுவர் சிலை – இசைக் கருவிகள் – மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் – தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

**அலகு 3 – நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்** 3

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

**அலகு 4 – தமிழர்களின் திணைக் கோட்பாடுகள்** **3**

தமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் – தமிழர்கள் போற்றிய அறக் கோட்பாடு – சங்க காலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் – சங்ககால நகரங்களும் துறைமுகங்களும் – சங்க காலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல் கடந்த நாடுகளில் சோழர்களின் வெற்றி.

**அலகு 5 – இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு** **3**

இந்திய விடுதலைப் போரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறபகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் – சுய மரியாதை இயக்கம் – இந்திய மருத்துவத்தில் சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத் துப் படிகள்– தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

**TOTAL : 15 PERIODS**

| **Course Outcomes** | | **Cognitive Level** |
|---|---|---|
| மாணவர்கள் இப்பாடத்தை கற்றபின் | | |
| **CO.1** | மொழி மற்றும் இலக்கியம், பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை , நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள் , திணைக் கோட்பாடுகள் மூலம் தமிழர் மரபை அறிந்து கொள்வார்கள். | அறிதல் (Understand) |
| **CO.2** | இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பை அறிந்து கொள்வார்கள். | அறிதல் (Understand) |

## TEXT - CUM REFERENCE BOOKS

1 தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே.பிள்ளை
(வெளியீடு. தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி – வைகை நதிக்கரையில் சங்க கால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by:
Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

### Course Articulation Matrix

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - |
| CO2 | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - |

High–3; Medium–2; Low–1

**Semester – III**

<table>
<tr><td colspan="2">Course Code:19MABC1302</td><td colspan="2">Course Title: Numerical Methods and Linear Algebra (Common to EE,EC and EI)</td></tr>
<tr><td colspan="2">Course Category: Basic Science</td><td colspan="2">Course Level: Introductory</td></tr>
<tr><td>L:T:P(Hours/Week)<br>3: 1: 0</td><td>Credits:4</td><td>Total Contact Hours:60</td><td>Max Marks:100</td></tr>
</table>

**Pre-requisites**

- Matrices and Calculus
- Ordinary Differential Equation and Complex variables

**Course Objectives**

The course is intended to:

1. Solve the system of linear equations, nonlinear equations & Calculate the dominant Eigen value.
2. Determine the unknown values from the given set of data & Compute derivatives and integrals.
3. Solve first ordinary differential equation.
4. Apply the concept of vector spaces to electrical network problems.
5. Apply the concept of Inner product spaces in Fourier approximation.

**Unit I SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS 9+3 Hours**

Solution of system of linear equations – Direct methods: Gaussian elimination method – Indirect methods: Gauss Jacobi method, Gauss-Seidel method – sufficient conditions for convergence – Solution of nonlinear equations: Newton Raphson method – Power method to find the dominant Eigen value and the corresponding Eigen vector. Application of Eigen value and the corresponding Eigen vector.

**Unit II INTERPOLATION, NUMERICAL DIFFERENTIATION AND INTEGRATION 9+3 Hours**

Newton's forward, backward interpolation — Lagrange’s interpolation. Numerical Differentiation and Integration — Trapezoidal rule — Simpson’s 1/3 rule — Double integration using Trapezoidal rule.

**Unit III NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATION 9+3 Hours**

Numerical solution of first order ordinary differential equation-Single step method: Taylor's series-Euler's method –Runge-Kutta method of fourth order — Multi step method: Milne’s and Adams – Bash forth predictor corrector methods for solving first order equations.

**Unit IV VECTOR SPACES 9+3 Hours**

System of linear equations -Vector spaces- Subspace of a vector space- basis and dimension of vector space - linear combination and spanning sets of vectors -linear independence and linear dependence of vectors-Row space, Column space and Null space- Rank and nullity of subspaces. Applications to linear equations: Simple electrical network problems to find loop current using Kirchhoff’s voltage law.

**Unit V ORTHOGONALITY AND INNER PRODUCT SPACES 9+3 Hours**

Inner product of vectors: length of a vector, distance between two vectors, and orthogonality of vectors-Orthogonal projection of a vector-Gram-Schmidt process to produce orthogonal and orthonormal basis -Inner product spaces- Fourier approximation of continuous functions using inner product spaces.

| **Course Outcomes** | **Cognitive Level** |
|---|---|
| At the end of this course, students will be able to: | |
| CO1: Solve the system of linear equations, nonlinear equations & calculate the dominant Eigen value. | Apply |
| CO2: Determine the unknown values from the given set of data & Compute derivatives and integrals. | Apply |
| CO3: Solve first ordinary differential equation. | Apply |
| CO4: Apply the concept of vector spaces to electrical network problems. | Apply |
| CO5: Apply the concept of Inner product spaces in Fourier approximation | Apply |

**Text Book(s):**


T1. Grewal, B.S. and Grewal, J. S., “Numerical Methods in Engineering and Science”, Eleventh Edition, Khanna Publishers, New Delhi, 2013.

T2. David C Lay, “Linear Algebra and its Applications’, 5th Edition, Pearson Education, 2015.


**Reference Book(s):**


R1. Gerald, C. F. and Wheatley, P. O., “Applied Numerical Analysis”, Seventh Edition, Pearson Education Asia, New Delhi, 2006.

R2. Jain M. K., Iyengar, S. R. and Jain, R. K, “Numerical Methods for Scientific and Engineering Computation’, New Age Publishers, 2012.

R3. Sastry.S.S “Introductory Methods of Numerical Analysis”, 4th Edition, PHI, 2010.

R4. Gilbert Strang, “Linear algebra and its Applications’, 4th Edition, Cengage Learning India Private Limited, 2012.

**Web References:**

1. http://nptel.ac.in/courses/122104018/node2.html
2. http://nptel.ac.in/courses/111105038/

**Course Articulation Matrix**

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

High-3; Medium-2;Low-1

| | | | |
|---|---|---|---|
| **Course Code:19EICN1301** | **Course Title: Electron Devices and Circuits** | | |
| **Course Category: Professional Core** | | **Course Level: Practice** | |
| **L:T:P(Hours/Week)**<br>**3: 0: 0** | **Credits: 3** | **Total Contact Hours:45** | **Max Marks:100** |

**Pre-requisites**

- NIL

**Course Objectives**

The course is intended to:

1. Explain the operation of Transistors.
2. Explain the operation of Transistor as amplifiers.
3. Explain the structure and applications of thyristors and special diodes
4. Explain the concept of Feedback amplifiers and oscillators
5. Explain the function of wave shaping circuits and multivibrators

**Unit I TRANSISTORS 9 Hours**

BJT, JFET, MOSFET- structure, operation, characteristics -Transistor Biasing

**Unit II AMPLIFIERS 9 Hours**

BJT small signal model – Analysis of CE, CB, CC amplifiers- Gain and frequency response –FET small signal model, Differential Amplifier, Multistage amplifier- Two stage RC coupled Amplifier, Tuned amplifier-Gain and Frequency Response.

**Unit III THYRISTORS AND SPECIAL DIODES 9 Hours**

UJT ,SCR,TRIAC,DIAC ,IGBT -structure and characteristics, Schottky barrier diode-Varactor diode –Tunnel diode- LASER diode

**Unit IV FEEDBACK AMPLIFIERS AND OSCILLATOR 9 Hours**

Advantages of negative feedback – voltage / current, series, Shunt feedback –positive feedback –Condition for oscillations, phase shift – Wien bridge, Hartley, Colpitts and Crystal oscillators.

**Unit V WAVE SHAPING CIRCUITS and MULTIVIBRATOR 9 Hours**

Wave shaping circuits-Differentiator -Integrator- Diode Clipper -Clampers-Multivibrators-Schmitt trigger.

| Course Outcomes<br>At the end of this course, students will be able to: | Cognitive Level |
|---|---|
| CO1:Explain the structure, characteristics and biasing of BJT and FET. | Understand |
| CO2:Determine Frequency Response and gain of BJT, FET and multistage amplifiers. | Understand |
| CO3: Illustrate the current voltage characteristics of UJT, thyristors and special diodes. | Understand |
| CO4:Analyze Feedback amplifiers and different oscillators for different frequency | Apply |
| CO5:Design different wave shaping circuits and multivibrators. | Apply |

**Text Book(s):**

T1. David A. Bell ,"Electronic devices and circuits", Oxford University higher education, 5th Edition,2010.

T2. Robert L.Boylestad, "Electronic Devices and Circuit Theory", 11th Edition, Pearson prentice hall, 2015.

**Reference Book(s):**

R1. Balbir Kumar, Shail.B.Jain, "Electronic devices and circuits" PHI learning private limited, 2nd Edition, 2014.

R2. Thomas L.Floyd, "Electronic devices" Conventional current version, Pearson prentice hall, 10thEdition, 2017.

R3. J.Millman, C.C.Halkias, and SatyabrathaJit "Electronic Devices and Circuits", Tata McGraw Hill, 2nd Edition, 2008.

R4. Robert L.Boylestad, "Electronic Devices and Circuit Theory", 11th Edition, Pearson prentice hall, 2015.

**Web References:**

1. https://nptel.ac.in/courses/122106025/
2. https://nptel.ac.in/courses/117103063/

## Course Articulation Matrix

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

High-3; Medium-2;Low-1

<table>
<tr><td colspan="2">Course Code:19EICN1302</td><td colspan="3">Course Title: Electrical Machines and Measurements</td></tr>
<tr><td colspan="3">Course Category: Professional Core</td><td colspan="2">Course Level: Practice</td></tr>
<tr><td>L:T:P(Hours/Week) 3: 0: 0</td><td colspan="2">Credits:3</td><td>Total Contact Hours:45</td><td>Max Marks:100</td></tr>
</table>

**Pre-requisites**

- NIL

**Course Objectives**

The course is intended to:

1. Summarize the operation and characteristics of types of DC Machine.
2. Demonstrate the different types of induction motor.
3. Explain the construction and working of meters used to measure current, voltage, Resistance, Inductance and capacitance.
4. Explain the construction and working of measurement techniques for power and energy.
5. Elaborate the construction and working of potentiometer and instrument transformers.

**Unit I D.C. MACHINES 9 Hours**

Construction of D.C. Machines - Principle of operation of D.C. generator -EMF equation -Various excitation schemes- Characteristics of D.C. generators- Principle of operation of D.C. motor-Types-Torque equation-Characteristics-Starters:3 point and 4 point starters.

**Unit II A.C. MACHINES 9 Hours**

Three phase Induction motor: principle of operation, Types- Starting methods and Speed control. Single phase induction motors: Double field revolving theory- Types - Capacitor start capacitor run motors.

**Unit III TRANSFORMERS AND SPECIAL MACHINES 9 Hours**

Transformers: Principle, Construction, EMF Equation and Equivalent Circuit –Instrument Transformer:-C.T and P.T construction, theory and operation. Stepper motor-Servo Motors -BLDC.

**Unit IV MEASUREMENT OF ELECTRICAL PARAMETERS 9 Hours**

Types of ammeters and voltmeters – PMMC Instruments – Moving Iron Instruments – Dynamometer type Instruments – bridges for measurement of R, L and C - Wheatstone bridge, Kelvin double bridge, Maxwell bridge, Wein bridge, Schering bridge

**Unit V POWER AND ENERGY MEASUREMENTS 9 Hours**

Electro dynamic type wattmeter – Theory and its errors– LPF wattmeter– Phantom loading – Measurement of three phase power- 3 wire and 4 wire supply- single phase and three phase energy meter - theory and Adjustments.

| **Course Outcomes** | **Cognitive Level** |
| --- | --- |
| At the end of this course, students will be able to: | |
| CO1: Summarize the characteristics of different types of DC Machines and starters. | Understand |
| CO2: Summarize the characteristics of different types of AC Machines and starters. | Understand |
| CO3: Explain the principles and operation of transformers and special machines. | Understand |
| CO4: Select a suitable instrument for measurement of voltage, current, R, L and C | Apply |
| CO5: Select a suitable method for the measurement of power and energy in single and three phase circuits. | Apply |

**Text Book(s):**


T1. Nagrath, I.J., and Kothari, D.P., "Electrical Machines", 4th Edition, Tata McGraw - Hill, 2016.

T2. R.B. Northrop, Introduction to Instrumentation and Measurements, 3rd Edition, Taylor & Francis, New Delhi, 2017

T3. J.J. Carr, Elements of Electronic Instrumentation and Measurement, Pearson Education India, New Delhi, 2011 (Ref)

T4. H.S. Kalsi, Electronic Instrumentation, Tata McGraw-Hill, New Delhi, 2010 (Ref)


**Reference Book(s):**


R1. Theraja, B.L., "A Text book of Electrical Technology", Vol.II, S.C Chandand Co., New Delhi, 2007. (Text Book)

R2. A.K. Sawhney, A Course in Electrical & Electronic Measurements & Instrumentation, DhanpatRai and Co, New Delhi, 2010 (Text Book)

R3. Bell, A.D., "Electronic Instrumentation and Measurements", 3rd Edition, Oxford University Press India, 2013.

**Web References:**

1. https://nptel.ac.in
2. https://qualifygate.com
3. https://www.electrical4u.com

**Course Articulation Matrix**

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

High-3; Medium-2;Low-1

| Course Code:19EECC2301 | Course Title: Digital Electronics<br>(Common to EE and EI) | | |
|---|---|---|---|
| Course Category: Professional Core | | Course Level: Practice | |
| L:T:P(Hours/Week)3: 0: 2 | Credits:4 | Total Contact Hours:75 | Max Marks:100 |

**Pre-requisites**

- Fundamental of Instrumentation Engineering

**Course Objectives**

The course is intended to:

1. Illustrate the number systems, Boolean laws and simplification techniques
2. Design Combinational circuits
3. Design synchronous sequential circuits
4. Design asynchronous sequential circuits
5. Examine the various memory devices, shift registers and logic families

**Unit I NUMBER SYSTEM AND BOOLEAN ALGEBRA 9 Hours**

Review of Number Systems - Complements: 1's and 2's - Arithmetic operation of Signed binary numbers - Boolean Algebra: Basic theorems, Simplification of Boolean functions, Representation of Boolean function in canonical and standard forms - Simplification of Boolean expressions using K maps and Quine Mccluskey method.

**Unit II COMBINATIONAL CIRCUITS 9 Hours**

Basic Gates, Universal gate implementation, Design of Adder, Subtractor, Comparators, Code converters, Encoders, Decoders, Multiplexers, De-multiplexers- Function realization using multiplexer.

**Unit III SYNCHRONOUS SEQUENTIAL CIRCUITS 9 Hours**

Flip Flops: SR, JK, T, D- Level and Edge Triggering- Analysis of Synchronous sequential circuits - Design of Synchronous sequential circuits with state diagram, state table, state reduction and state assignment - Design of counter.

**Unit IV ASYNCHRONOUS SEQUENTIAL CIRCUITS 9 Hours**

Analysis of Asynchronous Sequential Circuits - Design of Asynchronous sequential circuits with primitive flow table, State Reduction and State Assignment- Races, Cycles and Hazards: Static, Dynamic, Essential, Hazards Elimination.

**Unit V MEMORY DEVICES, SHIFT REGISTERS AND LOGIC FAMILIES 9 Hours**

Memories: RAM,ROM, PROM, EPROM – FPGA - Shift registers – Ripple counters –

Logic families: TTL, ECL, CMOS.

**Laboratory Component 30 Hours**

1. Simplification of Boolean Expression using K map and its implementation.
2. Design of full adder/ full subtractor using logic gates
3. Design of encoder/ decoder using logic gates
4. Design of multiplexer using logic gates
5. Design of basic flip flops
6. Design of shift registers

| **Course Outcomes** | **Cognitive Level** |
|---|---|
| At the end of this course, students will be able to: | |
| CO1: Illustrate the number systems, Boolean laws and simplification techniques used in digital design | Understand |
| CO2: Design and realize the combinational circuits using logic gates | Apply |
| CO3: Design and construct synchronous sequential circuits using basic flip flops | Apply |
| CO4: Design asynchronous sequential circuits eliminating hazards and races | Apply |
| CO5: Explain the various memory devices, shift registers and logic families | Understand |

**Text Book(s):**

T1.Morris Mano. M. Michael D Ciletti, “Digital Design”, Pearson Education, 5th Edition, 2012.

T2.John F.Wakerly, Digital Design Principles and Practice, Pearson Education, 5th edition, 2018

**Reference Book(s):**

R1. Malvino and Leach, “Digital Principles and Applications”, Tata McGraw Hill, New Delhi, 8th edition, 2014,

R2. S.Salivahanan and S.Arivazhagan, “Digital Circuits and Design”, Oxford University Press, 5th edition, 2018.

R3.A.Anandkumar, Fundamentals of digital circuits, $4^{th}$Edition, PHI Learning Pvt.Ltd, 2016

R4. John M.Yarbrough, “Digital Logic, Application & Design”, Thomson, 2010

R5. Donald D. Givone, “Digital Principles and Design”, McGraw Hill Education,2017

**Web References:**

1.https://nptel.ac.in/courses/117105080/

2. https://nptel.ac.in/courses/117106086/

**Course Articulation Matrix**

| CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 1 | - | - | 2 | - | - | 1 | 3 | 1 | - | - | - | - |
| CO2 | 3 | 2 | 1 | 1 | 2 | - | - | 1 | 3 | 1 | - | - | - | - |
| CO3 | 3 | 2 | 1 | 1 | 2 | - | - | 1 | 3 | 1 | - | - | - | - |
| CO4 | 3 | 2 | 1 | 1 | 2 | - | - | 1 | 3 | 1 | - | - | - | - |
| CO5 | 2 | 1 | - | 1 | 1 | - | - | 1 | 3 | 1 | - | - | - | - |

High-3; Medium-2; Low-1

| | | | |
|---|---|---|---|
| **Course Code:19EICN2301** | **Course Title: Sensors and Transducers** | | |
| **Course Category: Professional Core** | | **Course Level: Practice** | |
| **L:T:P(Hours/Week)**<br>**3: 0: 2** | **Credits:4** | **Total Contact Hours: 75** | **Max Marks:100** |

**Pre-requisites**

- Fundamentals of Electrical Engineering
- Engineering Physics

**Course Objectives**

The course is intended to:

1. Summarize the static and dynamic characteristics of Transducers.
2. Explain the principle and application of resistance transducers.
3. Describe the principle and application of variable inductance and capacitance transducers
4. Explain the principle and application of various types of special transducers.
5. Identify the application of different transducers.

**Unit I CHARACTERISTICS OF TRANSDUCERS 9 Hours**

Units and standards - Classification of errors - Error analysis – Statistical methods – Odds and uncertainty – Classification of transducers – characteristics of transducers – Zero, I and II order transducers - Response to step and impulse inputs.

**Unit II RESISTIVE TRANSDUCERS 9 Hours**

Principle of operation, construction details, characteristics and applications of potentiometer, strain gauge, resistance thermometer – 3wire & 4 wire RTD, Thermistor, hot-wire anemometer, piezo resistive sensor and humidity sensor.

**Unit III INDUCTIVE AND CAPACITIVE TRANSDUCERS 9 Hours**

Induction potentiometer – Variable reluctance transducers – EI pick up – Principle of operation, construction details, characteristics and applications of LVDT –Capacitive transducer and types – Capacitor microphone.

**Unit IV SPECIAL TRANSDUCERS 9 Hours**

Piezoelectric transducer - Hall Effect transducer – Magneto elastic load cell- Digital transducers : linear and rotary type –Fibre optic sensors – magnetometer – Nano sensor – MEMS - Smart Sensor

**Unit V APPLICATIONS OF TRANSDUCERS 9 Hours**

Strain Gauge: Load Cell – Torque measurement – Accelerometer. Piezo-electric type: Load Cell – Accelerometer – Seismic instrument. LVDT: Displacement – Accelerometer. Inductive Type: Accelerometer. Resistive and Capacitive type Humidity and Moisture Measurement

**List of Experiments 30 Hours**

1. Plot the hysteresis curve for Load cell and strain gauge.
2. Plot the Characteristics of LVDT and Capacitive type transducers.
3. Plot the Characteristics curve and step response curve of RTD.
4. Plot the Characteristics of Piezo electric and Hall Effect transducers.
5. Plot the hysteresis curve for torque sensor.
6. Measurement of Speed using optical transducer

| **Course Outcomes** | **Cognitive Level** |
|---|---|
| At the end of this course, students will be able to: | |
| CO1.Analyse the static and dynamic characteristics of transducers. | Apply |
| CO2.Explain the principle and application of resistance transducers. | Understand |
| CO3.Describe the principle and application of variable inductance and capacitance transducers. | Understand |
| CO4.Illustrate the concept of special and digital type transducers. | Understand |
| CO5. Analyse the characteristics experimentally for different transducers. | Apply |

**Text Book(s):**


T1.John P.Bentley, Principles of Measurement Systems, III Edition, Pearson Education, 2015.

T2.Doebelin E.O. and Manik D.N., Measurement Systems – Applications and Design, Special Indian Edition, Tata McGraw Hill Education Pvt. Ltd., 2017.


**Reference Book(s):**


R1.D. Patranabis, Sensors and Transducers, 2nd edition, Prentice Hall of India, 2013. E.A

R2.Neubert H.K.P., Instrument Transducers – An Introduction to their Performance and Design, Oxford University Press, Cambridge, 2013

R3.W.Bolton, Engineering Science, Elsevier Newnes, 5th Edition, 2006

**Web Reference:**

1. nptel.ac.in/courses/112103174
2. http://nptel.ac.in/courses/108105064
3. http://nptel.ac.in/courses/112106140

**Course Articulation Matrix**

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

High-3; Medium-2;Low-1

| Course Code:19EICN3301 | Course Title: Electron Devices and Circuits Laboratory | | |
|---|---|---|---|
| **Course Category: Professional Core** | | **Course Level: Practice** | |
| **L:T:P(Hours/Week) 0: 0: 3** | **Credits:1.5** | **Total Contact Hours:45** | **Max Marks:100** |

**Pre-requisites**

- NIL

**Course Objectives**

The course is intended to:

1. Analyze the characteristics of Transistors and Thyristors
2. Analyze the characteristics of transistor amplifiers.
3. Design transistor based voltage regulator and logic gates
4. Analyze different oscillators.
5. Analyze the characteristics of different wave shaping circuits and multivibrator

**List of Experiments**

1. Analyze the VI Characteristics of BJT.
2. Analyze the VI Characteristics of FET.
3. Analyze the Characteristics of SCR and TRIAC.
4. Analyze the Frequency Response of CE amplifier.
5. Design and verify Series voltage regulator using transistor
6. Design and verify transistor based logic gates.
7. Design and verify Two stage RC coupled amplifier.
8. Design and verify RC Phase shift Oscillator.
9. Design and verify Wave shaping circuits - Clipper /Clamper.
10. Design and verify Astable Multivibrator

| Course Outcomes: At the end of this course, students will be able to: | Cognitive/ Affective |
|---|---|
| CO1:Analyze the characteristics of Transistors and Thyristors using hardware /simulation. | Apply |
| CO2:Analyze the characteristics of transistor amplifiers using hardware /simulation. | Apply |
| CO3:Design transistor based voltage regulator and verify using hardware /simulation. | Apply |
| CO4:Analyze different oscillators using hardware /simulation. | Apply |
| CO5:Analyze the characteristics of different wave shaping circuits and multivibrator using hardware /simulation. | Apply |

**Course Articulation Matrix**

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

High-3; Medium-2;Low-1

<table>
<tr><td colspan="2">Course Code:19EICN3302</td><td colspan="2">Course Title: Electrical Machines and Measurements Laboratory</td></tr>
<tr><td colspan="2">Course Category: Professional Core</td><td colspan="2">Course Level: Introductory</td></tr>
<tr><td>L:T:P(Hours/Week)<br>0: 0: 3</td><td>Credits:1.5</td><td>Total Contact Hours:45</td><td>Max Marks:100</td></tr>
</table>

**Pre-requisites**

- NIL

**Course Objectives**

The course is intended to:

1. Facilitate the students to study the characteristics of DC shunt generator.
2. Obtain the various load characteristics of D.C motor.
3. Study the load characteristics of induction motor under various load condition
4. Provide practical knowledge on different measuring devices.
5. Measurement of power using different measurement devices.

**List of Experiments**

1. Open circuit and load characteristic of DC Shunt Generator
2. Load test on DC Shunt Motor and series motor
3. Speed control of DC motor
4. Load test on Single - phase Induction Motor
5. Load test on Three - phase Induction Motor
6. Wheatstone and Kelvin’s bridge for measurement of resistance
7. Schering Bridge for capacitance measurement and Maxwell Bridge for inductance measurement.
8. Calibration of Energy meter by Phantom Loading
9. Measurement of power and energy in 3 phase circuits
10. Measurement of current and voltage using CT and PT

| Course Outcomes: At the end of this course, students will be able to: | Cognitive/ Affective |
|---|---|
| CO1:Analyze the performance characteristics of DC shunt generators by conducting load tests | Apply |
| CO2:Implement the speed control techniques for DC motor | Apply |
| CO3:Determine the performance characteristics of induction machine by conducting direct load tests. | Apply |
| CO4:Design a bridge circuit to measure resistance, inductance and capacitance | Apply |
| CO5:Measure current, voltage, power and energy using different measurement devices. | Apply |

**Course Articulation Matrix**

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

High-3; Medium-2;Low-1

| Course Code: 19PSHG6004 | Course Title:TAMILS AND TECHNOLOGY (Common to all B.E/B.TechProgrammes) | | |
|---|---|---|---|
| Course Category: Humanities | | Course Level: Introductory | |
| L:T:P (Hours/Week) 1: 0 :0 | Credit: 1 | Total Contact Hours: 15 | Max Marks:100 |

**Pre–requisites**

- NIL

**Course Objectives**

The course is intended to:

1. Understand Weaving and Ceramic Technology, Design and Construction Technology, Manufacturing Technology, Agriculture and Irrigation Technology.
2. Understand the Scientific Tamil & Tamil Computing.

**TAMILS AND TECHNOLOGY**

**UNIT I WEAVING AND CERAMIC TECHNOLOGY 3**

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

**UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY 3**

Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions inSilappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- ThirumalaiNayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.

**UNIT III MANUFACTURING TECHNOLOGY 3**

Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and gold-Coins as source of history - Minting of Coins – Beads making-industries Stone beads -Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.

**UNIT IV AGRICULTURE AND IRRIGATION TECHNOLOGY 3**

Dam, Tank, ponds, Sluice, Significance of KumizhiThoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

**UNIT V SCIENTIFIC TAMIL & TAMIL COMPUTING 3**

Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.

**TOTAL : 15 PERIODS**

| **Course Outcomes** | **Cognitive Level** |
|---|---|
| At the end of this course, students will be able to: | |
| CO.1 Understand Weaving and Ceramic Technology, Designand Construction Technology, Manufacturing Technology, Agriculture and Irrigation Technology. | Understand |
| CO.2 Understand the Scientific Tamil & Tamil Computing. | Understand |

## TEXT - CUM REFERENCE BOOKS

1 தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே.பிள்ளை (வெளியீடு. தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி – வைகை நதிக்கரையில் சங்க கால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

## Course Articulation Matrix

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - |
| CO2 | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - |

High–3; Medium–2; Low–1

| Course Code: 19PSHG6004 | Course Title:TAMILS AND TECHNOLOGY (Common to all B.E/B.TechProgrammes) | | |
|---|---|---|---|
| Course Category: Humanities | | Course Level: Introductory | |
| L:T:P (Hours/Week) 1: 0 :0 | Credit: 1 | Total Contact Hours: 15 | Max Marks:100 |

**Pre–requisites**

- NIL

**Course Objectives**

மாணவர்கள் இப்பாடத்தை கற்றலின் மூலம்

**CO.1** நெசவு மற்றும் பானைத் தொழில்நுட்பம், வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம், உற்பத்தித் தொழில்நுட்பம், வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம் ஆகியன குறித்து அறிந்து கொள்ள இயலும்.

**CO.2** அறிவியல் தமிழ் மற்றும் கணினித் தமிழ் குறித்து அறிந்து கொள்ள இயலும்.

## தமிழரும் தொழில்நுட்பமும்

**அலகு 1 – நெசவு மற்றும் பானைத் தொழில்நுட்பம்** **3**

சங்க காலத்தில் நெசவுத் தொழில் – பானைத் தொழில்நுட்பம் – கருப்பு சிவப்பு பாண்டங்கள் – பாண்டங்களில் கீறல் குறியீடுகள்

**அலகு 2 – வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்** **3**

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் ஷ சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு – சங்க காலத்தில் கட்டுமானப் பொருட்களும் நடுகல்லும் – சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் – மாமல்லபுரச் சிற்பங்களும், கோவில்களும் – சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் – நாயக்கர் காலக் கோயில்கள் – மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம் மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் – செட்டிநாட்டு வீடுகள், பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ – சாரோசெனிக் கட்டிடக் கலை.

**அலகு 3 – உற்பத்தித் தொழில்நுட்பம்** **3**

கப்பல் கட்டும் கலை – உலோகவியல் – இரும்புத் தொழிற்சாலை – இரும்பை உருக்குதல், எஃகு – வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் – நாணயங்கள் அச்சடித்தல் – மணி உருவாக்கும் தொழிற்சாலைகள் – கல்மணிகள், கண்ணாடி மணிகள் – சுடுமண் மணிகள் – சங்கு மணிகள் – எலும்புத் துண்டுகள் – தொல்லியல் சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

**அலகு 4 வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம் 3**

அணை, ஏரி, குளங்கள், மதகு – சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம் – கால்நடை பராமரிப்பு – கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் – வேளாண்மை மற்றும வேளாண்மைச் சார்ந்த செயல்பாடுகள் – கடல்சார் அறிவு – மீன் வளம் – முத்து மற்றும் முத்துக் குளித்தல் – பெருங்கடல் குறித்த பண்டைய அறிவு – அறிவுசார் சமூகம்.

**அலகு 5 – அறிவியல் தமிழ் மற்றும் கணினித் தமிழ் 3**

அறிவியல் தமிழின் வளர்ச்சி – கணினித் தமிழ் வளர்ச்சி – தமிழ் நூல்களை மின் பதிப்பு செய்தல் – தமிழ் மென் பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல்விக் கழகம் – தமிழ் மின் நூலகம் – இணையத்தில் தமிழ் அகராதிகள் – சொற்குவைத் திட்டம்.

**TOTAL : 15 PERIODS**

| Course Outcomes | Cognitive Level |
|---|---|
| மாணவர்கள் இப்பாடத்தை கற்றபின் | |
| **CO.1** நெசவு மற்றும் பானைத் தொழில்நுட்பம், வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம், உற்பத்தித் தொழில்நுட்பம், வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம் ஆகியன குறித்து அறிந்து கொள்வார்கள். | அறிதல் (Understand) |
| **CO.2** அறிவியல் தமிழ் மற்றும் கணினித் தமிழ் குறித்து அறிந்து கொள்வார்கள். | அறிதல் (Understand) |

## TEXT - CUM REFERENCE BOOKS


1 தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே.பிள்ளை (வெளியீடு. தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி – வைகை நதிக்கரையில் சங்க கால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).

8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

**Course Articulation Matrix**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - |
| CO2 | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - |

High–3; Medium–2; Low–1

**Semester– IV**

| | | | |
|---|---|---|---|
| **Course Code:19MABG1401** | **Course Title: Probability and Statistics (Common to all)** | | |
| **Course Category: Basic Science** | | **Course Level: Introductory** | |
| **L:T:P(Hours/Week) 3: 1: 0** | **Credits:4** | **Total Contact Hours:60** | **Max Marks:100** |

**Pre-requisites**

- Matrices and Calculus
- Ordinary Differential Equation and Complex variables

**Course Objectives**

The course is intended to:

1. Calculate expectations and variances of random variables
2. Apply the concepts of standard distributions to solve practical problems
3. Calculate the correlation and regression for two variables
4. Test the samples based on hypothesis
5. Analyze the samples based on variance

**Unit I PROBABILITY AND RANDOM VARIABLES 9+3 Hours**

Axioms of Probability- Conditional Probability- Total Probability -Baye's Theorem- Random Variables- Probability Mass Function- Probability Density Functions- Properties - Moments- Moment generating functions and their properties.

**Unit II STANDARD DISTRIBUTIONS 9+3 Hours**

Binomial- Poisson- Uniform –Exponential- Normal Distributions and their properties-Functions of a random variable.

**Unit III TWO DIMENSIONAL RANDOM VARIABLES 9+3 Hours**

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and regression – Transformation of random variables.

**Unit IV TESTING OF HYPOTHESES 9+3 Hours**

Sampling Distributions- Testing of hypotheses for mean, variance, proportions and differences using Normal, t, Chi-Square and F distributions – Tests for independence of attributes and Goodness of fit.

**Unit V DESIGN OF EXPERIMENTS 9+3 Hours**

Analysis of Variance (ANOVA)- One way Classification – Completely Randomized Design(CRD) – Two way Classification – Randomized Block Design (RBD) – Latin square.

| Course Outcomes<br>At the end of this course, students will be able to: | Cognitive Level |
|---|---|
| CO1: Calculate expectations and variances of random variables | Apply |
| CO2: Apply the concepts of standard distributions to solve practical problems | Apply |
| CO3: Calculate the correlation and regression for two variables | Apply |
| CO4: Test the samples based on hypothesis | Apply |
| CO5: Analyze the samples based on variance | Apply |

**Text Book(s):**


T1. Veerajan T, "Probability, Statistics and Random process", 3rd Edition, Tata McGraw-Hill, New Delhi, 2017.

T2. Dr.J.Ravichandran, "Probability and Statistics for Engineers", 1st Edition, Wiley India Pvt.Ltd.,2010.


**Reference Book(s):**


R1. R.E. Walpole, R.H. Myers, S.L. Myers, and K Ye, "Probability and Statistics for Engineers and Scientists", 8th Edition Pearson Education, Asia, 2007.

R2. M.R. Spiegel,J. Schiller and R.A. Srinivasan, "Schaum's Outlines Probability and Statistics", Tata McGraw Hill edition, 2004.

R3. Morris DeGroot, Mark Schervish, "Probability and Statistics", Pearson Educational Ltd, 4th Edition, 2014.

R4. Johnson and C.B. Gupta,"Probability and Statistics for Engineers", 7th Edition,Pearson Education, Asia, 2007.


**Web References:**

1. https://onlinecourses.nptel.ac.in/111105041/
2. https://nptel.ac.in/downloads/111105041/
3. https://nptel.ac.in/courses/111105090/

## Course Articulation Matrix

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

High-3; Medium-2;Low-1

| Course Code :19EICN1401 | Course Title : Linear Integrated Circuits | | |
|---|---|---|---|
| Course Category: Professional Core | | Course Level: Practice | |
| L:T:P(Hours/Week)<br>3: 0: 0 | Credits:3 | Total Contact hours:45 | Max Marks:100 |

**Prerequisites:** The student should have undergone the course(s):

- Electronic Devices and Circuits

**Course Objectives**

**The course is intended to:**

1. Explain the IC packages and OP-AMP Characteristics
2. Design an amplifier and filter circuits using OPAMP
3. Design a converter circuits using OPAMP
4. Illustrate the internal functional blocks and the applications of special ICs like Timers, VCO, PLL circuits, regulator Circuits.
5. Summarize the special features of analog ICs.

**Unit I OPERATIONAL AMPLIFIER AND CHARACTERISTICS 9 Hours**

Introduction to Integrated Circuits – Types of IC packages - Thermal Characterization of IC Packages - OPAMP Internal blocks, Ideal OPAMP characteristics, DC characteristics, AC characteristics, Frequency response of OPAMP, Open-loop and closed-loop configurations.

**Unit II APPLICATIONS OF OP-AMP 9 Hours**

IC 741 - Inverting amplifier, Non Inverting amplifier, Summer, Differential amplifier, Differentiator, Integrator, Instrumentation amplifier, Log and Antilog amplifier, Active Filters: First and Second order active Low and high Pass filters.

**Unit III SPECIAL APPLICATIONS OF OP-AMP 9 Hours**

Comparators, Zero Crossing Detector - Schmitt Trigger- S/H circuit - I/V and V/I Converter – V/F and F/V Converter ,D/A converter: R-2R ladder and Weighted resistor types - A/D converter: Successive approximation and Flash types.

**Unit IV SPECIAL FUNCTION ICs 9 Hours**

555 Timer circuit – Functional block, characteristics & applications – 566 voltage controlled oscillator circuit – 565 Phase lock loop and applications, IC voltage regulators: Fixed and Variable regulators – 78XX, 79XX, 317, 723 regulators, Switching regulator.

**Unit V APPLICATION SPECIFIC ICs** **9 Hours**

Resistor chip – Rectifier ICs –LM35/AD590 Temperature sensor ICs– AD522 Instrumentation Amplifier - TL594 PWM ICs – L293 DC motor driver ICs– ULN2003 Stepper Motor Driver IC

| **Course Outcomes**<br>**At the end of the course students will be able to:** | **Cognitive Level** |
|---|---|
| **CO1:** Explain the structure of IC packages and frequency response of OPAMP | Understand |
| **CO2:**Design amplifier, differentiator, integrator and filters usingIC741 | Apply |
| **CO3:** Design a comparator and signal converter circuits usingIC741 | Apply |
| **CO4:** Describe the internal functional blocks and the applications of special ICs like Timers, PLL circuits and regulator Circuits. | Understand |
| **CO5:** Explain the functions of application specific ICs | Understand |

**Text Books**


T1. Ramakant A. Gayakward, 'Op-amps and Linear Integrated Circuits', 4thEdition, Pearson Education, 2016.

T2. Roy Choudhary.D., Sheil B. Jani, 'Linear Integrated Circuits', 4thEdition, New 2018.


**Reference Books**


R1. David A. Bell, 'Op-amp & Linear ICs', Prentice Hall of India, 2012.

R2. Jacob Millman, Christos C.Halkias, 'Integrated Electronics - Analog and Digital circuits system', Tata McGraw Hill, 2015.

R3. Robert F.Coughlin, Fredrick F.Driscoll, 'Op-amp and Linear ICs', Pearson Education, 4th edition, 2010.


**Web References**

1. https://onlinecourses.nptel.ac.in/explorer

## Course Articulation Matrix

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

High-3; Medium-2;Low-1

| | | | |
|---|---|---|---|
| **Course Code:19EICN1402** | **Course Title: Signals and Systems** | | |
| **Course Category: Professional Core** | | **Course Level: Practice** | |
| **L:T:P(Hours/Week)**<br>**3: 1 : 0** | **Credits:4** | **Total Contact Hours:60** | **Max Marks:100** |

**Pre-requisites**

- Matrices and Calculus
- Ordinary Differential equation and complex Variables

**Course Objectives**

The course is intended to:

1. Categorize various signals and systems and explain their mathematical representation.
2. Define sampling theorem and the need of signal reconstruction.
3. Realize the need of Fourier Series and Fourier Transform for continuous time signals.
4. Realize the need of Fourier Series and Fourier Transform for Discrete time signals.
5. Implement Z-Transform for discrete systems.

**Unit I Classification of Signals and Systems 9 + 3 Hours**

Introduction to signals and system, Continuous time(CT) and Discrete Time(DT) signals-Elementary signals, operation on independent and dependent variables, classification of CT and DT signals-periodic and Aperiodic, Deterministic and Random, Energy and Power-Impulse Signals, Time Shifting, Scaling-CT & DT systems-classification of systems-static and dynamic, Linear and Nonlinear, Time variant and Time invariant, causal and Non causal, stable and Unstable.

**Unit II Signal Discretization and LTI Systems 9 + 3 Hours**

Discretization of signals: Sample and Hold Circuits, Sampling: Sampling theorem, selection of sampling rate, Types of sampling, Aliasing and Quantization, Linear Time Invariant/Linear shift Invariant (LTI/LSI) systems, Linear and Circular Convolution, Overlap add and overlap save methods

**Unit III Fourier Representation of Continuous Time Signals 9 + 3 Hours**

Fourier Transform – Properties - Fourier representation of continuous time periodic signals-CTFS, Properties, Fourier representation of continuous time Non-periodic signals-CTFT, Properties

**Unit IV Fourier Representation of Discrete Time Signals 9 + 3 Hours**

Fourier representation of discrete time periodic signals-DTFS, Properties-Fourier representation of discrete time non- periodic signals-DTFT, properties.

**Unit V Applications of Z-Transform 9 + 3 Hours**

Z-Transform, ROC, Properties, Inverse Z Transform, Applications of Z-Transform

| Course Outcomes At the end of this course, students will be able to: | Cognitive Level |
|---|---|
| CO1: Classify signals and systems and familiarize their mathematical representation. | Understand |
| CO2: Describe sampling theorem and signal reconstruction | Understand |
| CO3: Apply Fourier series and Fourier Transform for continuous time signals | Apply |
| CO4: Apply Fourier series and Fourier Transform for discrete time signals | Apply |
| CO5: ApplyZ Transform for discrete systems | Apply |


**Text Books:**

T1.Allan V.Oppenheim, S.Wilsky and S.H.Nawab“ Signals and Systems”, Pearson Education, 2015.

T2.Simon Haykins and Barry Van Veen, “Signals and systems”, John Wiley and sons, 2nd EditionInc, 2018.

**Reference Books:**

R1.H.P.Hsu,RakeshRanjan, ”Signals and Systems”,Schaum’sOutlines,Tata McGraw Hill,Indian Reprint,2013

R2.Edward W Kamen& Bonnie’s Heck,”Fundamentals of Signals andSystems”,Pearson Education, 2014.

R3.B.P.Lathi,”Principles of Linear Systems and Signals”,2nd Edition,Oxford,2009.

R4.R.E.Zeimer,W.H.Tranter and R.D.Fannin,”Signals and Systems-Continuous and Discrete”,Pearson,2007.

R5.John AlanStuller,”AnIntroductionto signals and systems”,Thomson,2007.

**Web References:**

1. http://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011
2. http://nptel.ac.in/courses/117104074
3. http://www.nptel.ac.in/courses/117101055
4. https://www.tutorialspoint.com/signals_and_systems


**Course Articulation Matrix**

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

High-3; Medium-2;Low-1

| Course Code:19EICN2401 | Course Title: Industrial Instrumentation | | |
|---|---|---|---|
| **Course Category: Professional Core** | | **Course Level: Practice** | |
| **L:T:P(Hours/Week)<br>3: 0: 2** | **Credits:4** | **Total Contact Hours:75** | **Max Marks:100** |

**Pre-requisites**

- Sensors and Transducers
- Physics for Electrical Sciences

**Course Objectives**

The course is intended to:

1. Explain the various techniques for pressure measurement.
2. Explain non-contact type temperature measuring instruments.
3. Explain various level measurement techniques.
4. Describe working of electrical type flow meters.
5. Explain the principle and working of force, torque and velocity measuring instruments.

**Unit I PRESSURE MEASUREMENT 9 Hours**

Manometers, different types, Elastic type pressure gauges, Bourdon tube and diaphragms with strain gauge- Capacitive type pressure gauge - Measurement of vacuum - McLeod gauge- Thermal conductivity gauge - Ionization gauges - calibration of pressure gauges - Dead weight tester.

**Unit II TEMPERATURE MEASUREMENT 9 Hours**

Definitions and standards - Primary and secondary fixed points - Bimetallic thermometers - Thermocouples - Laws of thermocouple – Cold Junction Compensation - Radiation fundamentals - Radiation methods of temperature measurement - Total radiation pyrometers - Optical pyrometers - Fiber optic sensor for temperature measurement.– Selection of temperature measuring instrument for given applications

**Unit III LEVEL MEASUREMENT 9 Hours**

Level measurement – Float gauges - Displacer type –D/P methods - Load cell – Electrical types: Conductivity sensors – Capacitive sensors – Nucleonic gauge - Ultrasonic gauge – Boiler drum level measurement: – Differential pressure and Hydrastep methods - Solid level measurement – RADAR measurement

**Unit IV FLOW MEASUREMENT 9 Hours**

Expression for flow rate through restriction(compressible and incompressible flow) - Orifice plate -Venturi tube – Flow nozzle – Pitot tube – Positive displacement flow meters – Nutatingdisc and Oval gear flow meters – Rotameter - Mass flow meters: Thermal and Coriolis type – Electromagnetic flow meter – Ultrasonic flow meters – Selection of flow meter for given applications

**Unit V SPEED, TORQUE, DENSITY, FORCE, VISCOSITY, HUMIDITY AND MOISTURE 9 Hours**

Speed& Torque Measurement: Magnetic and Optical Method – Density Measurement: Float, Ultrasonic and Bridge gas type – Viscosity Measurement: Saybolt Viscometer and Rotameter Type – Humidity Measurement: Psychrometer and Hygroscopic Method - Moisture Measurement in Granular, Penetrable and Web type material

**List of Experiments 30 Hours**

1. Determine the discharge coefficient of Orifice plate and venture meter.
2. Determine the liquid level in an open tank using DPT.
3. Determine the liquid flow measurement using turbine flowmeter.
4. Analyze the error present in the RTD.
5. Determine the air pressure inside the closed tank using piezo electric type measurement.
6. Calibrate the bourdon gauge using Dead weight tester

| **Course Outcomes** | **Cognitive Level** |
|---|---|
| At the end of this course, students will be able to: | |
| **CO1.** Summarize the various techniques for pressure measurement. | Understand |
| **CO2.** Select a suitable temperature measuring instruments for the given application. | Apply |
| **CO3.**Review the various techniques for Level measurement. | Understand |
| **CO4.** Select a suitable flow measuring instruments for the given application. | Apply |
| **CO5.**Explain the different methods of measurement of speed, torque, viscosity measuring instruments. | Understand |

**Text Book:**

T1.Doebellin, E.O.andManikD.N., “Measurement systems Application and Design”, 6thEdition,

T2.D. Patranabis, “Principles of industrial instrumentation”, 3rd edition, McGraw Hill Education, 2017.

**Reference Book(s):**

R1.John P.Bentley, “Principles of Measurement Systems”, 3rdEdition, Pearson Education, 2015.

R2.W.Bolton, “Engineering Science”, Elsevier Newnes, 5th Edition, 2006

R3.B.C. Nakra and K.K.Chaudhary,“Instrumentation, Measurement and Analysis”, McGraw Hill Education India Private Limited, 4thedition,2016

**Web References:**

1. nptel.ac.in/courses/112103174
2. http://nptel.ac.in/courses/108105064
3. http://nptel.ac.in/courses/112106140
4.

**Course Articulation Matrix**

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

High-3; Medium-2;Low-1

| Course Code:19CSSC2401 | | Course Title: Data Structures and Algorithms (Common to EE and EI) | |
|---|---|---|---|
| Course Category: Engineering Science | | Course Level: Practice | |
| L:T:P(Hours/Week) 2: 0: 2 | Credits:3 | Total Contact Hours:60 | Max. Marks:100 |

**Pre-requisites**

- C Programming

**Course Objectives**

1. Design linear data structure
2. Implement Tree data structure
3. Implement Graph data structure
4. Demonstrate a familiarity with sorting in data structure
5. Apply suitable algorithm for searching and hashing techniques

**Unit I POINTERS** **6 Hours**

Data Structures types - Abstract Data Types - List ADT: Array and Linked List Implementation - Stack ADT: Stack Model - Array Implementation of Stack –Queue ADT: Queue Model - Array Implementation of Queue

**Unit II NON LINEAR DATA STRUCTURE: TREE** **6 Hours**

Tree - Preliminaries - Binary tree - Tree traversal - Applications - Expression tree - Binary search tree – 2-3 Tree

**Unit III LINEAR DATA STRUCTURE - LIST** **6 Hours**

Representation of graph – Graph Traversals: Depth first and breadth first traversal – Topological sort – Shaortest path algorithms : Dijkstra's algorithms – Minimum Spanning Tree : Prim's and Kruskal's algorithms.

**Unit IV SORTING** **6 Hours**

Simple Sorting Algorithms – Insertion sort -Shell Sort - Merge Sort – Quick Sort External Sorting.

**Unit V SEARCHING AND HASHING** **6 Hours**

Linear Search – Binary Search – Hashing: Hash Functions – Separate Chaining – Open Addressing – Linear Probing – Quadratic Probing – Double Hashing.

**List of Exercises** **30 Hours**

1. Create a C program to implement Singly Linked list using Linked list implementation
2. Create a C program to implement Stack using array implementation
3. Create a C program to implement Queue using array implementation
4. Develop a C program to implement Binary search tree.
5. Develop a C program to implement Dijkstra's algorithm.
6. Create a C program to implement Merge Sort / Quick Sort / Bubble Sort

| Course Outcomes | Cognitive Level |
|---|---|
| At the end of this course, students will be able to: | |
| CO1: Design Linear data structure such as Linked List, Stack and Queue using C | Apply |
| CO2: Implement Tree data structure for the given Scenario | Apply |
| CO3: Implement Tree data structure for the given application | Apply |
| CO4: Demonstrate a familiarity with sorting in data structures for a real time scenario | Apply |
| CO5:Apply suitable algorithm for searching and hashing techniques for given application | Apply |

**Text Book(s):**


T1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education Asia, New Delhi, 2011.


**Reference Book(s):**


R1. Sahni, "Data Structures Using C, The McGraw-Hill, New Delhi, 2006.

R2. Michael.T.Goodrich, "Data Structures and Algorithm Analysis in C", Wiley student Edition, New Delhi, 2007

R3. Thomas H.Cormen, Charles E. Leiserson, Ronald L Rivest, Clifford Stein, "Introduction to Algorithms", MIT Press, England, 2009.


**Web References:**


1. https://www.coursera.org/specializations/data-structures-algorithms
2. http://www.csse.monash.edu.au/~lloyd/tildeAlgDS
3. http://freevideolectures.com/Course/2279/Data-Structures-And-Algorithms

## Course Articulation Matrix

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

High-3; Medium-2;Low-1

| | | | |
|---|---|---|---|
| **Course Code:19EICN3401** | **Course Title: Signal Conditioning Laboratory** | | |
| **Course Category: Professional Core** | | **Course Level: Practice** | |
| **L:T:P(Hours/Week)**<br>**0: 0: 4** | **Credits: 2** | **Total Contact Hours:60** | **Max Marks:100** |

**Pre-requisites**

- NIL

**Course Objectives**

The course is intended to:

1. Develop OPAMP based different amplifier circuits
2. Design an amplifier for sensors
3. Conversion of sensor signal in to voltage, current and digital format
4. Design a signal conditioning circuits for RTD and Thermocouple
5. Design a signal conditioning circuits for optical type sensors

**List of Experiments**

1. OPAMP based amplifier circuits – Inverting amplifier, Non- Inverting amplifier, Summing amplifier and Differential amplifier.
2. Design of Integrator and differentiator.
3. Design of Voltage to current and frequency to voltage convertor.
4. Design of Flash type ADC
5. Design of R-2R type DAC.
6. Phase Locked Loop using IC 566
7. Design and implement the signal conditioning circuit for RTDusing Instrumentation Amplifier.
8. Design and implement the signal conditioning circuit for LDR.
9. Design and implement the signal conditioning circuit for Thermocouple.
10. Measurement of angular velocity using optical type transducer.

| Course Outcomes: | Cognitive/ Affective |
|---|---|
| At the end of this course, students will be able to: | |
| CO1: Identify the suitable amplifier as per the application using IC741 | Apply |
| CO2: Design of amplifier circuit depends on sensor using IC741 | Apply |
| CO3: Develop OPAMP circuits for sensor signal conversion in to voltage, current and digital format | Apply |
| CO4: Design a signal conditioning circuits for PT100 and J type Thermocouple using IC741 | Apply |
| CO5: Develop a signal conditioning circuits for LDR and IR sensor | Apply |

**Course Articulation Matrix**

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

High-3; Medium-2;Low-1

| Course Code: 19PSHG6002 | Course Title: Universal Human Values 2 :Understanding Harmony (Common to all) | | |
|---|---|---|---|
| **Course Category: Humanities** | | **Course Level: Practice** | |
| **L:T:P (Hours/Week) 2:1: 0** | **Credits:3** | **Total Contact Hours:45** | **Max Marks:100** |

**Pre-requisites**

- 19SHMG6101-Induction Program (UHV 1)

**Course Objectives**

The course is intended to:

1. Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
2. Strengthening of self-reflection
3. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
4. Development of commitment and courage to act

**Unit IIntroduction to Value Education 6+3 Hours**

Need for the Value Education; Self -exploration as the process for value education ; Continuous Happiness and Prosperity: A look at basic Human Aspirations; Right understanding: Relationship and Physical Facilities ; Happiness and Prosperity: current scenario ; Method to fulfill the Basic human aspirations

**Unit II Harmony in Human Being 6+3 Hours**

Human being as a co-existence of self ('I') and the material 'Body'; needs of Self ('I') and 'Body'; The Body as an instrument of 'I'; Harmony in the self ('I'); Harmony of the self ('I') with body; Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail. Programs to ensure Sanyam and Swasthya.

**Unit III Harmony in the Family and Society 6+3 Hours**

Harmony in the Family the basic unit of human interaction; Values in human to human relationship; Trust as the foundational values of relationship; Respect as the right evaluation ;Understanding harmony in the society ( society being an extension of family); Vision for the universal human order

**Unit IV Harmony in the Nature 6+3 Hours**

Understanding the harmony in the Nature Interconnectedness, self-regulation and mutual fulfillment among the four orders of nature; Existence as Co-existence at all levels; Holistic perception of harmony in existence.

**Unit V Harmony on Professional Ethics 6+3 Hours**

Natural acceptance of human values ;Definitiveness of Ethical Human Conduct; Basic for Humanistic Education, Humanistic Constitution and Humanistic Universal Order; Competence in professional ethics ;Case study: holistic technologies, management models and production systems ;Strategy for transition towards value based life and profession

| Course Outcomes | Affective Level |
|---|---|
| At the end of this course, students will be able to: | |
| CO1. Reflect on values, aspiration, relationships and hence identify strengths and weaknesses. | Responding |
| CO2. Appraise physical, mental and social wellbeing of self and practice techniques to promote wellbeing. | Responding |
| CO3. Value human relationships in family and society and maintain harmonious relationships. | Valuing |
| CO4. Respect nature and its existence for survival and sustainable of all life forms and hence practice conservation of nature | Valuing |
| CO5. Appreciate ethical behaviour as a result of value system in personal and professional situations | Receiving |

**Text Book(s):**

T1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010.

**Reference Book(s):**

R1.Jeevan Vidya: EkParichaya, A Nagaraj, JeevanVidyaPrakashan, Amarkantak, 1999.

R2.Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.

R3. The story of stuff, Annie Leonard, Free Press, New York 2010.

**Web References:**

1. https://aktu.ac.in/hvpe/ResourceVideo.aspx
2. http://hvpenotes.blogspot.com/
3. https://nptel.ac.in/courses/109/104/109104068/

**Course Articulation Matrix**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | - | - | - | - | - | - | 1 | 2 | 2 | - | - | 2 |
| CO2 | - | - | - | - | - | 1 | 2 | 2 | 2 | 1 | - | 2 |
| CO3 | - | - | - | - | - | 2 | 2 | 2 | 2 | 1 | - | 2 |
| CO4 | - | - | - | - | - | 2 | 2 | 2 | 2 | - | - | 2 |
| CO5 | - | - | - | - | - | 1 | 2 | 2 | 2 | - | - | 2 |

High-3; Medium-2;Low-1

| Course Code: 19EIPN6401 | Course Title: MINI-PROJECT | | |
|---|---|---|---|
| Course Category: Project | | Course Level: Practice | |
| L:T:P (Hours/Week) 0: 0: 4 | Credits: 2 | Total Contact Hours:60 | Max. Marks:100 |

**Pre-requisites:**

- Nil

**Course Objectives:**

The course is intended to:

1. Take up any challenging practical problems and find solution by formulatingproper methodology.
2. Work collaboratively on a team to successfully complete a design project
3. Effectively communicate the results of projects in a written and oral format

The objective of Mini Project is to enable the student to take up investigative study in the broad field of Electronics and Instrumentation Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an two/three students in a group, under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work.

The assignment to normally include:

1. Survey and study of published literature on the assigned topic.
2. Working out a preliminary Approach to the Problem relating to the assigned topic.
3. Conducting preliminary Analysis/Modelling/Simulation/Experiment/Design/Feasibility.
4. Preparing a Written Report on the Study conducted for presentation to the Department.
5. Final Seminar, as oral Presentation before a departmental committee.

| **Course Outcomes**<br>**At the end of this course, students will be able to:** | **Cognitive Level** |
|---|---|
| CO1: Take up any challenging practical problems and find solution by formulating proper methodology. | Apply |
| CO2: Work collaboratively on a team to successfully complete a design project | Apply |
| CO3: Effectively communicate the results of projects in a written and oral format | Apply |

## Course Articulation Matrix

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | - | - | 3 | 3 | 3 | 3 |
| **CO2** | - | - | - | - | - | - | - | 3 | 3 | - | 3 | 3 | 3 | 3 |
| **CO3** | - | - | - | - | - | - | - | - | - | 3 | - | 3 | 3 | 3 |

High-3; Medium-2; Low-1

**Semester– V**

| | | | |
|---|---|---|---|
| **Course Code:19EICN1501** | **Course Title: Control System** | | |
| **Course Category: Professional Core** | | **Course Level: Practice** | |
| **L:T:P(Hours/Week)**<br>**3: 1: 0** | **Credits:4** | **Total Contact Hours:60** | **Max Marks:100** |

**Pre-requisites**

- Engineering Mathematics – I
- Engineering Mathematics – II

**Course Objectives**

The course is intended to:

1. Practice the modelling of a physical dynamical system
2. Study time response and specifications of first and second order systems
3. Study frequency response and specifications of first and second order systems
4. Include the system stability
5. Design compensators

**Unit I CONTROL SYSTEM MODELING 9+3 Hours**

Basic Elements of Control System – Open loop and Closed loop systems - Transfer function, Modelling of Electrical systems, mechanical systems: Translational and rotational systems-Transfer function of armature and field controlled DC motor- Block diagram reduction Techniques – Signal flow graph.

**Unit II TIME RESPONSE ANALYSIS 9+3 Hours**

Standard test signals - Time response of first order systems - Impulse and Step Response analysis of second order systems – Time Domain specifications - Steady state errors and error constants – Effects of P, PI, PD and PID Controllers on the system's response

**Unit III FREQUENCY RESPONSE ANALYSIS 9+3 Hours**

Frequency Response – Bode Plot: Gain margin, Phase margin, gain & phase crossover frequency-Polar Plot: Gain margin, Phase margin, - Frequency Domain specifications from the plots – correlation between time domain and frequency domain specifications

**Unit IV STABILITY ANALYSIS 9+3 Hours**

Stability, Routh -Hurwitz Criterion, Concept of Root Locus Technique, Construction of Root Locus, Effects of adding poles and zeros – Nyquist Stability Criterion

**Unit V COMPENSATOR DESIGN 9+3 Hours**

Performance criteria – Lag, lead and lag-lead networks – Compensator design using bode plots. Compensator Design using simulation.

| Course Outcomes | | Cognitive Level |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Model electrical and mechanical systems using transfer function. | Understand |
| **CO2.** | Determine the time response and time domain specifications of first order and second order systems | Apply |
| **CO3.** | Determine the given first order and second order system with their frequency domain specifications. | Apply |
| **CO4.** | Execute the stability of the given system. | Apply |
| **CO5.** | Design compensator using bode plot technique | Apply |


T1. J. Nagrath and M. Gopal, ‘Control Systems Engineering’, New Age International Publishers, 6th Edition, 2018.

T2. Benjamin C. Kuo, ‘Automatic Control systems’, 10 edition Pearson Education, New Delhi, 10th Edition, 2017.


**Reference Book(s):**


R1. Norman S. Nise, ‘Control Systems Engineering’, John Wiley, New Delhi,Sixth Edition, 2010.

R2. SamarajitGhosh, ‘Control systems Theory and Applications ’, Pearson Education, New Delhi, Second Edition 2012.

R3. M. Gopal, ‘Control Systems, Principles and Design’, Tata McGraw Hill, New Delhi, Fourth Edition 2012.

R4. K. Ogata, ‘Modern Control Engineering’, Pearson Education India, New Delhi, Fifth Edition 2015.

R5. Richard C.Dort and Robert H.Bishop, "Modern Control Systems ", Pearson Prentice Hall , Thirteenth Edition 2016.


**Web References:**


1. http://nptel.ac.in/courses/108101037/1
2. https://www.tutorialspoint.com/control_systems/control_systems
3. http://lpsa.swarthmore.edu/Root_Locus/RLocusExamples.html
4. https://in.mathworks.com/help/control/examples/compensator-design-for-systems-

## Course Articulation Matrix

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

High-3; Medium-2; Low-1

| Course Code:19EICN1502 | Course Title: Microprocessor and Microcontroller | | |
|---|---|---|---|
| Course Category: Professional Core | | Course Level: Practice | |
| L:T:P(Hours/Week) 3: 0: 0 | Credits:3 | Total Contact Hours:45 | Max Marks:100 |

**Pre-requisites**

- Digital Electronics, Linear Integrated Circuits.

**Course Objectives**

The course is intended to:

1. Explain the architecture of 8085 microprocessor
2. Write assembly language programs for 8085 microprocessor
3. Explain the function of interfacing devices used with 8085 microprocessor
4. Describe the architecture of 8051 Microcontroller
5. Explain Interfacing techniques using 8051 microcontroller & architecture of PIC microcontroller

**Unit I 8085 MICROPROCESSOR 9Hours**

Introduction to 8085 Microprocessor: Architecture, Memory interfacing, I/O Devices Interfacing, Timing Diagram, Interrupt structure.

**Unit II PROGRAMMING OF 8085 PROCESSOR 9Hours**

Addressing modes - Instruction sets: Data transfer instruction set, Arithmetic & Logic Instruction set – Branching & control Instruction set – Assembly language format - Simple Assembly level programs.

**Unit III PERIPHERALS INTERFACING 9Hours**

Interfacing of 8085 with: Keyboard & display unit [8279 IC] – Parallel peripheral interface [8255] – Interrupt controller interface [8259 PIC] – USART interface [8251] - A/D & D/A converter interfacing with 8085.

**Unit IV 8051 MICROCONTROLLER 9Hours**

Architecture - Addressing modes and Instruction Sets – Interrupt structure – Timer –I/O ports – Serial communication.

**Unit V 8051 INTERFACING ANDPIC ARCHITECTURE 9 Hours**

Interfacing of 8051with: Analog Sensors - ADC – DAC - DC motor and Stepper motor. RISC Vs. CISC machines - PIC microcontroller Architecture and Pin details.

| Course Outcomes | | Cognitive Level |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Summarize the architecture of 8085 microprocessor | Understand |
| **CO2.** | Write the assembly language programs for 8085 microprocessor | Apply |
| **CO3.** | Understand the function of interfacing devices used with 8085 microprocessor | Understand |
| **CO4.** | Understand the architecture of 8051 Microcontroller | Understand |
| **CO5.** | Practice the Interfacing techniques using 8051 microcontroller and Illustrate the architecture of PIC microcontroller. | Apply |

**Text Book(s):**


T1. R.S.Gaonkar,"Microprocessor Architecture, Programming and Applications with the 8085", 6th Edition, Prentice Hall, 2013

T2. Kenneth J.Ayala., "The 8051 Microcontroller", 3rd Edition, Thompson Delmar Learning, 2005, New Delhi.

T3. Microcontrollers, principles and applications – Ajit pal – PHI Ltd., - 2012.


**Reference Book(s):**


R1. Muhammad Ali Mazidi and Janice GilliMazidi, "The 8051 Microcontroller and Embedded Systems", Pearson Education, 2007.

R2. A.K.Rai and K. M. Bhurchandi, "Advanced Microprocessors and peripherals" , 2$^{nd}$ edition, Tata McGraw- Hill, 2006.

R3. John B Peatman, "Design with PIC Microcontrollers", Pearson Education, 1998.


**Web References:**

1. http://nptel.ac.in/courses/Webcourse-contents/IIT KANPUR/microcontrollers/micro/ui/TOC.htm
2. http://www.nptel.ac.in/downloads/106108100/
3. http://www.ustudy.in/ece/mpmc/u1

**Course Articulation Matrix**

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

High-3; Medium-2; Low-1

<table>
<tr><td>Course Code:19CSSN2502</td><td colspan="3">Course Title: Object Oriented Programming</td></tr>
<tr><td colspan="2">Course Category: Engineering Science</td><td colspan="2">Course Level: Practice</td></tr>
<tr><td>L:T:P(Hours/Week) 3: 0: 2</td><td>Credits:4</td><td>Total Contact Hours:75</td><td>Max. Marks:100</td></tr>
</table>

**Pre-requisites**

- C Programming

**Course Objectives**

1. Explain the object-oriented paradigm and C++ programming
2. Describe various control flows and memory management techniques
3. Implement various principles of object orientation
4. Explain file handling techniques with C++ programming
5. Explain the trouble shooting procedures in OOPS

**Unit I INTRODUCTION 9 Hours**

Object – Oriented Paradigm, elements of object oriented programming – Merits and demerits of OO methodology – C++ fundamentals – data types, operators and expressions – control flow – arrays.

**UnitII CONTROL FLOW &DYNAMIC MEMORY MANAGEMENT 9 Hours**

Function declaration – Call by value and call by reference – Friend functions – Accessing functions between classes – Dynamic Memory Allocation - Constructors – Destructors – Realloc – Operator Overloading.

**UnitIII OOP PRINCIPLES 9 Hours**

Inheritance - Types of Inheritance – Polymorphism: Function overloading - Virtual functions - Abstraction - Abstract Class and Virtual base class - Encapsulation and Data Hiding.

**Unit IV FILE HANDLING 9 Hours**

C++ streams – console streams – console stream classes-formatted and unformatted console I/O operations, manipulators - File streams - classes file modes file pointers and manipulations file I/O.

**Unit V TEMPLATES AND EXCEPTION HANDLING 9 Hours**

Function and class templates - Exception handling – try-catch-throw paradigm – exception specification – terminate and unexpected functions – Uncaught exception

**List of Exercises** **30 Hours**

1. Write a C++ programs using operators, expressions, control flow and arrays.
2. Write a C++ programs using Constructors, Destructors and Operator Overloading.
3. Write a C++ programs using Inheritance
4. Develop a C++ program using Polymorphism Concepts
5. Write a C++ programs using File Handling Methods
6. Create a C++ programs using Exception handling

| **Course Outcomes** | | **Cognitive Level** |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1:** | Explain the object-oriented paradigm and C++ programming with their fundamentals | Apply |
| **CO2:** | Examine various control flows and memory management techniques | Apply |
| **CO3:** | Implement various principles of object orientation | Apply |
| **CO4:** | Illustrate handling of files with C++ programming | Apply |
| **CO5:** | Summarize the trouble shooting procedures in OOPS | Apply |

**Text Book(s):**

T1. Herbert Schildt, “Complete Reference:C++”, Fourth edition, Tata McGraw Hill, Noida, 2007.

**Reference Book(s):**

R1. Ira Pohl, “Object oriented programming using C++”, Pearson Education Asia, 2007.

R2. Malik.D.S, “C++ Programming from Problem Analysis to Program Design”, 3rd Edition, Thomson course Technology, New Delhi, 2007.

R3. John.R.Hubbard, "Programming with C++", Schaums outline series, Tata McGraw Hill, New Delhi ,2003.

R4. Herbert Schildt, “The Complete Reference: Java2”, Fifth edition, Tata McGraw Hill, Noida, 2007.

**Web References:**

1. www.nptel.ac.in/courses

## Course Articulation Matrix

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

High-3; Medium-2;Low-1

| Course Code:19EICN3501 | Course Title: Microprocessor and Microcontroller Laboratory | | |
|---|---|---|---|
| Course Category: Professional Core | | Course Level: Practice | |
| L:T:P(Hours/Week)<br>0: 0: 3 | Credits:1.5 | Total Contact Hours:45 | Max Marks:100 |

**Pre-requisites**

- Digital Electronics Lab, LIC Lab

**Course Objectives**

The course is intended to:

1. Explain the architecture of 8085 microprocessor
2. Write assembly language programs for 8085 microprocessor
3. Explain the function of interfacing devices used with 8085 microprocessor
4. Describe the architecture of 8051 Microcontroller
5. Explain Interfacing techniques using 8051 microcontroller & architecture of PIC microcontroller

**List of Experiments**

1. Programming for 8 bit Arithmetic operations using 8085.
2. Programming with control instructions using 8085.
3. Traffic Light Controller using 8085.
4. A/D and D/A interfacing with 8085.
5. Timer interfacing with 8085.
6. Programming for 8 bit Arithmetic operations using 8051
7. Interfacing of Keypad / Display units using 8051
8. Programming & Interfacing of DC motor with 8051
9. Programming &Interfacing of Servo /Stepper motor using 8051
10. 10.Interfacing a temperature sensor and controlling an LED/ Motor using PIC/AT mega/ARM controllers IDE through HLL.

| Course Outcomes: | | Cognitive/ Affective |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1:** | Summarize the architecture of 8085 microprocessor | Understand |
| **CO2:** | Write assembly language programs for 8085 microprocessor | Apply |
| **CO3:** | Explain the function of interfacing devices used with 8085 microprocessor | Apply |
| **CO4:** | Describe the 8051 Microcontroller architecture | Understand |
| **CO5:** | Practice the Interfacing techniques using 8051 microcontroller and Illustrate the architecture of PIC microcontroller. | Apply |

**Course Articulation Matrix**

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

High-3; Medium-2;Low-1

| Course Code:19EICN3502 | Course Title: Control System Laboratory | | |
|---|---|---|---|
| **Course Category: Professional Core** | | **Course Level: Practice** | |
| **L:T:P(Hours/Week) 0: 0: 3** | **Credits: 1.5** | **Total Contact Hours:45** | **Max Marks:100** |

**Pre-requisites**

- Nil

**Course Objectives**

The course is intended to:

1. Study the dynamics of second order systems.
2. Experiment with different filter circuit designs.
3. Model the System and to analyze the performance.
4. Analyze the stability of a system.
5. Demonstrate the Inverted Pendulum working.

**List of Experiments**

1. Determine the dynamics of second order system for different damping factor
2. Determine the step and ramp response of Instruments
3. Design a LPF and HPF circuits using MATLAB.
4. Identify the transfer function of DC Motor
5. Identify the transfer function of AC Servo Motor
6. DC Speed Control System
7. Linear System analysis (Time domain analysis) using MATLAB
8. Stability analysis (Bode, Root Locus) of linear time invariant system using MATLAB
9. Stability analysis (Nyquist) of linear time invariant system using MATLAB
10. Study on Inverted Pendulum

| Course Outcomes: | | Cognitive/ Affective |
|---|---|---|
| At the end of this course, students will be able to: | | |
| CO1: | Conduct the experiment to determine the dynamics of first and second order system. | Apply |
| CO2: | Conduct the experiment to design the different filter circuits. | Apply |
| CO3: | Model the Control System to predict their performance | Apply |
| CO4: | Determine the stability of linear time invariant system | Apply |
| CO5: | Demonstrate the operation of Inverted Pendulum | Apply |

**Course Articulation Matrix**

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

High-3; Medium-2;Low-1

| Course Code: 19PSHG6501 | Course Title: Employability Skills 1: Teamness and Interpersonal Skills<br>(Common to all) | | |
|---|---|---|---|
| Course Category: Humanities | Course Level: Introductory | | |
| L: T:P (Hours/Week): 0:0:2 | Credit :1 | Total Contact Hours: 30 | Total Marks: 100 |

**Pre-requisites:**

- **NIL**

**Course objectives:**

The course is intended to

1. Enrich effective communicative attributes and facilitate presentation and public speaking skills
2. Handle negativities and explore the true self
3. Inculcate interpersonal skills and to groom as a professional
4. Educate the importance of Nonverbal skill set to attain perfection
5. Provide teamness and its ethics to facilitate corporate working

**Unit I Effective Communication and Presentation Skills 6 Hours**

Barriers of Communication-Fear Of English- Handling Social Factors-Handling Psychological Factors-Handling-Practical Problems-Do’s & Don’t’s- **Effective Presentation** - Presentation- Importance of Presentation- Slide orientation– Introduction in a presentation - Styles of a slide - Slide Templates- Font ,color, Background-Graph Diagrammatic representation- Delivery of presentation- Body Language &Gestures - Verbal Attributes- Communication-Handling stammers and breaks- Handling fear of stage- Maintaining Confidence- Content delivery methods- Do’s and Don’ts in a presentation- Tips to handle it-Effective Conclusion

**Unit II Positive Attitude and Handling Rejections 6 Hours**

A,B,C’s Of Attitude-Influencing Factors -Individual Factors-Character Comparison -Strategies to Handle ourselves-Benefits of Positive Attitude- Do’s&Don’t’s- **Handling Rejections**- Identifying Negativities -Nuances of handling it -Necessary changes-To do List-Creating One’s self- Self Qualifiers

**Unit III Interpersonal Skills 6 Hours**

Life skills-Core IP Skills -Importance of IP Skills-Tips to improve IP Skills-Necessity of IP Skills.

**Unit IV Body Language, Dressing and Grooming** **6 Hours**

Unconscious Physical moments- Metrics of Body Language- Good Posture -Head Motion-Facial Expression- Eye contact–Gestures-Dressing - Grooming & Outlook - Necessity of good Body Language

**Unit V Team Ethics** **6 Hours**

Team Ethics-Necessity of Team Work- Teams Everywhere- Benefits of team culture -Reason for team failure-Conflicts- Handling Conflicts-Being a team player-Work difference from college

| **Course Outcomes** | **Cognitive Level** |
|---|---|
| At the end of the course students will be able to: | |
| CO1: Demonstrate effective communicative attributes as part of their skills and facilitate presentation & public speaking skills | Apply |
| CO2: Identify and explore the true self and handle negatives | Apply |
| CO3: Develop interpersonal skills and to groom as a professional | Apply |
| CO4: Explain the importance of Nonverbal skill set to attain perfection | Understand |
| CO5: Build teamness and its ethics to facilitate corporate working | Apply |

**Text Books**

T1: John C Maxwell, " The 17 Indisputable Laws of Teamwork: Embrace Them and Empower Your Team", Harper Collins Leadership Publishers, 2013

**Reference Books**

R1: Patrick Lencioni, " The Five Dysfunctions of a Team: A Leadership Fable" Jossey Bass Publishers, 2006

R2: Malcolm Gladwell, "Talking to Strangers: What We Should Know about the People We Don’t Know" Penguin Publishers, 2019

R3: Harvey Segler, " Body Language: Discovering & Understanding the Psychological secrets behind reading & Benefiting from Body Language” Kindle Edition, 2016

**Mode of Delivery:**

1. Continuous learning and reviews guided by faculty
2. Guided Learning Workshop

**Course Articulation Matrix:**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | P10 | P11 | P12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | - | - | - | - | - | - | - | - | - | 3 | - | 1 | - | - |
| CO2 | - | - | - | - | - | - | - | - | 2 | - | - | 1 | - | - |
| CO3 | - | - | - | - | - | - | - | - | 2 | - | 1 | 1 | - | - |
| CO4 | - | - | - | - | - | - | - | - | - | 1 | - | 1 | - | - |
| CO5 | - | - | - | - | - | - | - | 2 | 1 | - | - | 1 | - | - |

High -3, Medium – 2, Low-1

**Semester– VI**

| Course Code:19EICN1601 | Course Title: Process Control | | |
|---|---|---|---|
| **Course Category: Professional Core** | | **Course Level: Practice** | |
| **L:T:P(Hours/Week)<br>3: 0: 0** | **Credits:3** | **Total Contact Hours:45** | **Max Marks:100** |

**Pre-requisites**

- Engineering Mathematics – II
- Control Systems

**Course Objectives**

The course is intended to:

1. Explain the mathematical model and dynamic behavior of the process.
2. Outline the characteristics of continuous and discontinuous controllers.
3. Provide knowledge to modes of P/PI/PID controller.
4. Describe the construction and operation of final control elements including converters.
5. Illustrate the control strategies of multi loop processes.

**Unit I PROCESS CONTROL 9 Hours**

Need for process control – Mathematical model of Flow, Level, Pressure and Thermal processes – Interacting and non-interacting systems – Degrees of freedom – Continuous and batch processes – Self regulation – Servo and regulatory operations-process dynamics– Heat exchanger and CSTR.

**Unit II CONTROLLER TUNING 9 Hours**

Evaluation criteria –simple performance- ¼ decay ratio-time integral criteria IAE, ISE, ITAE and ¼ decay ratio - Tuning:- Process reaction curve method, Continuous cycling method and Damped oscillation method –selection of controller

**Unit III CONTROL ACTIONS 9 Hours**

Characteristic of on-off, proportional, single speed floating, integral and derivative controllers – P+I, P+D and P+I+D control modes – Electronic PID controller – Auto/manual transfer - Reset windup

**Unit IV FINAL CONTROL ELEMENTS 9 Hours**

I/P converter - Pneumatic and electric actuators – Valve Positioner – Control Valves – Characteristic of Control Valves: Inherent and Installed characteristics – Valvebody: Commercial valve bodies – Control valve sizing – Cavitation and flashing – Selection criteria.

**Unit V MULTILOOP CONTROL 9 Hours**

Feedback control - feed forward control – Ratio control – Cascade control-selective control – Inferential control – Split-range and introduction to multivariable control – case studies from distillation column and boiler systems

| **Course Outcomes** | | **Cognitive Level** |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Explain the mathematical model and dynamic behaviour of the process | Understand |
| **CO2.** | Summarize the characteristics of continuous and discontinuous controllers | Understand |
| **CO3.** | Select suitable P/PI/PID controller by applying tuning methods and performance criteria | Apply |
| **CO4.** | Describe the construction and operation of final control elements including converters | Understand |
| **CO5.** | Illustrate the control strategies of multi loop processes | Understand |

**Text Book(s):**

T1. Coughanowr, D.R., "Process Systems Analysis and Control", McGraw - Hill International Edition, 2004.

T2. Bequette, B.W., "Process Control Modeling, Design and Simulation", Prentice Hall of India, 2003.

**Reference Book(s):**

R1. Krishnasamy, K., "Process Control",New age international,2009

R2. Stephanopoulos, G., "Chemical Process Control - An Introduction to Theory and Practice",Prentice Hall of India, 2005.

R3. Curtis D. Johnson Process Control Instrumentation Technology, 8th Edition, Pearson, 2016.

R4. Bela.G.Liptak., "Process Control and Optimization"., Instrument Engineers' Handbook., volume 2, CRC press and ISA, 2005.

R5. Considine, D.M., Process Instruments and Controls Handbook, Second Edition, McGraw, 2008

**Web References:**

1. http://nptel.ac.in/courses/103105064/

**Course Articulation Matrix**

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

High-3; Medium-2; Low-1

| Course Code:19EICN1602 | Course Title: Embedded System Design | | |
|---|---|---|---|
| **Course Category: Professional Core** | | **Course Level: Practice** | |
| **L:T:P(Hours/Week)**<br>**3: 0: 0** | **Credits:3** | **Total Contact Hours:45** | **Max Marks:100** |

**Pre-requisites**

- Digital Electronics
- Microprocessor and Microcontroller

**Course Objectives**

The course is intended to:

1. Provide knowledge on the basic concepts of embedded systems
2. Provide knowledge on developing the real time models for different application
3. Realize the importance and various features in RTOS
4. Provide knowledge on Embedded IoT concepts
5. Realize the Network Protocols with different applications.

**Unit I INTRODUCTION 9 Hours**

Embedded System – Classification of Embedded System – Processors in the embedded system – Processor and Memory organization – DMA – Timer and Counting devices – Device drivers and interrupt service mechanism.

**Unit II REAL TIME MODELS 9 Hours**

State Machine and Concurrent Process model: Types of models – FSM – HCFSM and State chart Language – Program state machine model – Concurrent Process – Communication among process – Synchronization among process – Data flow model.

**Unit III REAL TIME OPERATING SYSTEMS 9 Hours**

Architecture of the Kernel – Tasks - Tasks states - Task priorities - Various task scheduling methods – Semaphores – Mutex - IPC: Mailboxes, Message Queues, Event Registers, Pipes, and Signals.

**Unit IV INTRODUCTION TO IoT 9 Hours**

Internet of Things Concepts - Internet of Things Framework – IoT Major Components – Challenges, Advantages and Disadvantages – LED interfacing – Relay interfacing – Sensor interfacing- Temperature sensor, IR sensor, Ultrasonic Sensor - local network- Bluetooth, LPWAN, XBEE- IoT gateway- Interfacing multiple nodes with gateway.

**Unit V IoT NETWORK PROTOCOLS AND APPLICATIONS 9 Hours**

IoT Networking Protocols: MQTT -CoAP – Implementation of IoT- Collect data from the devices in the local Network, Send the data to a server, control the device from the server- Applications: remote data logging system – remote Lamp control.

| **Course Outcomes** | | **Cognitive Level** |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Explain the basic functions, components and importance of Embedded Systems. | Understand |
| **CO2.** | Elucidate the Real Time Models based with application examples. | Understand |
| **CO3.** | Elaborate the functions of RTOS. | Understand |
| **CO4.** | Explain the Embedded IoT concepts. | Understand |
| **CO5.** | Illustrate the IoT Network protocols for data processing in IoT. | Understand |

**Text Book(s):**


T1. Rajkamal, “Embedded Systems: Architecture, Programming and Design”, Third Edition, Tata McGraw-Hill, New Delhi, 2017.

T2. Frank Vahid, Tony D. Givargis, John Wiley & Sons, “Embedded System Design-A Unified Hardware/Software Introduction” Wiley India, 2009.

T3. Internet of Things (A Hands-on-Approach), by Vijay Madisetti and ArshdeepBahga, 1st Edition, VPT, 2015


**Reference Book(s):**


R1. John.B.Peatman, “Design with Microcontrollers”, Pearson Education, 2008

R2. Tammy Noergaard, “Embedded Systems Architecture”, Second Edition, Elsevier, 2012.

R3. Ajay V. Deshmukh, “Microcontrollers Theory and Applications”, Tata McGraw Hill Publishing Company Ltd, 2011

R4. Raj Kamal, “Internet of Things: Architecture and Design Principles” McGraw Hill Education India, 2017.


**Web References:**


1. http://nptel.ac.in/courses/108102045/

2. http://www.nptelvideos.in/2012/11/embedded-systems.html

**Course Articulation Matrix**

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

High-3; Medium-2; Low-1

<table>
<tr><td>Course Code:19EICN3601</td><td colspan="3">Course Title: Process Control Laboratory</td></tr>
<tr><td colspan="2">Course Category: Professional Core</td><td colspan="2">Course Level: Practice</td></tr>
<tr><td>L:T:P(Hours/Week)<br>0: 0: 3</td><td>Credits: 1.5</td><td>Total Contact Hours:45</td><td>Max Marks:100</td></tr>
</table>

**Pre-requisites**

- Transducer and measurements Laboratory
- System Simulation Instrumentation Laboratory
- Industrial Instrumentation Laboratory

**Course Objectives**

The course is intended to:

1. Conduct experiment to obtain the mathematical model of the first order and second order system
2. Obtain the response of PID controller for first order and second order processes
3. Design the PID controller for first order and second order processes.
4. Determine the characteristics of control valve and obtain the response of complex control systems.
5. Analyze the closed loop response of various process

**List of Experiments**

1. Mathematical modelling of Interacting and non-interacting systems
2. Response of P+I+D controller using MATLAB
3. Response of Electronic PID Controller
4. PID Controller tuning with performance criteria using MATLAB
5. Characteristics of control valve with and without positioner
6. Modelling and response of flow/ level control loop
7. Modelling and response of temperature control loop
8. Modelling and response of pressure control loop
9. Response of complex control systems (Ratio control/Cascade)
10. Study of non-linear control loop (conical/spherical)

| Course Outcomes: | | Cognitive/ Affective |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1:** | Conduct experiment to obtain the mathematical model of the first order and second order system | Apply |
| **CO2:** | Obtain the response of PID controller for first order and second order processes | Apply |
| **CO3:** | Design the PID controller for first order and second order processes. | Apply |
| **CO4:** | Determine the characteristics of control valve and obtain the response of complex control systems. | Apply |
| **CO5:** | Obtain the closed loop response of various process | Apply |

**Course Articulation Matrix**

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

High-3; Medium-2;Low-1

| | | | |
|---|---|---|---|
| **Course Code:19EICN3602** | **Course Title: Embedded and IoT Laboratory** | | |
| **Course Category: Professional Core** | | **Course Level: Practice** | |
| **L:T:P(Hours/Week)**<br>**0: 0: 3** | **Credits: 1.5** | **Total Contact Hours:45** | **Max Marks:100** |

**Pre-requisites**

- Microprocessor and Microcontroller Laboratory

**Course Objectives**

The course is intended to:

1. Demonstrate the configuration of I/O ports, ADC, Timer, PWM and Serial Communication based Operations
2. Demonstrate the utilization of I/O parts for interfacing LCD and Keypad
3. Use Connectivity technologies for data transfer in IoT.
4. Provide an overview on the network protocols for data processing in IoT.
5. Implement simple applications in Home Automation using IoT

**List of Experiments**

1. Activation of LED and Generating delay for buzzer using timer.
2. Interfacing LCD with microcontroller
3. Interfacing of Matrix keypad and display the data on LCD using microcontroller.
4. Interfacing of temperature sensor and programming of ADC using microcontroller.
5. PWM Generation using microcontroller.
6. Interfacing temperature sensor and ultrasonic sensor (EDGE device)
7. Interfacing relay and control the Lamp (EDGE device)
8. Multi node connection to GATEWAY using local network. (EDGE and FOG devices)
9. Send the data to the server from GATEWAY.(FOG and CLOUD)
10. Control the home appliances (lamp and fan) from server. (EDGE,FOG and CLOUD)

| Course Outcomes: | | Cognitive/ Affective |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1:** | Demonstrate the configuration of I/O ports, ADC, Timer, PWM based Operations | Apply |
| **CO2:** | Interface LEDS and keypad with microcontroller | Apply |
| **CO3:** | Use Connectivity technologies for data transfer in IoT | Apply |
| **CO4:** | Implement protocols and architecture for data processing in IoT | Apply |
| **CO5:** | Implement simple applications in Home Automation using IoT. | Apply |

**Course Articulation Matrix**

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

High-3; Medium-2;Low-1

| Course Code: 19EIPN6601 | Course Title: INNOVATIVE AND CREATIVE PROJECT | | |
|---|---|---|---|
| Course Category: Project | | Course Level: Practice | |
| L:T:P (Hours/Week) 0: 0: 4 | Credits:2 | Total Contact Hours:60 | Max. Marks:100 |

**Pre-requisites:**

- Nil

**Course Objectives:**

The course is intended to:

1. Take up any challenging practical problems and find solution by formulating proper methodology.
2. Work collaboratively on a team to successfully complete a design project
3. Effectively communicate the results of projects in a written and oral format

The objective of Innovative and Creative Project is to enable the student to take up investigative study in the broad fieldof Electronics and Instrumentation Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an two/three students in a group, under the guidance of a Supervisor. This is expected to provide a good initiation forthe student(s) in R&D work. The assignment to normally include:

1. Survey and study of published literature on the assigned topic.
2. Working out a preliminary Approach to the Problem relating to the assigned topic.
3. Conducting preliminary Analysis/Modelling/Simulation/Experiment/Design/Feasibility.
4. Preparing a Written Report on the Study conducted for presentation to the Department.
5. Final Seminar, as oral Presentation before a departmental committee.

| **Course Outcomes**<br>**At the end of this course, students will be able to:** | **Cognitive Level** |
|---|---|
| CO1:Take up any challenging practical problems and find solution by Formulating proper methodology. | Apply |
| CO2:Work collaboratively on a team to successfully complete a design project | Create |

| | |
|---|---|
| CO3: Effectively communicate the results of projects in a written and oral format | Apply |

**Course Articulation Matrix**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | - | - | 3 | 3 | 3 | 3 |
| **CO2** | - | - | - | - | - | - | - | 3 | 3 | - | 3 | 3 | 3 | 3 |
| **CO3** | - | - | - | - | - | - | - | - | - | 3 | - | 3 | 3 | 3 |

High-3; Medium-2; Low-1

| Course Code: 19PSHG6601 | Course Title: Employability Skills 2: Campus to Corporate (Common to all) | | |
|---|---|---|---|
| Course Category: Humanities | Course Level: Introductory | | |
| L: T:P (Hours/Week): 0:0:2 | Credit :1 | Total Contact Hours: 30 | Total Marks: 100 |

**Pre-requisites:**

- Nil

**Course objectives:**

The course is intended to:

1. Understand emotions and necessity to handle it to evolve as an effective social animal
2. Build effective resumes to project the positives to be employable
3. Facilitate working in a collaborative work environment and to engage in healthy agreements for building person's professional facet
4. Enlighten the growth attribute to outperform, initiate and grow in professional arena
5. Practice effective handling of time and discarding the unprofessional habits.

**Unit I Emotional Intelligence 6 Hours**

Nature of Emotions- Importance of EI-EQ vs IQ-Behavioral difference between EQ & IQ-Acquiring Emotional Intelligence-Benefits of high EI -Steps to develop EI-Role of EI in Interviews

**Unit II Resume Preparation 6 Hours**

Importance of Resume- Good Resume -Planning Resume-Organizing Resume- Spell check -Benefits of good resume- Resume Writing

**Unit IIIGroup Discussion 6 Hours**

Purpose of GD-Prerequisites of GD-Benefits of GD-Features of GD-Do's & Don'ts in GD-Accept Criticism &Feedback-Accepting Suggestions-GD Phrases-Effective Introduction& Conclusion- Preferred Etiquette of GD.

**Unit IV Interview Etiquette (Netiquette) 6 Hours**

Definition of Interview-Types of Interview-Prior interview-Know the Company-Employer's perspective in interview-Non Verbal etiquette-Dressing-Verbal Communication in Interview-Facing Rejection in Interview-Do's & Don'ts in an Interview-Common Interview Questions-Handling Stress Questions- Handling Telephonic Interviews.

**Unit V Leadership Skills and Time Management 6 Hours**

**Leadership -**Leadership Traits-Leadership styles-Types of Leaders-Qualities of a leader-Developing Perspectives

**Time Management**-Necessity of Time Management- Types of time-Estimation of time-Process of Time management-Efficient utilization of Time-Time wasting culprits Tips to manage time-Goal setting in Time Management

| **Course Outcomes** | **Cognitive Level** |
|---|---|
| At the end of the course students will be able to: | |
| CO1: Understand the emotions and necessity to handle them | Understand |
| CO2: Build effective resumes to project the positives to be employable | Apply |
| CO3: Facilitate collaborative work environment and to engage in healthy agreements for building person’s professional facet | Understand |
| CO4: Formulate the growth attribute to outperform, initiate and grow in professional arena | Apply |
| CO5: Explain time management and impart leadership skills | Understand |

**Course Articulation Matrix:**

| CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | P 10 | P 11 | P 12 | PSO 1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | - | - | - | - | - | - | - | 1 | - | 1 | - | 1 | - | - |
| CO2 | - | - | - | - | - | - | - | - | - | 2 | - | 1 | - | - |
| CO3 | - | - | - | - | - | - | - | - | 1 | 1 | - | 1 | - | - |
| CO4 | - | - | - | - | - | - | - | - | 1 | | - | 1 | - | - |
| CO5 | - | - | - | - | - | - | - | 1 | - | - | 1 | 1 | - | - |

High -3, Medium – 2, Low-1

**Text Books**

T1: Thea Kelley, "Get That Job! The Quick and Complete Guide to a Winning Interview " Plover crest Press, 2017

**Reference Books**

R1: Daniel Goleman, " Emotional Intelligence Reader’s Guide", BANTAM PUBLISHERS, 1997

R2: Daniel Goleman, Richard Boyatzis & Annie McKee, " Primal Leadership: Unleashing the Power of Emotional Intelligence**"** Harvard Business Review Press; Anniversary edition, 2013

R3: Stephen R Covey, " The 7 Habits of Highly Effective People: Powerful Lessons in Personal Change" Simon & Schuster; Anniversary edition, 2013.

**Mode of Delivery:**

1. Continuous learning and reviews guided by faculty
2. Guided Learning Workshop

**Semester– VII**

| | | | |
|---|---|---|---|
| **Course Code:19EICN1701** | **Course Title: Introduction to Machine Learning** | | |
| **Course Category: Professional Core** | | **Course Level: Practice** | |
| **L:T:P(Hours/Week)**<br>**3: 0: 0** | **Credits:3** | **Total Contact Hours:45** | **Max Marks:100** |

**Pre-requisites**

- 19MBAC1202-Calculus and Transforms
- 19CSCN4401- Python Programming Laboratory
- Probability and Statistics

**Course Objectives**

The course is intended to:

1. Describe the types and challenges in Machine learning.
2. Illustrate the machine learning framework
3. Interpret the supervised learning techniques
4. Demonstrate the un-supervised learning methods
5. Construct the Neural network and deep learning models

Unit I **INTRODUCTION** **9 Hours**

Introduction to Machine Learning – Types of Machine Learning systems – Challenges in Machine Learning – Over fitting and Under fitting - Testing and Validating the model – Bias and Variance

Unit II **MACHINE LEARNING FRAMEWORK** **9 Hours**

Problem Formulation – Get the data - analyze and visualize the data – Prepare the data for ML algorithms – sample complexity - Hypothesis space – Model evaluation and Improvement: Cross validation – Grid search – Evaluation Metrics – Kernel functions

Unit III **SUPERVISED LEARNING** **9 Hours**

Linear and Logistic Regression – Eigen Values and Eigen vectors - Naïve Bayes Classifier: Maximum Likely hood, Minimum Description Length – Gradient Descent - Decision Trees – Ensembles of Decision Trees – Support Vector Machine(SVM)

Unit IV **UNSUPERVISED LEARNING** **9 Hours**

Clustering: k-Means clustering- Agglomerative Clustering – DBSCAN- Gaussian Mixtures- precision and recall - Collaborative filtering and Content Filtering

Unit V **NEURAL NETWORK AND DEEP LEARNING** **9 Hours**

Biological Neuron – Logical computation with Neuron – Perceptron – Sigmoid and soft max functions - Multi Layer Perceptron(MLP) with Back propagation – Regression MLPs – Classification MLPs – Fine Tuning NN models – Convolutional Neural Network: Architecture of Visual cortex – Convolutional Layers – Stacking Multiple Feature Maps-CNN architectures

| **Course Outcomes** | | **Cognitive Level** |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Describe the types and challenges in Machine learning for exploring the machine learning concepts | Understand |
| **CO2.** | Illustrate the machine learning framework for implementation of machine learning projects. | Apply |
| **CO3.** | Interpret the supervised learning techniques for classification | Apply |
| **CO4.** | Demonstrate the un-supervised learning methods for clustering and classification | Apply |
| **CO5.** | Construct the Neural network and deep learning models for classification | Apply |

**Text Book(s):**


T1. Aurélien Géron," Hands-on Machine Learning with Scikit-Learn, Keras, and TensorFlow", Seconf edition, O'Reilly Media, Inc,2019.

T2. Andreas C. Müller and Sarah Guido, " Introduction to Machine Learning with Python A Guide for Data Scientists", First Edition,O'Reilly,2017


**Reference Book(s):**


R1. Ethem Alpaydin, "Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series)", Third Edition, MIT Press, 2014

R2. Jason Bell, —Machine learning – Hands on for Developers and Technical Professionals‖, First Edition, Wiley, 2014

R3. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", First Edition, Cambridge University Press, 2012


**Web References:**

1. https://www.kaggle.com/kanncaa1/machine-learning-tutorial-for-beginners.
2. https://nptel.ac.in/courses/106/106/106106139/
3. https://archive.ics.uci.edu/ml/datasets.php


**Course Articulation Matrix**

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

High-3; Medium-2; Low-1

| Course Code:19EICN1702 | Course Title: Industrial Automation System | | |
|---|---|---|---|
| **Course Category: Professional Core** | | **Course Level: Practice** | |
| **L:T:P(Hours/Week)**<br>**3: 0: 0** | **Credits:3** | **Total Contact Hours:45** | **Max Marks:100** |

**Pre-requisites**

- Fundamentals of Electrical Engineering
- Digital Principles and Applications

**Course Objectives**

The course is intended to:

1. Explain architecture of PLC
2. Develop simple PLC programs using ladder logic programming
3. Understand the PLC troubleshooting techniques
4. Describe the concept of SCADA and open SCADA protocols.
5. Explain DCS

**Unit I PROGRAMMABLE LOGIC CONTROLLER BASICS 9 Hours**

Overview of PLC systems – parts of PLC –Input/ Output modules – power supplies and isolators – Fundamental PLC wiring diagram – relays – switches –transducers – sensors –seal-in circuits.

**Unit II PROGRAMMING OF PLC 9 Hours**

Fundamentals of logic – Types of PLC – Program scan – Relay logic – PLC programming languages – register basics - timers – counters – Arithmetic functions - comparison functions - Skip and MCR functions - data move systems - PLC Advanced intermediate functions - sequencer functions - matrix functions – Design of interlocks and alarms using PLC –connecting PLC to computer.

**Unit III PLC ADVANCED FUNCTIONS AND HMI 9 Hours**

Other programming languages – FBD-Structured Text- Analog PLC operation - PLC-PID functions - Networking of PLC - PLC installation - troubleshooting and maintenance - Necessity and Role of HMI in Industrial Automation, Text display - operator panels - Touch panels - Integrated displays (PLC & HMI)

**Unit IV SCADA 9 Hours**

Elements of SCADA system – history of SCADA – remote terminal unit (RTU) –discrete control – analog control – master terminal unit – (MTU) –operator interface. Open SCADA protocol – DNP3 – Case Study: Water Industry Application of DNP3

**Unit V DISTRIBUTED CONTROL SYSTEM 9 Hours**

Evolution – Different architectures – local control unit – Operator Interface –Displays – Engineering Interface – DCS integration with PLC and computers. Case study: DCS Applications in power plant and Cement plant..

| Course Outcomes | | Cognitive Level |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Describe the architecture of PLC and I/O devices | Understand |
| **CO2.** | Solve simple tasks using ladder programming | Apply |
| **CO3.** | Explain the development of operator panel for PLC | Understand |
| **CO4.** | Summarize the concepts of SCADA. | Understand |
| **CO5.** | Illustrate the operation of DCS | Understand |

**Text Book(s):**


T1. Frank D.Petruzella, 'Programmable Logic Controllers', Fourth edition, Tata McGraw Hill, 2010

T2. Clarke, G., Reynders, D. and Wright, E., "Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems", Newnes, 1st Edition, 2004

T3. Michael P. Lukas, 'Distributed Control System', Van No strand Reinhold CO, New york, 1986


**Reference Book(s):**


R1. John W. Webb, Ronald A. Reis 'Programmable Logic Controllers and Applications', PHI Learning, Fifth Edition, 2009.

R2. Stuart Boyer A, "Supervisory control and data Acquisition", Second edition, ISA

R3. Romily Bowden, "HART application guide and the OSI communication foundation", 1999.


**Web References:**


1. John W. Webb, Ronald A. Reis 'Programmable Logic Controllers and Applications', PHI Learning, Fifth Edition, 2009.
2. Stuart Boyer A, "Supervisory control and data Acquisition", Second edition,ISA

## Course Articulation Matrix

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

High-3; Medium-2; Low-1

| | | | |
|---|---|---|---|
| **Course Code:19EICN3701** | **Course Title: Industrial Automation Laboratory** | | |
| **Course Category: Professional Core** | | **Course Level: Practice** | |
| **L:T:P(Hours/Week)**<br>**0: 0: 3** | **Credits: 1.5** | **Total Contact Hours:45** | **Max Marks:100** |

**Pre-requisites**

- Digital Principles and Applications

**Course Objectives**

The course is intended to:

1. Interface pneumatic devices with PLC
2. Develop PLC programs for automation application
3. Develop PLC and HMI programs for process control applications
4. Develop SCADA based automation for real time process
5. Design LabVIEW based Control system for real time process

**List of Experiments**

1. Programming of PLC for latching, interlock, logic gates, motor forward reverse and motor starter
2. Interfacing of pneumatic type direction control valves with PLC
3. Programming of PLC for Automatic stamping machine
4. Bottle filling system using PLC
5. PLC programming for Parking system
6. Temperature process control using PLC and HMI
7. Flow process control using PLC and HMI
8. Remote monitoring of Temperature Process using SCADA.
9. SCADA programming to monitor and control multiple processes.
10. Remote monitoring of Process parameters using wireless Transmitters.

| Course Outcomes: | | Cognitive/ Affective |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1:** | Interface pneumatic devices with PLC | Apply |
| **CO2:** | Develop PLC programs for automation application | Apply |
| **CO3:** | Develop PLC and HMI programs for process control applications | Apply |
| **CO4:** | Develop SCADA based automation for real time process | Apply |
| **CO5:** | Design LabVIEW based Control system for real time process | Apply |

**Course Articulation Matrix**

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

High-3; Medium-2;Low-1

## Semester VIII

| Course Code: 19EIPN6801 | Course Title: PROJECT | | |
|---|---|---|---|
| Course Category: Project | | Course Level: Practice | |
| L:T:P (Hours/Week) 0: 0: 16 | Credits:8 | Total Contact Hours:240 | Max. Marks:100 |

**Pre-requisites:**

- Nil

**Course Objectives:**

The course is intended to:

1. Take up any challenging practical problems and find solution by formulating proper methodology.
2. Work collaboratively on a team to successfully complete a design project
3. Effectively communicate the results of projects in a written and oral format

The objective of Project is to enable the student to take up investigative study in the broad field of Electronics and Instrumentation Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an two/three students in a group, under the guidance of a Supervisor. This is expected to provide a good initiation forthe student(s) in R&D work.

The assignment to normally include:

1. Survey and study of published literature on the assigned topic.
2. Working out a preliminary Approach to the Problem relating to the assigned topic.
3. Conducting preliminary Analysis/ Modelling/ Simulation/ Experiment/ Design/ Feasibility.
4. Preparing a Written Report on the Study conducted for presentation to the department.
5. Final Seminar, as oral Presentation before a departmental committee.

| Course Outcomes<br>At the end of this course, students will be able to: | Cognitive Level |
|---|---|
| CO1:Take up any challenging practical problems and find solution by Formulating proper methodology. | Apply |
| CO2:Work collaboratively on a team to successfully complete a design project | Create |
| CO3:Effectively communicate the results of projects in a written and oral format | Apply |

**Course Articulation Matrix**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | - | - | 3 | 3 | 3 | 3 |
| **CO2** | - | - | - | - | - | - | - | 3 | 3 | - | 3 | 3 | 3 | 3 |
| **CO3** | - | - | - | - | - | - | - | - | - | 3 | - | 3 | 3 | 3 |

High-3; Medium-2; Low-1

## Sensors and Instrumentation Vertical Electives

| | | | |
|---|---|---|---|
| **Course Code:19EIEN1007** | **Course Title: Fiber Optics and Laser Instrumentation** | | |
| **Course Category: Professional Elective** | | **Course Level: Mastery** | |
| **L:T:P(Hours/Week)<br>3: 0: 0** | **Credits:3** | **Total Contact Hours:45** | **Max Marks:100** |

**Pre-requisites**

- Electric Circuits

**Course Objectives**

The course is intended to:

1. Introduce different types of electronic instruments and their applications.
2. Provide knowledge on various types of cathode ray oscilloscopes, their applications and different types of signal analyzers.
3. Introduce different types of waveform generators and analyzers and their applications.
4. Educate on virtual instrumentation, its applications, programming and DAQ cards and modules.
5. Provide exposure to telemetry, modulation techniques and multiplexing.

**Unit I OPTICAL FIBRES AND THEIR PROPERTIES 9 Hours**

Principles of light propagation through a fibre - Different types of fibres and their properties, fibre characteristics – Absorption losses – Scattering losses – Dispersion – Connectors and splicers – Fibre termination – Optical sources – Optical detectors.

**Unit II INDUSTRIAL APPLICATION OF OPTICAL FIBRES 9 Hours**

Fibre optic sensors – Fibre optic instrumentation system – Different types of modulators – Interferometric method of measurement of length – Moire fringes – Measurement of pressure, temperature, current, voltage, liquid level and strain.

**Unit III LASER FUNDAMENTALS 9 Hours**

Fundamental characteristics of lasers – Three level and four level lasers – Properties of laser – Laser modes – Resonator configuration – Q-switching and mode locking – Cavity damping – Types of lasers – Gas lasers, solid lasers, liquid lasers, semiconductor lasers..

**Unit IV INDUSTRIAL APPLICATION OF LASERS 9 Hours**

Laser for measurement of distance, length, velocity, acceleration, current, voltage and Atmospheric effect – Material processing – Laser heating, welding, melting and trimming of material – Removal and vaporization.

**Unit V HOLOGRAM AND MEDICAL APPLICATIONS 9 Hours**

Holography – Basic principle - Methods – Holographic interferometry and application, Holography for non-destructive testing – Holographic components – Medical applications of lasers, laser and tissue interactive – Laser instruments for surgery, removal of tumors of vocal cards, brain surgery, plastic surgery, gynecology and oncology.

| **Course Outcomes** | | **Cognitive Level** |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Understand the principle, transmission, dispersion and attenuation characteristics of optical fibers | Understand |
| **CO2.** | Apply the gained knowledge on optical fibers for its use as communication medium and as sensor as well which have important applications in production, manufacturing industrial and biomedical applications. | Understand |
| **CO3.** | Understand laser theory and laser generation system. | Understand |
| **CO4.** | Apply laser theory for the specific Industrial applications. | Understand |
| **CO5.** | Apply laser theory for the specific medical application. | Understand |

**Text Book(s):**

T1. J.M. Senior, Optical Fibre Communication – Principles and Practice, Prentice Hall of India,1985

T2. J. Wilson and J.F.B. Hawkes, Introduction to Opto Electronics, Prentice Hall of India, 2001.

T3. Eric Udd, William B., and Spillman, Jr., Fiber Optic Sensors: An Introduction for Engineers and Scientists, John Wiley and Sons, 2011

**Reference Book(s):**

R1. G. Keiser, Optical Fibre Communication, McGraw Hill, 1995..

R2. M. Arumugam, Optical Fibre Communication and Sensors, Anuradha Agencies, 2002.

R3. John F. Ready, Industrial Applications of Lasers, Academic Press, Digitized in 2008.

**Web References:**

1. http://iitg.vlab.co.in/?sub=61&brch=174

2. http://nptel.iitg.ernet.in/couses/Elec_Engg/IIT%20Bombay/Electrical%20and%20Electronic

**Course Articulation Matrix**

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

High-3; Medium-2; Low-1

| Course Code:19EIEN1009 | Course Title: Bio Medical Instrumentation | | |
|---|---|---|---|
| Course Category: Professional Elective | | Course Level: Mastery | |
| L:T:P(Hours/Week)<br>3: 0: 0 | Credits:3 | Total Contact Hours:45 | Max Marks:100 |

**Pre-requisites**

- Transducer Engineering

**Course Objectives**

The course is intended to:

1. Explain the basic physiology and biomedical applications of different types of transducers.
2. Explain the different Electro Physiological Measurements.
3. Explain the different non electrical parameter measurements on human body.
4. Explain the concept of modern methods of imaging techniques.
5. Explain the concept of medical assisting and therapeutic equipment.

**Unit I PHYSIOLOGY AND TRANSDUCERS 9 Hours**

Cell and its structure – Action and resting – Potential propagation of action potential – Sodium pump –Nervous system – CNS – PNS – Nerve cell –Synapse – Cardio pulmonary system – Physiology of heart and lungs –Circulation and respiration – Transducers– Piezoelectric, ultrasonic, resistive, capacitive, inductive transducers – selection criteria.

**Unit II ELECTRO – PHYSIOLOGICAL MEASUREMENTS 9 Hours**

Basic components of a biomedical system – Electrodes – Micro, needle and surface electrodes – Amplifiers – Preamplifiers, differential amplifiers, chopper amplifiers – Isolation amplifier. ECG – PCG – EEG – EMG – ERG – Lead systems and recording methods – Typical Waveforms.

**Unit III NON-ELECTRICAL PARAMETER MEASUREMENTS 9 Hours**

Measurement of blood pressure – Cardiac output – Cardiac rate –Respiratory rate – Gas volume –- pH of blood, GSR measurements – Plethysmography.

**Unit IV MEDICAL IMAGING AND PMS 9 Hours**

X-ray machine - Computer tomography – MRI – Ultrasonography – Endoscopy – Thermography – Different types of biotelemetry systems and patient monitoring – Electrical safety.

**Unit V ASSISTING AND THERAPEUTIC EQUIPMENTS 9 Hours**

Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators –Diathermy – Heart Lung machine – Audio meters – Dialyzers.

| Course Outcomes | | Cognitive Level |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Explain the basic physiology and biomedical applications of different types of transducers. | Understand |
| **CO2.** | Explain the different Electro Physiological Measurements. | Understand |
| **CO3.** | Explain the different non electrical parameter measurements on human body. | Understand |
| **CO4.** | Explain the concept of modern methods of imaging techniques. | Understand |
| **CO5.** | Explain the concept of medical assisting and therapeutic equipment. | Understand |

**Text Book(s):**


T1. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, 3rd Edition, New Delhi, 2014.

T2. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Prentice Hall of India, New Delhi, 2007.


**Reference Book(s):**


R1. John G. Webster, "Medical Instrumentation Application and Design", John Wiley and sons, 4th Edition New York, 2009.

R2. Joseph J. Carr and John M. Brown," Introduction to Biomedical Equipment Technology", John Wiley and sons, 4th Edition, New York, 2000.

R3. Duane Knudson," Fundamentals of Biomechanics", Springer, 2003.

R4. Ed. Joseph D. Bronzino, "The Biomedical Engineering Hand Book", 2nd Edition, Boca Raton, CRC Press LLC, 2000.


**Web References:**

1. http://www.mtu.edu/biomedical/research/biosensors/
2. http://www.eecs.umich.edu/courses/bme458

**Course Articulation Matrix**

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

High-3; Medium-2; Low-1

| Course Code:19EIEN1010 | Course Title: Analytical Instrumentation | | |
|---|---|---|---|
| Course Category: Professional Elective | | Course Level: Mastery | |
| L:T:P(Hours/Week) 3: 0: 0 | Credits:3 | Total Contact Hours:45 | Max Marks:100 |

**Pre-requisites**

- Engineering Chemistry

**Course Objectives**

The course is intended to:

1. Explain the concepts and application of various spectrophotometers.
2. Describe Nuclear magnetic resonance, types of mass spectrometers and electron microscope.
3. Compare different types of chromatography.
4. Summarize the working and characteristics of different analyzers.
5. Illustrate the measuring techniques for Pollutant gases from industries.

**Unit I COLORIMETRY AND SPECTROPHOTOMETRY 9 Hours**

Spectral methods of analysis– Beer-Lambert law – Colorimeters – UV-Visible spectrophotometers – Single and double beam instruments – Sources and detectors – IR Spectrophotometers – Types – Attenuated total reflectance flame photometers – Atomic absorption spectrophotometers – Sources and detectors – FTIR spectrophotometers – Flame emission photometers – Fluorescence spectrophotometer.

**Unit II NUCLEAR MAGNETIC RESONANCE AND MICROSCOPIC TECHNIQUES 9 Hours**

NMR – Basic principles – NMR spectrometer – Applications - Electron spin Resonance spectroscopy – Basic principles, Instrumentation and applications. Scanning Electron Microscope (SEM) - Basic principles, Instrumentation and applications. Transmission Electron Microscope (TEM) – Basic principles – Instrumentation and applications. Mass spectrometers – Different types – Applications.

**Unit III CHROMATOGRAPHY 9 Hours**

Different techniques – Techniques by chromatographic bed shape- Column chromatography Planer Chromatography - Paper Chromatography - Thin layer Chromatography-Applications – Techniques by physical state of mobile phase - Gas chromatography – Detectors – High-pressure liquid chromatographs – detectors - Applications - Techniques by separation mechanism Ion exchange chromatography-size-exclusion chromatography – Applications.

**Unit IV pH METERS AND DISSOLVED COMPONENT ANALYZERS 9 Hours**

Principle of pH measurement, glass electrodes, hydrogen electrodes, reference electrodes, selective ion electrodes, ammonia electrodes, biosensors, dissolved oxygen analyzer – Sodium analyzer – Silicon analyzer.

**Unit V INDUSTRIAL GAS ANALYZERS AND POLLUTION MONITORING INSTRUMENTS 9 Hours**

Types of gas analyzers – Oxygen, NO2 and H2S types, IR analyzers, thermal conductivity analyzers, analysis based on ionization of gases. Air pollution due to carbon monoxide, hydrocarbons, nitrogen oxides, sulphur dioxide estimation - Dust and smoke measurements.

| **Course Outcomes** | | **Cognitive Level** |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Explain the concepts and application of various spectrophotometers | Understand |
| **CO2.** | Describe Nuclear magnetic resonance, types of mass spectrometers and electron microscope. | Understand |
| **CO3.** | Contrast the different types of chromatography based on construction and working principle | Understand |
| **CO4.** | Summarise the working and characteristics of different analyzers | Understand |
| **CO5.** | Illustrate the measuring techniques for Pollutant gases from industries | Understand |

**Text Book(s):**


T1. R.S. Khandpur, Handbook of Analytical Instruments, Tata McGraw Hill publishing Co. Ltd., 2nd edition, 2006.

T2. G.W. Ewing, Instrumental Methods of Analysis, McGraw Hill, 2004.

T3. H.H.Willard, L.L.Merritt, J.A.Dean, F.A.Settle, Instrumental methods of analysis, CBS publishing & distribution, 1995.


**Reference Book(s):**


R1 Braun, R.D., Introduction to Instrumental Analysis, McGraw – Hill, Singapore, 2006.

R2 Liptak, B.G., Process Measurement and Analysis, CRC Press, 2005.


**Web References:**

1. www.nptel.ac.in

**Course Articulation Matrix**

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

High-3; Medium-2; Low-1

| Course Code:19EIEN1012 | Course Title: Agricultural Instrumentation | | |
|---|---|---|---|
| Course Category: Professional Elective | | Course Level: Mastery | |
| L:T:P(Hours/Week)<br>3: 0: 0 | Credits:3 | Total Contact Hours:45 | Max Marks:100 |

**Pre-requisites**

- Nil

**Course Objectives**

The course is intended to:

1. Explain the concept of soil properties
2. Understand the importance of sensors used in agricultural systems.
3. Explain the importance of instrumentation in irrigation
4. Understand the automation scheme for green house
5. Implement the automation techniques in agriculture

**Unit I Basics of Soil science 9 Hours**

Engineering properties of soil pH, conductivity, resistivity, temperature, soil moisture and salinity, ion concentration measurement, method of soil analysis, Instrumentation for environmental conditioning of seed germination and growth.

**Unit II Sensors 9 Hours**

Necessity of sensors in agriculture instrumentation, sonic anemometers, hygrometers, fine wire thermocouples, open & close path gas analysers,remote sensing and biosensors in agriculture: infrared & UV bio sensor methods in agriculture, agro-metrological instrumentation weather stations.

**Unit III Instrumentation for Irrigation 9 Hours**

Water distribution & management control, Auto drip & sprinkler irrigation systems, irrigation canal management systems, upstream & downstream control concept, SCADA for DAM parameters & control.

**Unit IV Greenhouse Parameters and Instrumentation 9 Hours**

Flow diagram of sugar plant, sensors & instrumentation set up, Flow diagram of fermenter & control (batch process), flow diagram of dairy industry & instrumentation set up for it, juice extraction control process & instrumentation set up.

**Unit V Agricultural Automation 9 Hours**

Automation in earth moving equipments & farm equipments, application of SCADA & PLC in packing industry and cold storage systems, implementation of hydraulic, pneumatic & electronics control circuits in harvesters cotton pickers. classification of pumps: pump characteristics, pump selection & installation.

| **Course Outcomes** | | **Cognitive Level** |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Explain about concept of soil properties. | Understand |
| **CO2.** | Describe the different sensors used in agricultural instrumentation | Understand |
| **CO3.** | Explain the Water distribution & management using irrigation system. | Understand |
| **CO4.** | Illustrate the concept of greenhouse automation system. | Understand |
| **CO5.** | Expalin automation techniques by evaluating agricultural parameter | Understand |

**Text Book(s):**


T1. Industrial Instrumentation by D. Patranabis, Tata Mcgraw Hill pub

T2. Mineral Processing Technology by Wills B.A., Pergamon Press, 4th Ed

T3. G.S. Sawhney —Non-Conventional Energy Resources, PHI Learning Private Limited, 1st ed., 2012


**Reference Book(s):**


R1. Agricultural Engineering; RadheyLal: Saroj Publication

R2. Principle of Farm Machinery, R.A Kepner, Roy Bainer;: CBS Publication


**Web References:**

1. 1.http://nptel.ac.in/video.php

## Course Articulation Matrix

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

High-3; Medium-2; Low-1

<table>
<tr><td colspan="2">Course Code:19EIEN1013</td><td colspan="2">Course Title: Instrumentation System Design</td></tr>
<tr><td colspan="2">Course Category: Professional Elective</td><td colspan="2">Course Level: Mastery</td></tr>
<tr><td>L:T:P(Hours/Week)<br>3: 0: 0</td><td>Credits:3</td><td>Total Contact Hours:45</td><td>Max Marks:100</td></tr>
</table>

**Pre-requisites**

- Nil

**Course Objectives**

The course is intended to:

1. Understand the basic concepts and standards of Instrumentation system
2. Develop Signal Conditioning circuit for Temperature Sensor
3. Explain the concepts the Control system design
4. Design Electronic PID controllers for Process Control Applications.
5. Design a Microcontroller based Instrumentation system for measuring and controlling.

**Unit I Instrumentation Basic Concepts 9 Hours**

Calibrating and testing standards for Instruments and transducer – NEMA, DIN, BIS and ANSI standards – P&I symbols: SAMA & ISA, P&I diagram for flow, pressure, level and temperature process.

**Unit II Signal Conditioning for Transducers 9 Hours**

Analog Signal Conditioning: Overview of bridge circuits and OP-AMP based amplifiers – Design consideration for thermocouple and RTD – Digital Signal Conditioning: Overview of ADCs and DACs – Analog and Digital Conversions – Hardware structure of DAS.

**Unit III Control System Instrumentation 9 Hours**

Standard Instrumentation Signal levels – Sensor Transmitter – Transmission lines – Steps in Control System design – Selection of Controlled, Manipulated and Measured variable – Process safety – Process alarms – Safety interlocks System (SIS) – Interlocks and Automatic shutdown systems.

**Unit IV Analog Controllers 9 Hours**

Electronic Controllers – Error detector – Single Mode: Design of Two Position and Three Position Control, Proportional, Integral, and Derivative modes – Composite Controller modes: Design of PI, PD, PID.

**9 Hours**

**Unit V Microcontroller Based Instrumentation**

Case study – Temperature Monitoring and control: Temperature IC Sensor, Signal Conditioning – ADC – Interface of Microcontroller – DAC – Driver circuit for Heater – PID algorithm and Programming for temperature control.

| **Course Outcomes** | | **Cognitive Level** |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Explain the basic concepts of Instrumentation system | Understand |
| **CO2.** | Design Signal Conditioning circuit (Analog and Digital) for Temperature Sensor | Apply |
| **CO3.** | Summarize the concepts of Control system design | Understand |
| **CO4.** | Design Analog PID controllers for Process Control Applications. | Apply |
| **CO5.** | Design a Microcontroller based Instrumentation system for measuring and controlling. | Apply |

**Text Book(s):**


T1. Dale E. Seborg, Thomas F.Edger, Process dynamics and Control, 2nd Edition, Willey,

T2. C. D. Johnson, Process Control Instrumentation Technology, 8th Ed, PHI, 2014 education


**Reference Book(s):**


R1. Instrumentation Engineers Handbook- Process measurement volume I and Process control volume II, by B.G.Liptak, Chilton Book Company, 2001

R2. Process Instrumentation and control handbook by Considine D. M., McGraw Hill pub.


**Web References:**

1. 1.http://nptel.ac.in/video.php

## Course Articulation Matrix

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

High-3; Medium-2; Low-1

| Course Code:19EIEN1025 | Course Title: Instrumentation and Testing | | |
|---|---|---|---|
| Course Category: Professional Elective | | Course Level: Mastery | |
| L:T:P(Hours/Week)<br>3: 0: 0 | Credits:3 | Total Contact Hours:45 | Max Marks:100 |

**Pre-requisites**

- Nil

**Course Objectives**

The course is intended to:

1. Explain the fundamental concepts of measurements
2. Understand the measurement of electrical quantities
3. Understand the measurement of physical quantities and functioning of display devices.
4. Describe the data acquisition and storage devices
5. Explain the test concept of virtual instrumentation and test procedures

**Unit I Basics of Measurements 9 Hours**

SI Units, Standards, Functional elements of an instrument, Static and Dynamic characteristics – Errors. PMMC and MI Instruments: Construction - Working - Errors – D Arsonval Galvanometer: Construction - Working - Errors.

**Unit II Electrical Quantity Measurements 9 Hours**

Bridges: Wheatstone‘s bridge, Maxwell bridge, Schering bridge and Wein bridge.

Potentiometers: Crompton potentiometer and drysdale polar potentiometers - Watt meter - Single phase energy meter, Power factor meter, LCR Meter - Instrument transformers.

**Unit III Physical Quantity Measurements and Display Devices 9 Hours**

Classification of transducer – Selection and specification of transducers – Resistive, Capacitive and Inductive transducers – Piezoelectric and Optical transducer. Display Devices: CRT Display, digital CRO, DSO, LED, LCD & Dot matrix display

**Unit IV Data Acquisition System and Storage Devices 9 Hours**

Data acquisition system: components - signal conditioning – Sample and hold circuit - ADC – DAC. Storage devices: X-Y recorder, magnetic tape recorder, hard disk, CD ROM, USB drive.

**Unit V Virtual Instrumentation and Test Procedures 9 Hours**

PC based instrumentation – Bed of nails fixtures. Introduction to LabVIEW environment - LabVIEW foundation – Signal acquisition using LabVIEW – Test procedure automation.

| Course Outcomes | | Cognitive Level |
|---|---|---|
| At the end of this course, students will be able to: | | |
| CO1. | Explain the fundamental concepts of measurements and measuring instruments. | Understand |
| CO2. | Describe the measurement of various electrical parameters. | Understand |
| CO3. | Illustrate the measurement of physical parameters and the concept of display devices. | Understand |
| CO4. | Describe data acquisition system and storage devices | Understand |
| CO5. | Explain the fundamentals of virtual instrumentation and the test procedures | Understand |

**Text Book(s):**

T1. A K. Sawhney ―A course in Electrical and Electronic Measurements and Instrumentation‖, Dhanbat Raj & Co., 2015

**Reference Book(s):**

R1. Alan V. Oppenheim, Alan S.Willsky, S.HamidNawab, ―Signals & Systems‖, 2ndEdition, Prentice Hall, 2015.

R2 K. Lal Kishore and Kishore, ―Electronic Measurements and Instrumentation‖, Pearson, 1st Edition, 2009

R3 Jovithajerome, ―Virtual Instrumentation Using LABVIEW, 2010, PHI learning Pvt ltd

R4 Jose Moreira, Hubert Werkmann, ―An Engineer's Guide to Automated Testing of High Speed Interfaces, 2nd Edition, ARTECH house, 2010

R5 Wilson, ―Test and measurements: know it all‖, Newnes (imprint of Elsevier), 2009,

**Web References:**

1. www.nptel.ac.in

## Course Articulation Matrix

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

High-3; Medium-2; Low-1

| Course Code: 19EIEN1026 | Course Title: Smart Sensor Instrumentation | | |
|---|---|---|---|
| Course Category: Professional Elective | Course Level: Mastery | | |
| L:T:P(Hours/Week) 3: 0: 0 | Credits:3 | Total Contact Hours:45 | Max Marks:100 |

**Pre-requisites**

- Nil

**Course Objectives**

The course is intended to:

1. Explain the structure of Smart Sensors
2. Describe the data acquisition through the sensor
3. Summarize the various communication protocol used for data processing
4. Elucidate wireless technology used in sensor system.
5. Provide knowledge on inbuilt sensors in Smart devices

**Unit I INTRODUCTION TO SMART SENSORS 9 Hours**

Mechanical to Electronic transition in Sensing – Nature of Sensor – Integration of Micromachining and Microelectronics - Evolution of Smart Sensors - Components of Smart Sensors – General Architecture of Smart Sensors

**Unit II DATA ACQUISITION THROUGH SENSOR 9 Hours**

Amplification and Signal Conditioning: Instrumentation amplifier – Sleep mode operational amplifier - Rail to Rail operational amplifier - 4-20ma Signal transmitter – Digital conversion: sampling, Quantizing and encoding – MCU control and sensor interface – Techniques and system integration: Linearization – PWM Control – Auto zero and Auto range – Diagnostics – Reducing EMC and RFI

**Unit III COMMUNICATION FOR SMART SENSOR 9 Hours**

Overview of Communication Organization and standards – Automotive protocols: CAN – LIN – Media Oriented Systems Transport – Flex ray - Industrial usage of CAN – MCU with integrated CAN – LonTalk Protocol – MI bus – Other aspects of Network communications

**Unit IV WIRELESS SENSING 9 Hours**

Introduction of RF and Spread spectrum – Wireless data and communication – Zigbee – ANT+ - 6LoWPAN – NFC – Zwave – Dust networks – RF Sensing: Surface acoustic waves - RADAR – LIDAR – GPS – Remote emission sensing – Intelligent transportation system - RFID – Telemetry.

**Unit V SMART SENSOR DEVICES 9 Hours**

Case Study: Sensors in Mobile phones: Touch sensor, Proximity Sensor, Ambient light sensor, Hall sensor and Finger print sensor – Sensors in Automotive vehicles: Air flow sensor, Engine speed sensor, Manifold Absolute Pressure Sensor, Spark Knock Sensor, Fuel Temperature Sensor and Voltage Sensor - Sensors in Wearables: Electro-chemical Bio Sensor, Wearable electrodes, Stain, temperature and pressure sensors.

| **Course Outcomes** | | **Cognitive Level** |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Explicate the Structure of Smart Sensors and build the sensor | Understand |
| **CO2.** | Describe the data acquisition from sensor to other devices | Understand |
| **CO3.** | Summarize the various communication protocol used for data processing | Understand |
| **CO4.** | Elucidate wireless technology used in sensor system | Understand |
| **CO5.** | Explain the sensors used in various smart devices | Understand |

**Text Book(s):**


T1. Randy Frank "Understanding Smart Sensors" 3rd Edition, CRC Press, 2014

T2. Krzysztof Iniewski "Smart Sensors for Industrial applications" CRC Press, 2013


**Reference Book(s):**


R1. Kevin Yallup, Krzysztof Iniewski "Technologies for Smart Sensors and Smart fusion" CRC Press, 2014

R2. Gerard Meijer, Kofi Makinwa, MichielPertijs "Smart Sensor Systems: Emerging Technologies and applications" John wiley and Sons Ltd, 2014

R3. S.C.Mukhopadhyay, G.S.Gupta "Smart Sensors and Sensing Technology" Springer, 2008


**Web References:**


1. https://new.abb.com/motors-generators/service/advanced-services/smart-sensor
2. https://www.intersil.com/en/applications/industrial/smart-sensor.html
3. http://www.smartsensors.com/

## Course Articulation Matrix

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 1 | - | 1 | 1 | - | - | 1 | - | 1 | - | - |
| **CO2** | 2 | 1 | - | 1 | 1 | - | - | 1 | - | 1 | - | - |
| **CO3** | 2 | 1 | - | 1 | 1 | - | - | 1 | - | 1 | - | - |
| **CO4** | 2 | 1 | - | 1 | 1 | - | - | 1 | - | 1 | - | - |
| **CO5** | 2 | 1 | - | 1 | 1 | - | - | 1 | - | 1 | - | - |

High-3; Medium-2; Low-1

<table>
<tr><td colspan="2">Course Code: 19EIEN1027</td><td colspan="3">Course Title: Wireless Sensor Networks</td></tr>
<tr><td colspan="3">Course Category: Professional Elective</td><td colspan="2">Course Level: Mastery</td></tr>
<tr><td>L:T:P(Hours/Week)<br>3: 0: 0</td><td colspan="2">Credits:3</td><td>Total Contact Hours:45</td><td>Max Marks:100</td></tr>
</table>

**Prerequisites:** The student should have undergone the course(s):

- Nil

**Course Objectives**

**The course is intended to:**

1. Understand the Adhoc WSN
2. Know the architecture of WSN
3. Describe the sensor data processing through networking
4. Illustrate the topology structure of WSN
5. Explain the WSN hardware and its s/w tool

**UNIT I – INTRODUCTION TO WSN 9**

Fundamentals of Wireless Communication Technology – The Electromagnetic Spectrum – Radio propagation Mechanisms – Characteristics of the Wireless Channel -mobile ad hoc networks (MANETs) and wireless sensor networks (WSNs): concepts and architectures. Applications of Ad Hoc and Sensor Networks. Design Challenges in Ad hoc and Sensor Networks.

**UNIT II – ARCHITECTURES 9**

Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes, Operating Systems and Execution Environments, Network Architecture - Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts.

**UNIT III – NETWORKING SENSORS 9**

Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - S-MAC, The Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses

**UNIT IV – INFRASTRUCTURE ESTABLISHMENT 9**

Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control

**UNIT V – SENSOR NETWORK PLATFORMS AND TOOLS 9**

Operating Systems for Wireless Sensor Networks, Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node level Simulators, State-centric programming.

| **Course Outcomes**<br>**At the end of the course students will be able to:** | | **Cognitive Level** |
|---|---|---|
| CO1. | Attain the knowledge on Adhoc and Sensor Networks | Understand |
| CO2. | Explain the sensor Node architecture | Understand |
| CO3. | Illustrate the knowledge on Network protocols | Understand |
| CO4. | Describe the operation of Sensor Tasking and Control. | Understand |
| CO5. | Elucidate the plat form of sensor network and its tools | Understand |

**Text Books**


1. Holger Karl, Andreas Willig, ‘Protocols and Architectures for Wireless Sensor Networks’, John Wiley, 2005.
2. Feng Zhao, Leonidas J. Guibas, ‘Wireless Sensor Networks- An Information Processing Approach’, Elsevier, 2007


**Reference Books**


1. C. Siva Ram Murthy, and B. S. Manoj, "Ad Hoc Wireless Networks: Architectures and Protocols ", Prentice Hall Professional Technical Reference, 2008.
2. KazemSohraby, Daniel Minoli, and TaiebZnati, “Wireless Sensor Networks- Technology, Protocols, and Applications”, John Wiley, 2007.
3. Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003.
4. BhaskarKrishnamachari,’Networking Wireless Sensors’, Cambridge Press,2005.
5. Mohammad IlyasandImadMahgaob, ‘Handbook of Sensor Networks: Compact Wireless And Wired Sensing Systems’, Crc Press, 2005


**Web References**


1. www.nptel.ac.in

**Course Articulation Matrix**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 1 | - | 1 | 1 | - | - | 1 | - | 1 | - | - |
| **CO2** | 2 | 1 | - | 1 | 1 | - | - | 1 | - | 1 | - | - |
| **CO3** | 2 | 1 | - | 1 | 1 | - | - | 1 | - | 1 | - | - |
| **CO4** | 2 | 1 | - | 1 | 1 | - | - | 1 | - | 1 | - | - |
| **CO5** | 2 | 1 | - | 1 | 1 | - | - | 1 | - | 1 | - | - |

High-3; Medium-2; Low-1

## Control and Automation Electives

| Course Code:19EIEN1018 | Course Title: Fluid Power System | | |
|---|---|---|---|
| Course Category: Professional Elective | Course Level: Mastery | | |
| L:T:P(Hours/Week) 3: 0: 0 | Credits:3 | Total Contact Hours:45 | Max Marks:100 |

**Pre-requisites**

- Nil

**Course Objectives**

The course is intended to:

1. Understand the principles of fluid power system
2. Illustrate the construction and working of hydraulic system and its components.
3. Explain the working of valves, actuators and industrial hydraulic circuits
4. Understand the working of components in pneumatic system
5. Explain the pneumatic DCVs and pneumatic circuits

**Unit I FLUID POWER PRINCIPLES AND FUNDAMENTALS 9 Hours**

Introduction to Fluid power - Types of fluid power systems - Hydraulic system components - Pneumatic system components - Application of Pascal's Law in hydraulics-Advantages of fluid power system -Applications of Fluid power system -Properties of hydraulic fluids - Types of fluids.

**Unit II HYDRAULIC SYSTEM AND COMPONENTS 9 Hours**

Pumping theory - Pump classification - Construction and working of gear pumps, Vane pumps, Piston pumps - Construction and working of linear actuators - Special cylinder - Rotary actuator – Construction and operation of direction control valves (DCV), Pressure control valve, Flow control valve – Construction and operation of accumulators, Intensifiers

.

**Unit III HYDRAULIC CIRCUITS 9 Hours**

Hydraulic symbols - Hydraulic circuits using 4/2 and 4/3 DCVs – Electro Hydraulic circuits - Speed control circuits - Sequencing circuit - Regenerative circuit - Accumulator circuit – Application of intensifier - Hydraulic circuit for Grinding Machine - Hydraulic braking in Automobiles.

**Unit IV PNEUMATIC SYSTEM AND COMPONENTS 9 Hours**

Properties of air – Compressor - Types of compressor - Construction and operation of air filter, air regulator and air lubricator - Pneumatic symbols - Pneumatic linear actuator - Rotary actuator - Constriction and working of pneumatic direction control valves and Flow controls valve.

**Unit V PNEUMATIC CIRCUITS 9 Hours**

Pneumatic circuits for single acting cylinder and Double acting cylinder using 3/2, 5/2 and 5/3 DCVs – Electro Pneumatic circuits - Cascade method for two Cylinders - Hydro-Pneumatic circuit - Material handling system circuit.

| **Course Outcomes** | | **Cognitive Level** |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Explain the principles of fluid power system | Understand |
| **CO2.** | Describe the construction and working of hydraulic system and its components. | Understand |
| **CO3.** | Illustrate the working of valves, switches, actuators and industrial hydraulic circuits | Understand |
| **CO4.** | Summarize the working of components in pneumatic system | Understand |
| **CO5.** | Describe the pneumatic DCVs, pneumatic circuits and application | Understand |

**Text Book(s):**

T1. Anthony Esposito, “Fluid Power with Applications”, 7th edition, Pearson education, 2014

T2. Srinivasan, R., “Hydraulic and Pneumatic Controls”, 2nd edition, Vijay Nicole Imprints, 2008

**Reference Book(s):**

R1. Andrew Parr,”Hydraulics& Pneumatics”, Jaico Publishing House, 2014.

R2. Majumdar, “Oil Hydraulics: Principles and Maintenance”, Tata McGraw Hill, 2004.

R3. Majumdar, “Pneumatic system: Principles and Maintenance”, Tata McGraw Hill, 2014

**Web References:**

1. www.nptel.ac.in

## Course Articulation Matrix

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

High-3; Medium-2; Low-1

| Course Code:19EIEN1020 | Course Title: Power Plant Instrumentation | | |
|---|---|---|---|
| Course Category: Professional Elective | Course Level: Mastery | | |
| L:T:P(Hours/Week) 3: 0: 0 | Credits:3 | Total Contact Hours:45 | Max Marks:100 |

**Pre-requisites**

- Industrial Instrumentation
- Process Control

**Course Objectives**

The course is intended to:

1. Introduce the concept of different power generation techniques
2. Describe the various measurements in power plants
3. Apply the different control schemes in boiler side
4. Apply the different control schemes in furnace side
5. Illustrate the different control schemes in turbine

**Unit I OVERVIEW OF POWER GENERATION 9 Hours**

Survey of methods of power generation – hydro, thermal, nuclear, solar and wind power – Importance of instrumentation in power generation – Thermal power plant – Building blocks – Boiler Accessories– sub critical and supercritical boilers – Condensers – Cooling towers.

**Unit II MEASUREMENTS & ANALYSERS IN POWER PLANTS 9 Hours**

Measurement of feed water flow, air flow, steam flow and coal flow – Drum level measurement – Steam pressure and temperature measurement – Turbine speed and vibration measurement – Flue gas analyzer – Fuel composition analyzer.

**Unit III BOILER CONTROL - I 9 Hours**

Combustion of fuel and excess air – Firing rate demand – Steam temperature control – Control of deaerator – Drum level control: Single, two and three element control – Furnace draft control – implosion – flue gas dew point control – Trimming of combustion air – Soot blowing.

**Unit IV BOILER CONTROL - II 9 Hours**

Burners for liquid and solid fuels – Burner management system – Furnace safety interlocks – Coal pulverizer control – Combustion control for liquid and solid fuel fired boilers – air/fuel ratio control – fluidized bed boiler.

**Unit V CONTROL OF TURBINE 9 Hours**

Turbine - Types of steam turbines: impulse turbine, reaction turbine and compounding turbines – Turbine governing system – Automatic Load Frequency Control – Turbine oil system – Oil pressure drop relay – Oil cooling system.

| Course Outcomes | | Cognitive Level |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Explain overview of different methods of power generation and boiler process | Understand |
| **CO2.** | Illustrate the various measurements involved in power generation plants. | Understand |
| **CO3.** | Apply the different control schemes in boiler side | Apply |
| **CO4.** | Apply the different control schemes in furnace side. | Apply |
| **CO5.** | Elucidate the different control schemes to monitor turbine parameters. | Understand |

**Text Book(s):**


T1. Sam Dukelow, Control of Boilers, Second Edition, Instrument Society of America, 1991.

T2. Rajput R.K., A Text book of Power plant Engineering. Fifth Edition, Lakshmi Publications, 2013


**Reference Book(s):**


R1. Everett Woodruff , Herbert Lammers, Thomas Lammers, Steam Plant Operation,9th Edition McGraw Hill, 2012

R2. Krishnaswamy.K and Ponnibala.M., Power Plant Instrumentation, PHI Learning Pvt.Ltd., New Delhi, 2011

R3. Liptak B.G., Instrumentation in Process Industries, Chilton Book Company, 2005

R4. Jain R.K., Mechanical and Industrial Measurements, Khanna Publishers, New Delhi, 1999.

R5. P.K.Nag, Powerplant Engineering, Tata McGraw-Hill Education, 3rd edition, 2007


**Web References:**

1. www.nptel.ac.in

## Course Articulation Matrix

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

High-3; Medium-2; Low-1

| Course Code:19EIEN1022 | Course Title: Industrial safety and standards | | |
|---|---|---|---|
| Course Category: Professional Elective | Course Level: Mastery | | |
| L:T:P(Hours/Week) 3: 0: 0 | Credits:3 | Total Contact Hours:45 | Max Marks:100 |

**Pre-requisites**

- Industrial Data Communication Networks

**Course Objectives**

The course is intended to:

1. Summarize basics of industrial safety.
2. Identify preventive and periodic maintenance.
3. To make review on the instruments used for measurement of basic process parameters like level, flow, pressure and temperature.
4. To explore the various types of analyzers used in industrial applications.
5. To make aware of basic concepts of safety instrumented system, standards.

**Unit I BASICS OF INDUSTRIAL SAFETY 9 Hours**

Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, Safety color codes. Fire prevention and firefighting, equipment and methods.

**Unit II PERIODIC AND PREVENTIVE MAINTENANCE 9 Hours**

Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, Definition, need, steps and advantages of preventive maintenance. Repair cycle concept and importance.

**Unit III STANDARDS ORGANIZATION 9 Hours**

Standards: Introduction, International and National Standards organization, IEC, ISO, IEEE, ISA, API, BIS, DIN and ANSI − API: Process Measurement and Instrumentation (APIRP551), recommended practice for installation of the instruments – flow, level, temperature, pressure - Process Instrument and Control (API RP554): performance requirements and considerations for the selection, specification, installation and testing of process instrumentation and control systems

**Unit IV ISA STANDARDS 9 Hours**

Documentation of Measurement and Control− Instruments and System (ISA 5): 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7 − General Requirement for Electrical Equipment in Hazardous Location (ISA 12): 12.2, 12.4, 12.24, 12.29. Instrument Specification Forms (ISA20) − Measurement Transducers (ISA37)

**Unit V ISA STANDARDS - CONTROL VALVE AND ACTUATOR 9 Hours**

Control Valve Standards (ISA75): 75.01, 75.04, 75.05, 75.13, 75.14, 75.23, 75.24, 75.26. − Valve Actuator (ISA 96): 96.01, 96.02, 96.03, 96.04

| **Course Outcomes** | | **Cognitive Level** |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Ability to summarize basics of industrial safety. | Understand |
| **CO2.** | Ability to identify preventive and periodic maintenance. | Understand |
| **CO3.** | Ability to understand the role of standards organization. | Understand |
| **CO4.** | Ability to interpret and follow different standards while carrying out installation of sensors, transmitters, Industrial automation systems, PLC programming, documentation, equipment selection in hazardous area and instrument specification forms | Understand |
| **CO5.** | Ability to understand and follow different standards while performing control valve sizing, actuator sizing and orifice sizing etc., | Understand |

**Text Book(s):**


T1. Garg H P, Maintenance Engineering, S. Chand and Company, 1987.

T2. Higgins & Morrow, Maintenance Engineering Handbook, 8th Edition,2008.

T3. William Bolton, “Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering”, 5th Edition, PHI, 2013.

T4. ISA standard 75, “Control Valve Standards”, ISA, North Carolina, USA.


**Reference Book(s):**


R1. Audels, Pump-hydraulic Compressors, Mcgrew Hill Publication, 1978.

R2. Hans F. Winterkom, Foundation Engineering Handbook, Chapman & Hall London, 2013.

**Web References:**

1. https://nptel.ac.in/courses/117/105/117105079/
2. https://nptel.ac.in/courses/117/105/117105135/
3. https://nptel.ac.in/courses/117/104/117104020/

**Course Articulation Matrix**

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

High-3; Medium-2; Low-1

<table>
<tr><td colspan="2">Course Code:19EIEN1028</td><td colspan="2">Course Title: Virtual Instrumentation</td></tr>
<tr><td colspan="2">Course Category: Professional Elective</td><td colspan="2">Course Level: Mastery</td></tr>
<tr><td>L:T:P(Hours/Week)<br>3: 0: 0</td><td>Credits:3</td><td>Total Contact Hours:45</td><td>Max Marks:100</td></tr>
</table>

**Pre-requisites**

- Nil

**Course Objectives**

The course is intended to:

1. Discuss the importance of virtual instrumentation
2. Develop virtual instruments
3. Apply the concept of Arrays, Strings and File I/O tasks
4. Select suitable Data acquisition system interfaces
5. Examine DAQ hardware's and LabVIEW

**Unit I GRAPHICAL SYSTEM DESIGN 9 Hours**

Graphical System Design Model – Virtual Instrumentation – Virtual Instrument and Traditional Instrument – Hardware and software in virtual instrumentation – Virtual instrumentation for test, control and Design – Conventional and Graphical programming

**Unit II LabVIEW BASICS I 9 Hours**

Front Panel and Block Diagram – Tools, Controls and Functions palette. Modular programming – Sub VI. Structures – FOR, WHILE Loops, Case, Sequence, event structures, Formula node.

**Unit III LabVIEW BASICS II 9 Hours**

Arrays, Clusters, Strings, File I/O, Time and Dialog controls, Waveform chart, Graph, XY Graph and operations Report generation, Web Publishing tool.

**Unit IV DATA ACQUISITION SYSTEM 9 Hours**

Instrument control: GPIB – VISA – Instrument drivers – Serial Port communication. Data Acquisition: Review of Transducers and signal conditioning, DAQ hardware – AI, AO, DIO. DAQ Assistant and configuration.

**Unit V LabVIEW APPLICATIONS 9 Hours**

LabVIEW RT, Process control applications, Physical applications, Speed control, Data visualization, Imaging and Sound. Level, flow, temperature process, biomedical application - Pulse rate

| Course Outcomes | | Cognitive Level |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Discuss the importance of virtual instrumentation using LabVIEW | Understand |
| **CO2.** | Develop virtual instruments using LabVIEW graphical programming tools | Understand |
| **CO3.** | Apply the concept of Arrays, Strings and File I/O tasks in Data acquisition | Understand |
| **CO4.** | Select suitable Data acquisition system interfaces based on the requirement | Understand |
| **CO5.** | Examine DAQ hardware's and LabVIEW in various real time environments | Understand |

**Text Book(s):**


T1. Jovitha Jerome, 'Virtual Instrumentation using LabVIEW' PHI Learning Private Limited, New Delhi, Second Printing, 2011.

T2. Gary W Johnson, Richard Jennings, 'LabVIEW Graphical Programming' Fourth Edition, McGraw Hill, 2006


**Reference Book(s):**


R1. Sanjay Gupta, Joseph John, 'Virtual Instrumentation using LabVIEW' Tata McGraw Hill, 5th Reprint, 2010

R2. Robert H Bishop. 'Learning with LabVIEW 2009' Pearson Education, 2010


**Web References:**

1. http://www.av.it.pt/conftele2009/Papers/125.pdf
2. https://www.researchgate.net/publication/3420671_What_is_virtual_instrumentation
3. http://www.ni.com/pdf/manuals/374629c.pdf

**Course Articulation Matrix**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | 1 | - | 1 | 1 | - | - | 1 | 1 | 1 | - | - |
| CO2 | 1 | 1 | - | 1 | 1 | - | - | 1 | 1 | 1 | - | - |
| CO3 | 1 | 1 | - | 1 | 1 | - | - | 1 | 1 | 1 | - | - |
| CO4 | 1 | 1 | - | 1 | 1 | - | - | 1 | 1 | 1 | - | - |
| CO5 | 1 | 1 | - | 1 | 1 | - | - | 1 | 1 | 1 | - | - |

High-3; Medium-2; Low-1

| Course Code:19EIEN1029 | Course Title: Industrial Drives and Control | | |
|---|---|---|---|
| Course Category: Professional Elective | | Course Level: Mastery | |
| L:T:P(Hours/Week) 3: 0: 0 | Credits:3 | Total Contact Hours:45 | Max Marks:100 |

**Pre-requisites:**

- Electrical Machines and Measurements

**Course Objective:**

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

1. Identify the need and choice of various drives.
2. Exposed in different speed control methods in D.C and A.C drives using thyristor based control schemes.
3. Understand how to use Microprocessors in the control of Electric Drives
4. Memorize special machines stepper motor, servo motor and brushless motor drives and their control.
5. Analyze and design controllers for closed loop operation.

**UNIT I INTRODUCTION 9**

Selection of drives – Factors influencing the choice of drive – Braking methods – Temperature rise and RMS rating – Power converters using IGBT and MOSFET – Open loop and closed loop control of drives – Sensors used in drives.

**UNIT II CONTROL OF DC DRIVES 9**

Single phase and three phase converter fed drives – Continuous and discontinuous modes – Chopper fed drives – Four quadrant drives – Closed loop drive system.

**UNIT - III CONTROL OF AC DRIVES 9**

Voltage control, v/f control of induction motor – VSI and CSI fed drives – Rotor resistance control and slip power recovery scheme – Closed loop control induction motor drives – Vector control.

**UNIT - IV CONTROL OF SPECIAL DRIVES - I 9**

Stepper motor – Types- Static and Dynamic Characteristics- Driver circuit – Digital Implementation- Open loop and Closed Loop Control - AC and DC servomotor control.

**UNIT -V CONTROL OF SPECIAL DRIVES - II 9**

Permanent Magnet DC (PMDC) motor-Principle-Performance Characteristics -Types - BLDC motor- Principle, Construction and operation- Types of BLDC motor- Control of BLDC motor- Microprocessor and DSP based control schemes -Sensor less Control- Applications.

| **Course Outcomes** | | **Cognitive Level** |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Identify the need and choice of various drives. | Understand |
| **CO2.** | Exposed in different speed control methods in D.C and A.C drives using thyristor based control schemes. | Understand |
| **CO3.** | Understand how to use Microprocessors in the control of Electric Drives | Understand |
| **CO4.** | Memorize special machines stepper motor, servo motor and brushless motor drives and their control. | Understand |
| **CO5.** | Analyze and design controllers for closed loop operation | Understand |

**Text Books:**


1. R. Krishnan, ‘Electric Motor and Drives: Modelling Analysis and Control’, Pearson Education, 2001.
2. G.K. Dubey, ‘Fundamentals of Electrical Drives’, Narosa Publication, 2002.


**Reference Books:**


1. E.G.Janardanan, ‘Special Electrical Machines’, Prentice Hall of India, 2014.
2. Bimal. K. Bose, ‘Modern Power Electronics and AC Drives’, Prentice Hall of India, 2003.
3. Chesmond, Wilson and Lepla, ‘Advanced Control System Technology’, Viva low priced student edition, 1998.


**Web References:**


1. www.nptel.ac.in

## Course Articulation Matrix

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

High-3; Medium-2; Low-1

<table>
<tr><td colspan="2">Course Code:19EIEN1030</td><td colspan="2">Course Title: PLC Programming</td></tr>
<tr><td colspan="2">Course Category: Professional Elective</td><td colspan="2">Course Level: Mastery</td></tr>
<tr><td>L:T:P(Hours/Week)<br>3: 0: 0</td><td>Credits:3</td><td>Total Contact Hours:45</td><td>Max Marks:100</td></tr>
</table>

**Pre-requisites**

- Digital Electronics

**Course Objectives**

The course is intended to:

1. Explain the components and standards of Programmable Logic Controllers.
2. Elaborate the hardware modules in PLC and its functioning
3. Develop PLC Ladder logic programs for sequential control applications
4. Explain DCS
5. To introduce types of programming languages of PLC with few exercise programs

**UNIT I INTRODUCTION 9**

Programmable Logic Controller (PLC)- Block diagram of PLC- Programming languages of PLC Basic instruction sets- Design of alarm and interlocks- Networking of PLC- Overview of safety of PLC with case studies- Process Safety Automation: Levels of process safety through use of PLCs- IEC 61131-3 Standard - Application of international standards in process safety control.

**UNIT II I/O MODULES AND MEMORY** 7

Digital input module -Digital output module - Analog input module - Analog output module - Local and remote I/O expansion - Special purpose modules - Memory organization - I/O addressing - Programming devices.

**UNIT III PLC PROGRAMMING 11**

PLC programming - Basic relay logic instructions - Timers and Counter instructions - Data transfer instructions - Data manipulation instructions - Program control instructions - Simple programs using LD instructions - Functional block diagram programming and Sequential chart programming: Simple example programs.

**UNIT IV SCADA** **9**

Elements of SCADA system- History of SCADA, Remote Terminal Unit- Discrete control- Analog control, Master Terminal Unit- Operator interface.

**UNIT V PLC APPLICATIONS** **9**

Traffic Light Control: Two way and Four ways – Water Level Control- Automatic Stamping Machine- Automatic Bottle Filling System and Single lane Parking system.

**COURSE OUTCOMES:**

| **Course Outcomes** | | **Cognitive Level** |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Explain the components and standards of Programmable Logic Controllers. | Understand |
| **CO2.** | Elaborate the hardware modules in PLC and its functioning | Understand |
| **CO3.** | Develop PLC Ladder logic programs for sequential control applications | Apply |
| **CO4.** | Explain DCS | Understand |
| **CO5.** | To introduce types of programming languages of PLC with few exercise programs | Apply |

**TEXT BOOKS:**


1. Frank D. Petruzella, “Programmable Logic Controllers”, 5th Edition, McGraw- Hill, New York, 2019.
2. Stuart Boyer A, “SCADA: Supervisory control and data Acquisition”, Fourth Edition, ISA- The Instrumentation, Systems, and Automation Society,2010


**REFERENCES**


1. Bolton. W, “Programmble Logic Controllers”, Elsevier Newnes, 6th Edition 2015.


**Website:**

1 https://nptel.ac.in/courses/108105062

2 https://nptel.ac.in/courses/108105088

3 http://www.nitttrc.edu.in/nptel/courses/video/105105201/lec56.pdf

4 https://nptel.ac.in/courses/108106022

5.https://new.siemens.com/global/en/products/automation/systems/industrial/plc/logo/logosoft ware.html

**Course Articulation Matrix**

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

High-3; Medium-2; Low-1

<table>
<tr><td colspan="2">Course Code:19EIEN1031</td><td colspan="3">Course Title: Advanced Process Control</td></tr>
<tr><td colspan="3">Course Category: Professional Elective</td><td colspan="2">Course Level: Mastery</td></tr>
<tr><td>L:T:P(Hours/Week)<br>3: 0: 0</td><td colspan="2">Credits:3</td><td>Total Contact Hours:45</td><td>Max Marks:100</td></tr>
</table>

**Prerequisites:** The student should have undergone the course(s):

- Process Control

**Course Objectives**

**The course is intended to:**

1. Demonstrate control schemes for satisfying the process requirements
2. Determine system behaviour by time and frequency analysis
3. Design advanced controllers based on process model
4. Analyze the multivariable control systems for sensitivity and operability
5. Demonstrate digital controllers dynamic response and stability

**UNIT I – ADVANCED CONTROL STRATEGIES 9**

Feed forward, cascade, dead time compensation, split range, selective and override control, adaptive control; automatic tuning and gain scheduling.

**UNIT II – SYSTEM IDENTIFICATION 9**

Model based control – IMC structure – development and design; IMC based PID control, Model Predictive Control.

**UNIT III – INTERNAL MODEL CONTROL 9**

Model based control – IMC structure – development and design; IMC based PID control, Model Predictive Control.

**UNIT IV – MULTIVARIABLE CONTROL 9**

Control loop interaction – general pairing problem, relative gain array and application, sensitivity. Multivariable control – zeros and performance limitations, directional sensitivity and operability, decoupling control

**UNIT V – DISCRETE SYSTEMS 9**

Z – Transform and inverse Z – transform properties, Discrete – Time Response of dynamic system, Pulse Transfer Function, Closed Loop System Stability.

| **Course Outcomes** | | **Cognitive Level** |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Demonstrate control schemes for satisfying the process requirements | Understand |
| **CO2.** | Determine system behavior by time and frequency analysis | Understand |
| **CO3.** | Design advanced controllers based on process model | Understand |
| **CO4.** | Analyze the multivariable control systems for sensitivity and operability | Understand |
| **CO5.** | Demonstrate digital controllers dynamic response and stability | Understand |

**Text Books**


1. Bequette, B.W., “Process Control Modeling, Design and Simulation”, Prentice Hall of India, 2004.
2. Stephanopoulos, G., “Chemical Process Control - An Introduction to Theory and Practice”, Prentice Hall of India, 2005.
3. Bela.G. Liptak “Instrument Engineers Handbook:Process Control and Optimization”


**Reference Books**


1. Coughanowr, D.R., “Process Systems Analysis and Control”, McGraw -Hill international Edition, 2004.
2. Seborg, D.E., Edgar, T.F. and Mellichamp, D.A., “Process Dynamics and Control”, Wiley John and Sons, 2nd Edition, 2003
3. E. Ikonen and K. Najim, “Advanced Process Identification and Control”, Marcel Dekker, Inc. Newyork, 2002.
4. P. Albertos and S. Antonio, “Multivariable Control Systems An Engineering Approach”, SpringerVerlag, 2004.


**Web References**


1. nptel.ac.in/downloads/103101003/

**Course Articulation Matrix**

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

High-3; Medium-2; Low-1

| Course Code:19EIEN1032 | Course Title: Hydraulics and Pneumatics | | |
|---|---|---|---|
| Course Category: Professional Elective | | Course Level: Mastery | |
| L:T:P(Hours/Week) 3: 0: 0 | Credits:3 | Total Contact Hours:45 | Max Marks:100 |

**Prerequisites:** The student should have undergone the course(s):

- Nil

**Course Objectives**

**The course is intended to:**

1. Understand the fluid power concept
2. Illustrate the components used in Hydraulic system
3. Describe the different hydraulic valves
4. Elucidate the pneumatic system used in industry application
5. Develop the electrical hydraulic and pneumatic circuit for different applications

**UNIT I – FLUID POWER PRINCIPLES AND FUNDAMENTALS 9**

Introduction to fluid power – Advantages and Applications – Fluid power systems – Types of fluids –Properties of fluids – Basic of Hydraulics: Pascal's Law, Principles of flow, work, Power and Torque. Properties of air – Perfect Gas Laws

**UNIT II – HYDRAULIC SYSTEM AND COMPONENTS 9**

Pumping Theory – Pump Classification – Fixed and Variable displacement Pumps: Working, Advantages, Disadvantages and Performances. Hydraulic Actuators: Cylinders, Types and Construction Hydraulic motors – Performance charts. Accessories – Accumulator and Intensifiers.

**UNIT III – CONTROL OF HYDRAULIC SYSTEMS 9**

Control Components: Direction control, flow control and pressure control valves – Types, Applications – Types of actuation – Pressure Switches – Fluid power ANSI Symbol.

Industrial Hydraulic circuits – Regenerative, Double-Pump, sequence, Reciprocation, Synchronization, Fail - Safe, Speed Control – Hydrostatic Transmission..

**UNIT IV – PNEUMATIC SYSTEM 9**

Compressors – Filter, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators – Introduction to Fluidics – Pneumatic logic circuits AND, OR, MEMORY, etc

**UNIT V – ELECTRO-HYDRALIC AND ELECTRO-PNEUMATIC CIRCUITS 9**

Sequential circuits – design for simple applications using cascade method – Electro Pneumatic circuits – Microprocessor and PLC – Applications in Hydraulic and Pneumatics – Low cost Automation – Hydraulic and Pneumatic Power Packs – Installation, Fault finding and Maintenance.

**Course Outcomes**

| **Course Outcomes** | | **Cognitive Level** |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Explain the principles of fluid power system | Understand |
| **CO2.** | Describe the construction and working of hydraulic system and its components | Understand |
| **CO3.** | Illustrate the working of valves, switches, actuators and industrial hydraulic circuits | Understand |
| **CO4.** | Summarize the working of components in pneumatic control system | Understand |
| **CO5.** | Describe the electro-hydraulic and electro-pneumatic systems with proper installation, fault finding and their maintenance | Understand |

**Text Books**


1. Anthony Esposito, “Fluid Power with Applications”, 7th edition, Pearson education, 2014
2. Srinivasan, R., “Hydraulic and Pneumatic Controls”, 2nd edition, Vijay Nicole Imprints, 2008


**Reference Books**


1. William W. Reaves, “Technology of Fluid Power”, Delmer Publishers, 1997.

2. Petor Rohner, “Fluid power logic circuit Design”, Macmillon Press Ltd, 1990.
3. Andrew Parr,”Hydraulics & Pneumatics”, Jaico Publishing House, 2004.
4. Majumdar, “Oil Hydraulics: Principles and Maintenance”, Tata McGraw Hill, 2004.
5. Majumdar, “Pneumatic system: Principles and Maintenance”, Tata McGraw Hill, 2004

**Web References**

1. www.nptel.ac.in

**Course Articulation Matrix**

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

High-3; Medium-2; Low-1

**Embedded System & VLSI Electives**

| Course Code: 19EEEC1002 | Embedded Control of Power Electronics (Common to EE & EI) | | |
|---|---|---|---|
| Course Category: Professional Elective | | Course Level: Mastery | |
| L:T:P (Hours/Week) 3: 0: 0 | Credits:3 | Total Contact Hours:45 | Max. Marks:100 |

**Prerequisites:** The student should have undergone the course(s):

- Nil

**Course Objectives**

The course is intended to:

1. Understand the architecture and addressing modes of PIC 16C7X microcontroller.
2. Study the peripherals of PIC 16C7X
3. Understand the architecture and addressing modes of TMS320F2812 processor
4. Study the peripherals of TMS320F2182 processor
5. Apply control logics to converter and drives applications using PIC 16C7X and TMS320F2182

**UNIT I- PIC 16C7X Microcontroller** **9 Hours**

Architecture memory organization – Addressing modes – Instruction set – Programming Techniques – simple programs

**UNIT II - Peripherals of PIC 16C7X** **9 Hours**

Timers – interrupts – I/O ports – I2C bus for peripheral chip access – A/D converter – UART.

**UNIT III - TMS320F2812 DSP** **9 Hours**

Introduction- System configuration registers - Memory Addressing modes – Instruction set Programming techniques – simple programs

**UNIT IV – Peripherals of TMS320F2812 DSP** **9 Hours**

General purpose Input/output (GPIO) Functionality- Interrupts - A/D converter-Event Managers (EVA, EVB) - PWM signal generation

**UNIT V – Applications of PIC and Signal Processors** **9 Hours**

Digital Controller Design for Buck Converter ,Voltage regulation of DC-DC converters- Stepper motor and DC motor control- Clarke's and Parks transformation-Space vector PWM- Control of Induction Motors and PMSM. Programming in assembly language -Typical applications in the control of power electronic converters for power supplies and electric motor drives.

| Course Outcomes | Cognitive Level |
|---|---|
| At the end of this course, students will be able to: | |
| CO1. Describe the architecture, addressing modes and Instruction set of PIC 16C7X microcontroller | Understand |
| CO2. Explain the peripherals of PIC 16C7X and their importance to power Converter applications. | Understand |
| CO3. Develop the programs using TMS320F2812 digital signal Processor | Apply |
| CO4. Explain the peripherals of TMS320F2812 and their importance to power converter applications | Understand |
| CO5. Implement simple switching logics for power converters using PIC 16C7X and TMS320F2812 | Apply |

**Text Book(s):**

1. John B.Peatman, 'Design with PIC Microcontrollers', 8 th Edition, Pearson Education, Asia 2009.
2. Hamid A.Toliyat, Steven Campbell, 'DSP based electromechanical motion control',CRC Press, 2003.

**Reference Book(s):**

1. Bar Ba, C Programming and Application of a DSP to Control and Regulate Power Electronic Converters: Programming in C++" Anchor Academic Publishing, 2014.
2. Luca Corradini, Dragan Maksimović, Paolo Mattavelli, Regan Zane, "Digital Control of High-Frequency Switched-Mode Power Converters" IEEE press, Wiley , 2015.
3. Simone Buso, Paolo Mattavelli, "Digital Control in Power Electronics", Morgan and Claypool Publisher, 2006.

**Web Reference(s):**

1. Web References: 1. https://onlinecourses.nptel.ac.in/noc20_ee28/preview 2.
2. https://nptel.ac.in/courses/108/107/108107128/# 3.
3. https://onlinecourses.nptel.microcontroller.ac.in/noc21_ee18/preview

**Course Articulation Matrix**

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

High-3; Medium-2; Low-1

| Course Code: 19EEEC1022 | Course Title: Advanced Microprocessors (Common to EE & EI) | | |
|---|---|---|---|
| Course Category: Professional Elective | | Course Level: Mastery | |
| L:T:P (Hours/Week) 3: 0: 0 | Credits:3 | Total Contact Hours:45 | Max. Marks:100 |

**Prerequisites:** The student should have undergone the course(s):

- Nil

**Course Objectives**

The course is intended to:

1. Explain the basic concepts of advanced microprocessors.
2. Describe the architecture of Pentium processors.
3. Discuss the concepts and architecture of RISC processor.
4. Describe the concepts of the superscalar processors
5. Explain the architecture programming and interfacing of PC hardware

**UNIT I Microprocessor Architecture** **9**

Instruction Set – data formats -addressing modes-memory hierarchy-register file-cache—virtual memory and paging-segmentation- pipelining- instruction pipeline— pipeline hazard-instruction level parallelism-reduced instruction set- RISC VS CISC

**UNIT II Pentium Microprocessors** **9**

Introduction to Pentium Microprocessor- real and production mode operation- software model of Pentium – function description –registers-data organization- summary of the 80286,80386, and 80486- CPU architecture –bus operation-pipelining-branch

**UNIT III RISC Processors I** **9**

PowerPC620 – Instruction fetching – Branch Prediction – Fetching – Speculation, Instruction Dispatching –dispatch stalls – Instruction Execution – Issue stalls- Execution Parallelism– Instruction completion – Basics of P6 micro architecture – Pipelining – Memory subsystem.

**UNIT IV RISC Processors II** **9**

Intel i960 – Intel IA32- MIPS R8000 – MIPS R10000 – Motorola 88110 – Ultra SPARC Processor- SPARC version 8 – SPARC version 9.

**UNIT V PC Hardware Overview** **9**

Functional Units & Interconnection, New Generation Mother Boards 286 to Pentium 4 Bus Interface- ISA- EISA- VESA- PCI- PCIX. Peripheral Interfaces and Controller, Memory and I/O Port Addresses.

| **Course Outcomes** | **Cognitive Level** |
|---|---|
| At the end of this course, students will be able to: | |
| CO1:Explain the basic concepts of advanced microprocessors | Understand |
| CO2: Describe the architecture of Pentium processors. | Understand |
| CO3: Discuss the concepts and architecture of RISC processor. | Understand |
| CO4: Identify the concepts in the Superscalar Processors | Apply |
| CO5:Explain the overview of PC hardware | Understand |

**Text Book(s):**


1. B.B.Brey The Intel Microprocessor 8086/8088 /80186/80188, 80286, 80386, 80486PENTIUM, PENTIUM Pro, PII, PIII & IV Architecture, Programming & Interfacing,
2. John Paul Shen, MikkoH. Lipasti, ―Modern Processor Design‖, Tata Mcgraw Hill,2006


**Reference Book(s):**


1. Daniel Tabak , ―Advanced Microprocessors‖, McGrawHill.Inc., 2ndEdition 1995.
2. James L. Antonakos, ― The Pentium Microprocessor‖, Pearson Education, 1997.
3. Gene .H.Miller, ―Micro Computer Engineering‖, Pearson Education, 2003
4. Douglas V.Hall, ―Microprocessors and Interfacing‖, Tata McGraw Hill, 2nd Edition 2006
5. Mohamed Rafiquzzaman, ―Microprocessors and Microcomputer Based System Design‖, 2nd Edition, CRC Press, 2007.


**Web Reference(s):**


1. http://nptel.ac.in/courses/Webcourse-
2. https://ee641dm.wordpress.com/study-materials/
3. https://www.tutorialspoint.com/microprocessor/index.html

**Course Articulation Matrix**

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

High-3; Medium-2;Low-1

<table>
<tr><td colspan="1">Course Code:19EEEC1028</td><td colspan="3">Course Title: CMOS Analog IC Design<br>(Common to EE & EI)</td></tr>
<tr><td colspan="2">Course Category: Professional Elective</td><td colspan="2">Course Level: Mastery</td></tr>
<tr><td>L:T:P (Hours/Week)<br>3: 0: 0</td><td>Credits:3</td><td>Total Contact Hours:45</td><td>Max. Marks:100</td></tr>
</table>

**Prerequisites:** The student should have undergone the course(s):

- Nil

**Course Objectives**

The course is intended to:

1. Analyze the concept of CMOS Technology and Analog MOSFET models
2. Analyze the basic Analog MOS circuits.
3. Construct an amplifier and switching circuits using CMOS
4. Design an Op-amp and various nonlinear circuits using Op-amp.
5. Compare the performance of different forms of data conversion techniques.

**UNIT I Introduction to CMOS Technologies and Analog MOSFET Model** **9**

MOSFET- Structure, MOSFET Capacitances, Threshold Voltage , IV Characteristics , SPICE modeling, DC equations, Short Channel MOSFET . MOS Passive Elements – Capacitors and Resistors, Temperature and Voltage dependence of Capacitors and Resistors. Analog MOSFET models - Low frequency model , High frequency model , Temperature effects , Noise in MOSFET

**UNIT II Analog MOS Modeling** **9**

Current Mirror, Current sources, Self-biasing techniques, Band gap voltage references, Beta Multiplier based references. Common Drain and Common Gate amplifiers, Voltage dividers

**UNIT III Differential Amplifiers and Dynamic Analog Circuits** **9**

Differential Amplifier – Source coupled pair, Source cross coupled pair, Cascade load, Wide swing differential amplifiers. Dynamic Analog Circuits –MOSFET switch, Switched capacitor circuit.

**UNIT IV Operational Amplifiers** 9

Operational Amplifiers – Basic CMOS Op-amp, Operational Trans conductance amplifier, Differential output Op-amp. Non Linear Analog Circuits – CMOS comparator, Analog multiplier, Level shifting circuit, Multiplier using squaring circuit

**UNIT V Mixed Signal Circuits** **9**

Data Conversion Fundamentals – Analog Vs. Discrete time signal, Converting analog to digital signal - Sample and hold circuit, mixed signal layout issues. Data Conversion Architecture – DAC, ADC.

| **Course Outcomes**<br>At the end of this course, students will be able to: | **Cognitive Level** |
|---|---|
| CO1:Utilize the concept of CMOS Technology using MOSFET structure | Apply |
| CO2: Model the basic analog circuits using CMOS technology | Apply |
| CO3: Construct an amplifier and switching circuits using CMOS | Apply |
| CO4:Design an Op-amp and various nonlinear circuits using Op-amp | Apply |
| CO5: Identify the performance of different forms of data conversion techniques using mixed signal MOSFET circuits | Apply |

**Text Book(s):**


1. Jacob Baker.R., Li.H.W., and Boyce.D.E., CMOS Circuit Design ,Layout and Simulation, Prentice-Hall of India,1988..
2. Mohammed Ismail and Terri Faiz, Analog VLSI Signal and Information Process, McGraw-Hill Book company,1994.


**Reference Book(s):**


1. Paul R. Gray and Meyer.R.G., Analysis and design of Analog Integrated circuits, John Wiley and Sons inc., USA, 3rd Edition, 1993.Reprint, 2002.
2. David. A. Johns and Martin. K., Analog Integrated Circuit Design, Wiley, 1997.
3. Malcom.R.Haskard, LanC.May, —Analog VLSI Design - NMOS and CMOS ",Prentice Hall, 998.
4. Jose E.France, YannisTsividis, —Design of Analog-Digital VLSI Circuits for Telecommunication and signal Processing ", Prentice Hall, 1994
5. Randall L Geiger, Phillip E. Allen, Noel K.Strader, —VLSI Design Techniques for Analog and Digital Circuits ", McGraw Hill International Company, 1990.


**Web Reference(s):**


1. http://nptel.ac.in/courses/117101105/
2. http://www.nptel.ac.in/syllabus/117101006/
3. http://www.people.rit.edu /iffeee/basic-analog-circuits.pdf

**Course Articulation Matrix**

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

High-3; Medium-2;Low-1

| Course Code:19EEEC1030 | Course Title: Testing of VLSI Circuits (Common to EE & EI) | | |
|---|---|---|---|
| Course Category: Professional Elective | | Course Level: Mastery | |
| L:T:P (Hours/Week) 3: 0: 0 | Credits:3 | Total Contact Hours:45 | Max. Marks:100 |

**Prerequisites:** The student should have undergone the course(s):

- Nil

**Course Objectives**

The course is intended to:

1. Identify the faults in the digital circuits
2. Create Test Patterns for combinational logic circuit.
3. Create Test Patterns for sequential logic circuit.
4. Explain the different testability techniques for Testing
5. Explain various BIST Architecture and test algorithms.

**UNIT I Testing and Logic Simulation 9**

Introduction to testing – Faults in Digital Circuits – Modeling of faults – Logical Fault Models – Fault detection and redundancy – Fault equivalence and fault Location – Fault dominance – Logic simulation – Types of simulation – Delay models – Gate Level Event – driven simulation.

**UNIT II Test Generation for Combinational Circuits 9**

Test generation for combinational logic circuits – Testable combinational logic circuit design.

**UNIT III Test Generation for Sequential Circuits 9**

Test generation for sequential circuits – design of testable sequential Logic circuits.

**UNIT IV Design for Testability** 9

Design for Testability – Ad-hoc design – generic scan based design – classical scan based design – system level DFT approaches.

**UNIT V Self-Test and Test Algorithms 9**

Built-In-Self-Test – test pattern generation for BIST – Circular BIST – BIST Architectures – Testable Memory Design – Test Algorithms – Test generation for Embedded RAMs.

| Course Outcomes At the end of this course, students will be able to: | Cognitive Level |
|---|---|
| CO1: Identify the faults in the digital circuits. | Apply |
| CO2: Create test Patterns for Combinational Logic Circuits. | Apply |
| CO3: Create test Patterns for sequential logic Circuits. | Apply |
| CO4: Model the different testability techniques for testing. | Apply |

| | |
|---|---|
| CO5: Identify various BIST Architecture and test algorithms | Apply |

**Text Book(s):**


1. M.Abramovici, M.A.Breuer and A.D. Friedman, ―Digital systems and Testable Design‖,Jaico Publishing House, 2002.

2. P.K. Lala, ―Digital Circuit Testing and Testability‖, Academic Press, Academic Press, 2012.


**Reference Book(s):**


1. M.L.Bushnell and V.D.Agrawal, ―Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits‖, Kluwer Academic Publishers, 2002.
2. A.L.Crouch, ―Design Test for Digital IC‘s and Embedded Core Systems‖, Prentice Hall.International, 2002.
3. Robert J., Jr. Feugate, stevan M. McIntyre, ―Introduction to VLSI Testing‖, Prentice Hal International, 1988.
4. Angela Krstic and Kwang-Ting Cheng ―Delay fault testing for VLSI Circuits‖, Kluwer Academic Publishers, 1998 .
5. Mike Tien and Chien Lee, ―High-Level Test Synthesis of Digital VLSI Circuits‖, Artech House, Inc., 1997.


**Web Reference(s):**


1. http://onlinelibrary.wiley.com/doi/10.1002/0471457787.fmatter/pdf

2. http://nptel.ac.in/courses/106103016/30

3. www.cs.colostate.edu/~malaiya/530/08/resources.html


**Course Articulation Matrix**

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

High-3; Medium-2;Low-1

| Course Code: 19EEEC1031 | Course Title: ASIC Design (Common to EE & EI) | | |
|---|---|---|---|
| Course Category: Professional Elective | | Course Level: Practice | |
| L:T:P (Hours/Week) 3: 0: 0 | Credits:3 | Total Contact Hours:45 | Max. Marks:100 |

**Prerequisites:** The student should have undergone the course(s):

- Nil

**Course Objectives**

The course is intended to:

1. Explain the different types of ASICs and logic cells used in ASIC design
2. Explain the architecture of various programmable logic cells
3. Explain the inter connects in programmable logic cells and design software.
4. Develop a digital circuit using HDL.
5. Explain the physical design in ASIC Design flow

**UNIT I Introduction to ASIC** **9**

Types of ASICs - Design flow – CMOS transistors- CMOS Design rules –Combinational logic Cell - Sequential logic cell - Transistor as Resistor - Transistor parasitic capacitance – Library cell design.

**UNIT II Programmable ASICS, Logic Cells and I/O Cells** **9**

Anti-fuse - Static RAM - EPROM and EEPROM technology - Actel ACT - Xilinx LCA, Xilinx I/O blocks –- Altera MAX 5000 - Altera FLEX

**UNIT III ASIC Interconnect and Design Software** **9**

Actel ACT -Xilinx LCA - Xilinx EPLD - Altera MAX 5000 - Altera FLEX –Design systems – Logic Synthesis - Half gate ASIC -Low level design language - PLA tools

**UNIT IV Logic Synthesis** 9

A logic synthesis example:- Adder and MUX units, FSM synthesis in VHDL, Memory synthesis in VHDL

**UNIT V Floor Planning, Placement and Routing** **9**

Floor planning, Placement, Routing- Global routing, detailed routing, special routing, Parasitic extraction, LVS and DRC.

| Course Outcomes | Cognitive Level |
|---|---|
| At the end of this course, students will be able to: | |
| CO1:Explain the different types of ASICs and logic cells used in ASIC design | Understand |
| CO2: Explain the architecture of various programmable logic cells. | Understand |

| | |
|---|---|
| CO3: Explain the inter connects in programmable logic cells and design software. | Understand |
| CO4:Model the digital circuit using HDL | Apply |
| CO5:Explain the physical design in ASIC Design flow | Understand |

**Text Book(s):**


1. Michael John Sebastian Smith‖ Application Specific Integrated Circuits‖ Pearson Education 2006
2. Norman G. Einspruch, "Application Specific Integrated Circuit (ASIC) Technology", Academic Press, 2012.


**Reference Book(s):**


1. Morris Mano.M, —Digital Design‖, Pearson Education Pvt.Ltd, 3rd Edition ,2013.
2. DouglasL. Perry, —VHDL: Programming by Example‖, McGraw-Hill, 4th Edition,2002


**Web Reference(s):**


1. www.vlsi.wpi.edu/cds/explanations/lvs.html
2. http://www.eng.auburn.edu/
3. http://www.geoffknagge.com/fyp/index.shtml#asic


**Course Articulation Matrix**

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

High-3; Medium-2;Low-1

<table>
<tr><td colspan="2">Course Code: 19EEEC1064</td><td colspan="2">Course Title: Embedded C Programming<br>(Common to EE & EI)</td></tr>
<tr><td colspan="2">Course Category: Professional Elective</td><td colspan="2">Course Level: Mastery</td></tr>
<tr><td>L:T:P (Hours/Week)<br>3: 0: 0</td><td>Credits:3</td><td>Total Contact Hours:45</td><td>Max. Marks:100</td></tr>
</table>

**Prerequisites:** The student should have undergone the course(s):

- Nil

**Course Objectives**

The course is intended to:

1. Expose the students to the fundamentals of embedded Programming
2. Introduce the GNU C Programming Tool Chain.
3. Study the basic concepts of embedded C.
4. Teach the basics of 8051 Programming.
5. Involve Discussions/ Practice/Exercise in revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills.

**UNIT I BASIC C PROGRAMMING** **9**

Typical C Program Development Environment - Introduction to C Programming - Structured Program Development in C - Data Types and Operators - C Program Control - C Functions - Introduction to Arrays.

**UNIT II EMBEDDED C** **9**

Adding Structure to 'C' Code: Object-oriented programming with C, Header files for Project and Port, Examples. Meeting Real-time constraints: Creating hardware delays - Need for timeout Mechanism - Creating loop timeouts - Creating hardware timeouts.

**UNIT III 8051 Programming in C** **9**

Data types and time delay in 8051, I/O programming in 8051, Logic operations in 8051, Data conversion program in 8051 Accessing code ROM space in 8051, Data serialization using 8051

**UNIT IV 8051 SERIAL PORT AND INTERRUPT PROGRAMMING IN C** 9

Basics of serial communication, 8051 interface to RS232- serial port programming in 8051. 8051 Interrupts and programming, Programming for timer configuration.

**UNIT V 8051 INTERFACING** **9**

8051: ADC interfacing , DAC interfacing, Sensor interfacing, LCD interfacing, Stepper motor Interfacing.

| Course Outcomes | Cognitive Level |
|---|---|
| At the end of this course, students will be able to: | |
| CO1: Deliver insight into embedded C programming and its salient features for embedded systems. | Understand |
| CO2:Illustrate the software and hardware architecture for distributed computing in embedded systems | Understand |
| CO3: Develop a solution for problems by using the concept learn in programming using the embedded controllers | Apply |
| CO4: Develop simple applications with 8051 by using its various features and interfacing with various external hardware. | Apply |
| CO5: Improved Employability and entrepreneurship capacity due to knowledge upgradation on recent trends in embedded programming skills. | Apply |

**Text Book(s):**


1. Paul Deitel and Harvey Deitel, “C How to Program”, 9th Edition, Pearson Education Limited, 2022, 1st edition.
2. Michael J Pont, "Embedded C", Addison-Wesley, An imprint of Pearson Education, 2002.
3. William von Hagen, "The Definitive Guide to GCC", 2nd Edition, Apress Inc., 2006
4. Gowrishankar S and Veena A, "Introduction to Python Programming", CRC Press, Taylor & Francis Group, 2019.


**Reference Book(s):**


1. Noel Kalicharan, "Learn to Program with C", Apress Inc., 2015, 1st edition.
2. Steve Oualline, "Practical C programming", O'Reilly Media, 1997, 3rd edition
3. Muhammad Ali Mazidi, Janice G. Mazidi and Rolin D. McKinlay, ‘The 8051 Microcontroller and Embedded Systems’ Prentice Hall, 2nd Edition 2007.
4. Myke Predko, “Programming and customizing the 8051 microcontrollers”,McGraww Hill 2000, 1st edition


**Web Reference(s):**


1. https://www.hackerrank.com/
2. https://www.cprogramming.com/
3. https://www.allaboutcircuits.com/technical-articles/introduction-to-the-c-programminglanguage-for-embedded-applications/
4. https://onlinecourses.nptel.ac.in/noc19_cs42/preview
5. https://microcontrollerslab.com/8051-microcontroller-tutorials-c/
6. https://www.circuitstoday.com/getting-started-with-keil-uvision

**Course Articulation Matrix**

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

High-3; Medium-2;Low-1

| Course Code: 19EEEC1065 | Course Title: Embedded Systems for Automotive Applications (Common to EE & EI) | | |
|---|---|---|---|
| Course Category: Professional Elective | | Course Level: Mastery | |
| L:T:P (Hours/Week)<br>3: 0: 0 | Credits:3 | Total Contact Hours:45 | Max. Marks:100 |

**Prerequisites:** The student should have undergone the course(s):

- Nil

**Course Objectives**

The course is intended to:

1. Understand the fundamentals and building of Electronic Engine Control systems.
2. Teach on sensor functional components for vehicles.
3. Discuss on programmable controllers for vehicles management systems.
4. Teach logics of automation & communication techniques for vehicle communication.
5. Introduce the infotainment system development.

**UNIT I- INTRODUCTION TO AUTOMOTIVE SYSTEMS** **9 Hours**

Overview of Automotive systems, fuel economy, air-fuel ratio, emission limits and vehicle Performance; Electronic control Unit– open-source ECU.

**UNIT II – SENSORS AND ACTUATORS FOR AUTOMOTIVES** **9 Hours**

Review of automotive sensors- sensors interface to the ECU, Smart sensor and actuators for automotive applications.

**UNIT III – VEHICLE MANAGEMENT SYSTEMS** **9 Hours**

Energy Management system -Adaptive cruise control - anti-locking braking system - Safety and Collision Avoidance.

**UNIT IV – ONBOARD DIAGONSTICS AND COMMUNICATION** **9 Hours**

OBD, Vehicle communication protocols - Bluetooth, CAN, LIN, FLEXRAY and MOST.

**UNIT V – RECENT TRENDS** **9 Hours**

Navigation- Autonomous car- Role of IoT in Automotive systems.

| Course Outcomes<br>At the end of this course, students will be able to: | Cognitive Level |
|---|---|
| CO1: Insight into the significance of the role of embedded system for automotive applications. | Understand |
| CO2: Illustrate the need, selection of sensors and actuators and interfacing with ECU | Apply |
| CO3: Develop the Embedded concepts for vehicle management and control systems. | Apply |
| CO4: Demonstrate the need of Electrical vehicle and able to apply the embedded system technology for various aspects of EVs | Apply |
| CO5: Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design and its application in automotive systems. | Apply |

**Text Book(s):**

1. William B. Ribbens ,"Understanding Automotive Electronics", Elseiver,8th Edition, 2017.

2.Jurgen, R., Automotive Electronics Hand Book, McGraw Hill, 2nd Edition, 1999.

3. L.Vlacic,M.Parent,F.Harahima,"Intelligent Vehicle Technologies", SAE International, 2001, 1st Edition, 2017.

**Reference Book(s):**

1. Ali Emedi, Mehrdedehsani, John M Miller , "Vehicular Electric power system- land, Sea, Air and Space Vehicles" Marcel Decker, 2004, 1st Edition.
2. Jack Erjavec,JeffArias,"Alternate Fuel Technology-Electric ,Hybrid& Fuel Cell Vehicles",Cengage ,2012, 2nd Edition.
3. Electronic Engine Control technology – Ronald K Jurgen Chilton's guide to Fuel Injection – Ford 2nd Edition, 2004.
4. Automotive Electricals / Electronics System and Components, Tom Denton, 5th Edition, 2017.
5. Automotive Hand Book, Robert Bosch, Bently Publishers, 10th Edition, 2018

**Web Reference(s):**

1. https://www.autosar.org/fileadmin/ABOUT/AUTOSAR_EXP_Introduction.pdf
2. https://microcontrollerslab.com/can-communication-protocol/
3. https://ackodrive.com/car-guide/different-types-of-car-sensors/
4. https://www.tomtom.com/blog/automated-driving/what-is-adaptive-cruise-control/
5. https://prodigytechno.com/difference-between-lin-can-and-flexray-protocols/

**Course Articulation Matrix**

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

High-3; Medium-2;Low-1

| Course Code: 19EEEC1066 | Course Title: IoT for Smart Systems (Common to EE & EI) | | |
|---|---|---|---|
| Course Category: Professional Elective | | Course Level: Mastery | |
| L:T:P (Hours/Week) 3: 0: 0 | Credits:3 | Total Contact Hours:45 | Max. Marks:100 |

**Prerequisites:** The student should have undergone the course(s):

- Nil

**Course Objectives**

The course is intended to:

1. Introduce the Internet of Things technologies and its role in real time applications.
2. Select the Infrastructure required for IoT
3. Provide insight about the embedded processor and sensors required for IoT
4. Familiarize the accessories and communication techniques for IoT.
5. Familiarize the different platforms and Attributes for IoT

**UNIT I INTRODUCTION TO INTERNET OF THINGS** **9**

Overview, Hardware and software requirements for IoT, Sensor and actuators ,Technology drivers , Business drivers, Typical IoT applications , Trends and implications.

**UNIT II IoT ARCHITECTURE** **9**

IoT reference model and architecture -Node Structure - Sensing, Processing, Communication, Powering, Networking - Topologies, Layer/Stack architecture , IoT standards, Cloud computing for IoT

**UNIT III IoT PROTOCOLS :** **9**

MQTT, CoAP, Bluetooth and BLE, LoRA and LORAWAN, RFID, Zig bee, GSM, GPRS, WiFi LWM2M - Recent trends.

**UNIT IV Embedded processors for IoT** 9

Introduction to Python programming - Building IoT with Rasperry pi / Arduino - Implementation of IoT- Collect data from the edge devices to gateway using local network, Send the data to a server, Control the device from a server – Security.

**UNIT V CASE STUDIES** **9**

Industrial IoT - Home Automation - Smart cities - Smart Grid - Connected vehicles - Patient Monitoring in Health Care – Agriculture - Productivity Applications - IoT Defense.

| Course Outcomes | Cognitive Level |
|---|---|
| At the end of this course, students will be able to: | |
| CO1: Explain the concepts of IoT and its present developments. | Understand |
| CO2: Analyze different IoT technologies | Apply |
| CO3: Describe the different platforms and infrastructures available for IoT | Apply |
| CO4: Comprehend the embedded processors for IoT and its implementation | Apply |
| CO5: Implement IoT solutions for smart applications | Apply |

**Text Book(s):**

1. Arshdeep Bahga and Vijai Madisetti : A Hands-on Approach “Internet of Things”,Universities Press 2015.
2. Oliver Hersent , David Boswarthick and Omar Elloumi “ The Internet of Things”, Wiley,2016.
3. Samuel Greengard, “ The Internet of Things”, The MIT press, 2015
4. Adrian McEwen and Hakim Cassimally “Designing the Internet of Things “Wiley,2014.

**Reference Book(s):**

1. Jean- Philippe Vasseur, Adam Dunkels, “Interconnecting Smart Objects with IP: The Next Internet” Morgan Kuffmann Publishers, 2010.
2. Adrian McEwen and Hakim Cassimally, “Designing the Internet of Things”, John Wiley and sons, 2014
3. Lingyang Song/Dusit Niyato/ Zhu Han/ Ekram Hossain,” Wireless Device-to-Device Communications and Networks, CAMBRIDGE UNIVERSITY PRESS,2015
4. OvidiuVermesan and Peter Friess (Editors), “Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems”, River Publishers Series in Communication, 2013

**Web Reference(s):**

1. https://www.arduino.cc/reference/en/
2. https://www.raspberrypi.org/

**Course Articulation Matrix**

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

High-3; Medium-2;Low-1

**Electric Vehicle Technology Electives**

<table>
<tr><td colspan="2">Course Code: 19EEEC1047</td><td colspan="2">Course Title: Smart Grid Interface for EV (Common to EE & EI)</td></tr>
<tr><td colspan="2">Course Category: Professional Elective</td><td colspan="2">Course Level: Mastery</td></tr>
<tr><td>L:T:P(Hours/Week)<br>3: 0: 0</td><td>Credits:3</td><td>Total Contact Hours:45</td><td>Max Marks:100</td></tr>
</table>

**Pre-requisites**

- Nil

**Course Objectives**

The course is intended to:

1. Explain the smart grids components and architecture
2. Describe the functions of energy management systems
3. Explain the modern power distribution system functions
4. Understand the smart meter applications and standards.
5. Disseminate the role of smart grid in Electric Vehicles.

**Unit I Introduction to Smart Grid 9 Hours**

Introduction - Definitions and Need for Smart Grid -Today's Gird Versus Smart Grid, Rationale for Smart Grid- Evolution of Electric Grid, Smart Grid Concept– Functions – Opportunities – Benefits and challenges Computational Intelligence, Power System Enhancement, Communication and Standards, Environment and Economics, Shareholders Roles and Function, Architecture, Technology Drivers.

**Unit II Energy Management Systems 9 Hours**

Energy Management System - Smart substations - Substation Automation - Feeder Automation, SCADA – Remote Terminal Unit – Intelligent Electronic Devices – Protocols, Phasor Measurement Unit – Wide area monitoring protection and control, Smart integration of energy resources – Renewable, intermittent power sources – Energy Storage.

**Unit III Distribution Management System 9 Hours**

Distribution Management System – Volt / VAR control – Fault Detection, Isolation and Service Restoration, Network Reconfiguration, Outage management System, Customer Information System, Geographical Information System, Effect of Plug in Hybrid Electric Vehicles

**Unit IV Smart Meters 9 Hours**

Introduction to Smart Meters – Advanced Metering infrastructure, AMI protocols – Standards and initiatives, Demand side management and demand response programs, Demand pricing and Time of Use, Real Time Pricing, Peak Time Pricing.

**Unit V Electric Vehicles 9 Hours**

Plugin Electric Vehicles and hybrid, Vehicle classes, Vehicle Architecture, Gird to Vehicle Charging, Grid Impacts, Vehicle to Grid .

| **Course Outcomes** | | **Cognitive Level** |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Explain the smart grids components and architecture | Understand |
| **CO2.** | Explain the functions of energy management systems | Understand |
| **CO3.** | Summarize the modern power distribution system functions | Understand |
| **CO4.** | Make use of the smart meter in applications and standards | Apply |
| **CO5.** | Identify the role of smart grid in Electric Vehicles | Apply |

**Text Book(s):**

T1 Stuart Borlase 'Smart Grid: Infrastructure, Technology and Solutions', CRC Press 2012.

T2 Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, 'Smart Grid: Technology and Applications', Wiley, 2012.

**Reference Book(s):**

R1 James Momoh, "Smart Grid: Fundamentals of design and analysis", John Wiley & sons Inc, IEEE press 2012.

R2 Yokoyama, "Smart Grid: Technology and Applications", John Wiley & Sons Inc, 2012.

R3 Lars.T.Berger, K.Iniewski, “Smart Grid: Applications, Communications & Security” Wiley India Pvt. Ltd, Reprint 2015.

R4 Fereidoon P. Sioshansi, “Smart Grid: Integrating Renewable, Distributed & Efficient Energy”, Academic Press, 2012.

**Web References:**

1. https://onlinecourses.nptel.ac.in/noc18_ee42/preview
2. https://www.energy.gov/oe/services/technology-development/smart-grid-future-electric-grid

**Course Articulation Matrix**

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

High-3; Medium-2; Low-1

| Course Code: 19EEEC1049 | Course Title: Advanced Sensors for Electric Vehicle (Common to EE & EI) | | |
|---|---|---|---|
| **Course Category: Professional Elective** | | **Course Level: Mastery** | |
| **L:T:P(Hours/Week) 3: 0: 0** | **Credits:3** | **Total Contact Hours:45** | **Max Marks:100** |

**Pre-requisites**

- Electronic devices
- Engineering physics

**Course Objectives**

The course is intended to:

1. Inculcate knowledge of digital transducers
2. Understand the seven generations of IoT sensors to appear.
3. Introduce the sensor technology for advanced driver assistance systems.
4. Disseminate the knowledge of sensor networks.
5. Provide the basic concepts of intelligent sensor systems.

**Unit I Digital Transducers 9 Hours**

Digital voltmeter -Ramp type, Integrating type, ADC, Digital frequency meter - Working principle and applications. Frequency meter, Electronic counters - Transducers for the measurement of DC and AC voltages and currents - CTs, PTs for supply frequency as well as high frequency, Hall Effect Current Sensors, High Voltage Sensors.

**Unit II Seven Generations of IoT Sensors 9 Hours**

Industrial sensors –Description and Characteristics–First Generation –Description and Characteristics–Advanced Generation –Description and Characteristics–Integrated IoT Sensors –Description and Characteristics–Polytronics Systems –Description and Characteristics–Sensors' Swarm –Description and Characteristics–Printed Electronics –Description and Characteristics–IoT Generation Roadmap

**Unit III Sensor Technology for Advanced Driver Assistance Systems 9 Hours**

Basics of Radar Technology and Systems - Ultrasonic Sonar Systems - Lidar Sensor Technology and Systems - Camera Technology - Night Vision Technology - Use of Sensor Data Fusion - Integration of Sensor Data to On-Board Control Systems

**Unit IV Sensor Networks 9 Hours**

Introduction to sensor network, Unique constraints and challenges, Localization and Tracking, Networking Sensors, Infrastructure establishment, Sensor Tasking and Control, Sensor network databases, Sensor Network Platforms and tools, Industrial Applications and Research directions.

**Unit V Intelligent Sensor Systems 9 Hours**

Intelligent Sensor Systems- Intelligent pressure, Flow, Level, Temperature Sensors - Intelligent sensor, Complex sensors, biometric sensors - Application of intelligent sensor in electric vehicles.

| **Course Outcomes** | | **Cognitive Level** |
|---|---|---|
| At the end of this course, students will be able to: | | |
| CO1. | Explain the concept digital transducers | Understand |
| CO2. | Describe the seven generations of iot sensors to appear. | Understand |
| CO3. | Make use of the sensor technology for advanced driver assistance systems. | Apply |
| CO4. | Outline the sensor networks. | Understand |
| CO5. | Make use of the different intelligent sensor systems. | Apply |

**Text Book(s):**


T1. Hybrid Electric Vehicle System Modeling and Control - Wei Liu, General Motors, USA, John Wiley & Sons, Inc., 2017.

T2. Electric and Hybrid Vehicles, Tom Denton, Taylor & Francis, 2018


**Reference Book(s):**


R1. Robert Bosch Gmbh, Automotive Electrics and Automotive Electronics, Systems and Components, Networking and Hybrid drive, 5th Edition, Springer Vieweg, Wiesbaden 1998.

R2. Mehrdad Ehsani Yimin Gao Stefano Longo Kambiz M. Ebrahimi, Modern Electric, Hybrid Electric, and Fuel Cell Vehicles, Taylor & Francis Group, LLC, 2018.

R3. Denton.T , Automobile Electrical and Electronic Systems: Automotive Technology: Vehicle Maintenance and Repair, 2012

**Web References:**

1. http://nptel.ac.in/courses/117106093/
2. https://www.electronicsweekly.com/power/sensors-for-battery-management-systems-

**Course Articulation Matrix**

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

High-3; Medium-2; Low-1

| Course Code: 19EEEC1051 | Course Title: Automotive Electrical & Electronic Systems (Common to EE & EI) | | |
|---|---|---|---|
| **Course Category: Professional Elective** | | **Course Level: Mastery** | |
| **L:T:P(Hours/Week)<br>3: 0: 0** | **Credits:3** | **Total Contact Hours:45** | **Max Marks:100** |

**Pre-requisites**

- Nil

**Course Objectives**

The course is intended to:

1. Understand the types of batteries, performance and lighting techniques of automotive systems
2. Analyze the various types of ignition system used in automobiles
3. Illustrate the components of charging and starting systems of vehicles
4. Summarize the various types of sensors and actuators used in automobiles
5. Analyze the Electronic Engine Control techniques

**UNIT I BATTERIES AND LIGHTING SYSTEM 9 Hours**

Lead acid and alkaline batteries, construction and working, battery rating, battery charging methods, testing and maintenance. Lighting system: insulated and earth return system, head light and side light, LED lighting system, head light dazzling and preventive methods.

**UNIT II IGNITION SYSTEM 9 HOURS**

Ignition system- Construction and working of magneto coil and battery coil ignition systems, Centrifugal and Vacuum Advance Mechanism, spark plug types, spark advance mechanisms, electronic ignition systems - Transistorized ignition system, solid state ignition systems, capacitor discharge ignition system and distributor less ignition system.

**UNIT III STARTING AND CHARGING SYSTEM 9 HOURS**

Requirements of Starter Motor, Starter Motor types, construction and characteristics, Starter drive mechanisms, Starter Switches and Solenoids, Charging system components, Generators and Alternators, types, construction and Characteristics. Voltage and Current Regulation, Cut-out relays and regulators. Charging circuits for D.C. Generator.

**UNIT IV SENSORS AND ACTUATORS 9 HOURS**

Sensors - Oxygen Sensors, Throttle Position Sensor, Engine Speed Sensor, Ignition Timing Sensor, Crankshaft Position Sensor, Manifold Absolute Pressure Sensor -Engine Coolant Temperature Sensor, Knock Sensor, Airflow rate sensor. Actuators - Fuel Metering Actuator, Fuel Injector, and Ignition Actuator.

**UNIT V ELECTRONIC ENGINE CONTROL SYSTEMS 9 HOURS**

Comparison indirect and direct injection- mechanical and hydraulic actuated EDC - In-line fuel-injection pumps, helix and port controlled axial piston distributor, solenoid valve control, unit injectors, common rail systems, data processing, lambda closed loop control, torque-controlled EDC systems, control and triggering of actuators, gasoline direct injection systems, air assisted systems, principles and features of Bosch electronic systems, idle speed, knock and spark timing control. Case study of solar powered vehicle.

| **Course Outcomes** | | **Cognitive Level** |
|---|---|---|
| At the end of this course, students will be able to: | | |
| CO1. | Differentiate various types of batteries and their testing methods and lightening systems employed in automobiles. | Understand |
| CO2. | Summarize various types of ignition techniques adopted in automobiles. | Understand |
| CO3. | Examine the operating principle of starter motor for starting and generator for charging system. | Apply |
| CO4. | Explain various types of sensors and actuators, their construction, operating principle and uses. | Understand |
| CO5. | Apply the various electronic control techniques for diesel and gasoline systems. | Apply |

**Text Book(s):**


T1. Tom Denton, Automobile Electrical and Electronic Systems, Automotive Technology ,Routledge Taylor and Francis Group,2017

T2. Tony Tranter “Automobile Electrical and Electronic Systems Essential theory & Practice”, Haynes Publishers, 2009.


**Reference Book(s):**


R1. A W Judge, Modern Electrical Equipment for Automobiles, Chapman & Hall, 2009.

R2. P. L. Kohli, Automotive Electrical Equipment, First Edition, McGraw-Hill, 2017.

R3. Robert Bosch Automotive Hand Book, 9th Edition, Robert Bosch, 2014.

R4. W. H. Crouse, Automotive Electrical Equipment, McGraw-Hill, 2009.

**Web References:**

1. https://nptel.ac.in/courses/107/106/107106088/
2. https://www.ti.com/solution/electrical-and-electronics-automotive-applications

**Course Articulation Matrix**

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

High-3; Medium-2; Low-1

| Course Code: 19EEEC1067 | Course Title: Testing of Electric Vehicles (Common to EE & EI) | | |
|---|---|---|---|
| Course Category: Professional Elective | | Course Level: Mastery | |
| L: T:P (Hours/Week): 3:0:0 | Credit :3 | Total Contact Hours: 45 | Total Marks: 100 |

**Pre-requisites**

**Nil**

**Course objectives:**

The course is intended to

1. know various standardization procedures
2. learn the testing procedures for EV & HEV components
3. know the functional safety and EMC
4. realize the effect of EMC in EVs
5. study the effect of EMI in motor drives and in DC-DC converter system

**Unit I EV STANDARDIZATION 9 Hours**

Introduction - Current status of standardization of electric vehicles, electric Vehicles and Standardization - Standardization Bodies Active in the Field – Standardization activities in countries like Japan. The International Electro Technical Commission - Standardization of Vehicle Components.

**Unit II TESTING OF ELECTRIC MOTORS AND CONTROLLERS FOR ELECTRIC AND HYBRID ELECTRIC VEHICLES 9 Hours**

Test Procedure Using M-G Set, electric motor, controller, application of Test Procedure, Analysis of Test Items for the Type Test - Motor Test and Controller Test (Controller Only). - Test Procedure Using Eddy Current Type Engine Dynamometer, Test Strategy, Test Procedure, Discussion on Test Procedure. Test Procedure Using AC Dynamometer.

**Unit III FUNDAMENTALS OF FUNCTIONAL SAFETY AND EMC 9 Hours**

Functional safety life cycle - Fault tree analysis - Hazard and risk assessment – software development - Process models - Development assessments - Configuration management – Reliability - Reliability block diagrams and redundancy - Functional safety and EMC - Functional safety and quality - Standards - Functional safety of autonomous vehicles.

**Unit IV EMC IN ELECTRIC VEHICLES 9 Hours**

Introduction - EMC Problems of EVs, EMC Problems of Motor Drive, EMC Problems of DC-DC Converter System, EMC Problems of Wireless Charging System, EMC Problem of Vehicle Controller, EMC Problems of Battery Management System, Vehicle EMC Requirements.

**Unit V EMI IN MOTOR DRIVE AND DC-DC CONVERTER SYSTEM 9 Hours**

Overview -EMI Mechanism of Motor Drive System, Conducted Emission Test of Motor Drive System, IGBT EMI Source, EMI Coupling Path, EMI Modelling of Motor Drive System. EMI in DC-DC Converter, EMI Source, The Conducted Emission High-Frequency, Equivalent Circuit of DC-DC Converter System, EMI Coupling Path

| **Course Outcomes** | | **Cognitive Level** |
|---|---|---|
| At the end of this course, students will be able to: | | |
| CO1 | describe the status and other details of standardization of EVs | Understand |
| CO2 | illustrate the testing protocols for EVs and HEV components | Understand |
| CO3 | analyze the safety cycle and need for functions safety for EVs | Apply |
| CO4 | analyze the safety cycle and need for functions safety for EVs | Apply |
| CO5 | evaluate the EMI in motor drive and DC-DC converter system | Apply |

**Text Books**

T1. Vehicle Inspection Handbook”, JJ Keller and Associates ,Inc,2020

T2. Michael Plint& Anthony Martyr, “Engine Testing & Practice”, Butterworth Heinmenn, 3rd Edition, 2007

**Reference Books**

R1. Proceedings- Automotive Testing & Certification held on 20th to 24th July 2010

R2. Bosch Automotive Handbook, Robert Bosch, 7th Edition, 2007

R3. Arvey Segler, " Body Language: Discovering & Understanding the Psychological secrets behind reading & Benefiting from Body Language” Kindle Edition, 2016

R4. M. Ehsani, Y. Gao, S. Gay and A. Emadi, Modern Electric, Hybrid Electric, and Fuel Cell Vehicles, CRC Press, 2005.

**Web References:**

1. https://www.nrel.gov/transportation/electric-vehicle-testing.html
2. https://www.tuv.com/world/en/e-mobility/electric-vehicle-testing-and-certification.html

**Course Articulation Matrix**

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

High-3; Medium-2; Low-1

| Course Code: 19EEEC1068 | Course Title: Design of Electric Vehicle Charging System (Common to EE & EI) | | |
|---|---|---|---|
| Course Category: Professional Elective | | Course Level: Mastery | |
| L : T : P (Hours/Week) 3: 0: 0 | Credits : 3 | Total Contact Hours : 45 | Max Marks :100 |

**Pre-requisites**

- Nil

**Course Objectives**

**The course is intended to:**

- Know the charging station and standards
- Learn the concepts of power converters in charging
- Find the charging scheme in renewable based EV charging
- Demonstrate the wireless power transfer technique
- Design & simulate power factor correction circuits

**Unit I-CHARGING STATIONS AND STANDARDS 9 Hours**

Introduction-Charging technologies- Conductive charging, EV charging infrastructure, International standards and regulations - Inductive charging, need for inductive charging of EV, Modes and operating principle, Static and dynamic charging, Bidirectional power flow, International standards and regulations

**Unit II- POWER ELECTRONICS FOR EV CHARGING 9 Hours**

Layouts of EV Battery Charging Systems-AC charging-DC charging systems- Power Electronic Converters for EV Battery Charging- AC–DC converter with boost PFC circuit, with bridge and without bridge circuit - Bidirectional DC–DC Converters- Non-isolated DC–DC bidirectional converter topologies- Half-bridge bidirectional converter.

**Unit III-EV CHARGING USING RENEWABLE AND STORAGE SYSTEMS 9 Hours**

Introduction- - EV charger topologies , EV charging/discharging strategies - Integration of EV charging-home solar PV system , Operation modes of EVC-HSP system , Control strategy of EVCHSP system - fast-charging infrastructure with solar PV and energy storage.

**UNIT IV- WIRELESS POWER TRANSFER** **9 Hours**

Introduction - Inductive, Magnetic Resonance, Capacitive types. Wireless Chargers for Electric Vehicles - Types of Electric Vehicles - Battery Technology in EVs -Charging Modes in EVs - Benefits of WPT. - WPT Operation Modes - Standards for EV Wireless Chargers, SAE J2954, IEC 61980. ISO 19363

**UNIT V- POWER FACTOR CORRECTION IN CHARGING SYSTEM** **9 Hours**

Need for power factor correction- Boost Converter for Power Factor Correction, Sizing the Boost Inductor, Average Currents in the Rectifier and calculation of power losses.

| **Course Outcomes**<br>At the end of this course, students will be able to: | **Cognitive Level** |
|---|---|
| CO1: Illustrate various charging techniques and to know charging standards and regulations | Understand |
| CO2: Demonstrate the working of DC-DC converters used for charging systems and principles | Understand |
| CO3: Illustrate the advantages of renewable system based charging systems | Understand |
| CO4:Demonstrate the principles of wireless power transfer & To analyze the standards for wireless charging | Understand |
| CO5: Design and simulate boost converter based power factor correction. | Apply |

**Text Book(s)**

T1. Mobile Electric Vehicles Online Charging and Discharging, Miao Wang Ran Zhang Xuemin (Sherman) Shen, Springer 2016, 1st Edition.

T2. Alicia Triviño-Cabrera, José M. González-González, José A. Aguado, Wireless Power Transferor Electric Vehicles: Foundations and Design Approach, Springer Publisher 1st Edition. 2020.

**Reference Book(s)**

R1.Nil Patel, Akash Kumar Bhoi, Sanjeevikumar Padmanaban, Jens Bo Holm-Nielsen, Electric Vehicles Modern Technologies and Trends. Springer Publisher 1st Edition, 2021.

R2.Cable Based and Wireless Charging Systems for Electric Vehicles, Technology and control, management and grid integration, Rajiv Singh, Sanjeevikumar Padmanaban, Sanjeet Dwivedi, Marta Molinas and Frede Blaabjerg, IET 2021, 1st Edition.

R3.Electric and Hybrid Electric Vehicles, James D Halderman, Pearson, 2022, 1st Edition.

R4. Handbook of Automotive Power Electronics and Motor Drives, Ali Emadi, Taylor & Francis,2005.

**Web References**

1. https://iaeimagazine.org/features/electric-vehicle-charging-station-design/
2. https://www.energy.gov/eere/electricvehicles/downloads/design-guidelines-electric vehicle-charging-stations

## Course Articulation Matrix

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

High-3; Medium-2; Low-1

| Course Code: 19EEEC1069 | | Course Title: Electric Vehicle Architecture (Common to EE & EI) | |
|---|---|---|---|
| Course Category: Professional Elective | | | Course Level: Mastery |
| L : T : P (3:0:3) | Credits : 3 | Total Contact Hours : 45 | Max Marks : 100 |

**Pre-requisites**

- Nil

**Course Objectives**

**The course is intended to**

1. Understand the structure of Electric Vehicle, Hybrid Electric Vehicle
2. Explain the vehicle mechanics
3. Describe about the EV conversion components
4. Understand about the details and specifications for Electric Vehicles
5. Understand the concepts of Plug-in Hybrid Electric Vehicle

**Unit I ELECTRIC VEHICLE ARCHITECTURES 9 Hours**

Electric vehicle history, Evolution of electric vehicles, Social and environmental importance of hybrid and electric vehicles, Layout of an electric vehicle- Electric drive-train topologies, Transmission types for EV – Power flow control in electric drive train. Mountain Bike - Motorcycle - Electric Cars and Heavy duty EVs.-Details and Specification.

**Unit II HYBRID VEHICLE ARCHITECTURES 9 Hours**

Concepts of hybrid electric drive train, Hybrid vehicle architectures- Series, Parallel and Series parallel Architecture, Micro and Mild architectures. Power flow control in all hybrid vehicle configurations.

**Unit III VEHICLE MECHANICS, POWER COMPONENTS AND BRAKES 9 Hours**

Vehicle mechanics- Roadway fundamentals, Laws of motion, Vehicle Kinetics, Dynamics of vehicle motion, propulsion power, velocity and acceleration, Tire Road mechanics, Propulsion system design. Power train component sizing- Gears, Clutches, Differential, Transmission and vehicle brakes.

**Unit IV - HYBRID VEHICLE CONTROL STRATEGY 9 Hours**

Vehicle supervisory control, Mode selection strategy, Modal Control strategies.

**Unit V - PLUG-IN HYBRID ELECTRIC VEHICLE** **9 Hours**

Introduction-History-Comparison with electrical and hybrid electrical vehicle-Construction and working of PHEV-Block diagram and components-Charging mechanisms-Advantages of PHEVs.

| Course Outcomes<br>At the end of this course, students will be able to: | CognitiveLevel |
|---|---|
| CO1: Summarize the History and Evolution of EVs, Hybrid and Plug-In Hybrid EVs | Remember |
| CO2: Classify the various architectures of hybrid electric vehicles. | Understand |
| CO3: Describe the basics of vehicle mechanics, power components and brakes. | Understand |
| CO4: Describe the hybrid vehicle control strategy | Analysis |
| CO5: Describe the concepts related in the Plug-In Hybrid Electric Vehicles | Understand |

**Text Book(s)**


T1. Mehrdad Ehsani, YiminGao, Sebastian E. Gay, Ali Emadi, 'Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design', CRC Press, 2004.

T2. Build Your Own Electric Vehicle,Seth Leitman , Bob Brant, McGraw Hill, Third Edition 2013.

T3. Advanced Electric Drive Vehicles, Ali Emadi, CRC Press, First edition 2017.


**Reference Book(s)**


R1. Hybrid Electric Vehicles: A Review of Existing Configurations and Thermodynamic Cycles, Rogelio León , Christian Montaleza , José Luis Maldonado , Marcos Tostado - Véliz and Francisco Jurado, Thermo, 2021, 1, 134–150.

R2.Electric Vehicles Modern Technologies and Trends, Nil Patel, Akash Kumar Bhoi, Sanjeevikumar Padmanaban, Jens Bo Holm-Nielsen Springer, 2020.

R3. The Electric Vehicle Conversion Handbook: How to Convert Cars, Trucks, Motorcycles,and Bicycles -- Includes EV Components, Kits, and Project Vehicles Mark Warner, HP Books, 2011.


**Web references**


1. https://www.nrel.gov/transportation/electric-vehicle-components.html
2. https://www.evaap.org/electric-vehicle-architecture/

## Course Articulation Matrix

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

High-3; Medium-2; Low-1

<table>
<tr><td colspan="2">**Course Code: 19EEEC1070**</td><td colspan="2">**Course Title: Design of Motor and Power Converters for Electric Vehicles<br>(Common to EE & EI)**</td></tr>
<tr><td colspan="2">**Course Category: Professional Elective**</td><td colspan="2">**Course Level: Mastery**</td></tr>
<tr><td>**L:T:P(Hours/Week)<br>3: 0: 0**</td><td>**Credits:3**</td><td>**Total Contact Hours:45**</td><td>**Max Marks:100**</td></tr>
</table>

**Pre-requisites**

- Nil

**Course Objectives**

The course is intended to:

1. Review the drive cycles and requirements of EVs
2. Know the working of motors used in Electric Vehicle
3. Analyze and model the buck/boost converter operation and to design the same
4. Learn the simulation basics of control systems
5. Derive transfer functions for DC-DC converters.

**Unit I ELECTRIC VEHICLE DYNAMICS 9 Hours**

Standard drive cycles-Dynamics of Electric Vehicles-Tractive force-Maximum speed, torque, power, energy requirements of EVs.

**Unit II MOTORS FOR ELECTRIC VEHICLES 9 Hours**

Introduction – Speed And Torque control of above and below rated speed-Speed control of EV in the constant power region of electric motors. DC Motors, Induction Motor, Permanent Magnet Synchronous Motors (PMSM), Brushless DC Motors, Switched Reluctance Motors (SRMs). Synchronous Reluctance Machines-Choice of electric machines for EVs.

**Unit III BASICS OF SIMULATION IN CONTROL SYSTEMS 9 Hours**

Transfer Function-How to build transfer function, identify Poles, zeros, draw time response plots, bode plot (Bode Plots for Multiplication Factors, Constant, Single and Double Integration Functions, Single and Double Differentiation Functions, Single Pole and Single Zero Functions, RHP Pole and RHPZero Functions), state space modelling-transfer function from state space Model.

**Unit IV MODELING OF DC-DC CONVERTERS 9 Hours**

Overview of PWM Converter Modelling -Power Stage Modelling - PWM Block Modelling – Voltage Feedback Circuit and Small-Signal Model of PWM Converter - Averaging Power Stage Dynamics -Average Models for buck/boost Converter - Small-Signal Model of Converter Power Stage -Frequency Response of Converter.

**Unit V POWER STAGE TRANSFER FUNCTIONS OF DC – DC CONVERTERS 9 Hours**

Power Stage Transfer Functions of buck-boost Converter in CCM Operation, Input-to-Output Transfer Function, Duty Ratio-to-Output Transfer Function, Load Current-to-Output Transfer Function

| **Course Outcomes** | | **Cognitive Level** |
|---|---|---|
| At the end of this course, students will be able to: | | |
| CO1. | use appropriate electric machine for electric vehicle application | Understand |
| CO2. | compute transfer function with factors such as constant, integral, differential, first order factor and second order factor (both numerators & denominators) | Apply |
| CO3. | compute transfer function from state models | Apply |
| CO4. | Design buck, boost and buck-boost converter. | Apply |
| CO5. | compute a power stage transfer functions for DC-DC converters | Apply |

**Text Book(s):**


T1. K. T. Chau, " electric vehicle machines and drives design, analysis and application ", First Edition, Wiley Publishers, 2015

T2. James Larminie, “Electric Vehicle Technology Explained”, First Edition, Wiley Publishers , 2003


**Reference Book(s):**


R1. P.C. Krause, O. Wasynczuk, and S. D. Sudhoff, “Analysis of Electric Machinery”, McGraw-Hill Book Company,1995.

R2. R. Krishnan, “Electric Motor Drives: Modeling, Analysis and Control”, Prentice Hall,2015.

R3. P. S. Bhimbra, “Generalized Theory of Electric Machines”, Khanna Publication,2018.

R4. B. K. Bose, “Modern Power Electronics and AC Drives”, Pearson Education. s, Processes, Methods and Tools, SAE, 2016

**Web References:**

1. https://nptel.ac.in/courses/108/104/108104011/
2. t https://www.nrel.gov/docs/fy19osti/72198.pdf

**Course Articulation Matrix**

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

High-3; Medium-2; Low-1

| | | | |
|---|---|---|---|
| **Course Code: 19EEEC1071** | **Course Title: Intelligent Control of Electric Vehicles (Common to EE & EI)** | | |
| **Course Category: Professional Elective** | | **Course Level: Mastery** | |
| **L:T:P(Hours/Week)<br>3: 0: 0** | **Credits:3** | **Total Contact Hours:45** | **Max Marks:100** |

**Pre-requisites**

- Nil

**Course Objectives**

The course is intended to:

1. Design and drive the mathematical model of a BLDC motor and its characteristics
2. Learn the different control schemes for BLDC motor
3. Study the basics of fuzzy logic
4. Study the FPGA & VHDL basics
5. Implement fuzzy logic control of BLDC motor in real time

**UNIT I MATHEMATICAL MODEL AND CHARACTERISTICS ANALYSIS OF THE BLDC MOTOR — 9 Hours**

Structure and Drive Modes - Basic Structure, General Design Method, Drive Modes. Mathematical Model, Differential Equations, Transfer Functions, State-Space Equations. Characteristics Analysis, Starting Characteristics, Steady-State Operation, Dynamic Characteristics, Load Matching Commutation Transients

**UNIT II SPEED CONTROL FOR ELECTRIC DRIVES — 9 hours**

Introduction -PID Control Principle, Anti windup Controller, Intelligent Controller. Vector Control. Control applied to BLDC motor.

**UNIT III FUZZY LOGIC — 9 hours**

Membership functions: features, fuzzification, methods of membership value assignments Defuzzification: lambda cuts - methods - fuzzy arithmetic and fuzzy measures: fuzzy arithmetic - extension principle - fuzzy measures - measures of fuzziness -fuzzy integrals - fuzzy rule base and approximate reasoning : truth values and tables, fuzzy propositions, formation of rules decomposition of rules, aggregation of fuzzy rules, fuzzy reasoning-fuzzy inference systems, overview of fuzzy expert system-fuzzy decision making.

**Unit IV FPGA AND VHDL BASICS 9 Hours**

Introduction – FPGA Architecture-Advantages-Review of FPGA family processors- Spartan 3, Spartan 6 and Spartan 7. VHDL Basics- Fundamentals-Instruction set-data type-conditional Statements - programs like arithmetic, sorting, PWM generation, Speed detection.

**Unit V REAL TIME IMPLEMENTATION 9 Hours**

Inverter design, identifying rotor position via hall effect sensors, open loop and fuzzy logic control of 48 V BLDC motor using FPGA.

| **Course Outcomes** | | **Cognitive Level** |
|---|---|---|
| At the end of this course, students will be able to: | | |
| CO1. | Design the mathematical model of a BLDC motor and to discuss about its characteristics | Understand |
| CO2. | Demonstrate the PID control, ant windup controller, Intelligent Controller and Vector Control. | Understand |
| CO3. | Illustrate the basics of fuzzy logic system | Understand |
| CO4. | Describe the basics of VHDL & FPGA applied to control of EVs. | Understand |
| CO5. | Design and implement of fuzzy logic control scheme for BLDC motor using FPGA in real time | Apply |

**Text Book(s):**

T1. Electric Powertrain Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles, John G. Hayes, G. Abas Goodarzi, Wiley 1st Edition 2018

T2. Qbal Hussain, “Electric and Hybrid Vehicles: Design Fundamentals, Third Edition” CRC Press, Taylor & Francis Group, 2021, 1st Edition

**Reference Book(s):**

R1. VHDL Primer, A (3rd Edition), Jayaram Bhasker, Prentice Hall, 1 st Edition 2015.

R2. Chang-liang, Permanent Magnet Brushless DC Motor Drives and Controls, Xia Wiley 2012, 1

R3. M.N. Cirstea, A. Dinu, J.G. Khor,M. McCormick, Neural and Fuzzy Logic Control of Drives and Power Systems, Newnes publications, 1 st Edition, 2002

R4. Electric and Plug-in Hybrid Vehicle Networks Optimization and Control, Emanuele Crisostomi • Robert Shorten, Sonja Stüdli • Fabian Wirth, CRC Press, 1

**Web References:**

1 https://nptel.ac.in/courses/

2 https://www.sciencedirect.com/science/article/pii/S1474667017403436

**Course Articulation Matrix**

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

High-3; Medium-2; Low-1

## Internet of Things Electives

| Course Code:19EIEN1023 | | Course Title: Industrial Internet of Things | |
|---|---|---|---|
| Course Category: Professional Elective | | Course Level: Mastery | |
| L:T:P(Hours/Week)<br>3: 0: 0 | Credits:3 | Total Contact Hours:45 | Max Marks:100 |

**Pre-requisites**

- Embedded systems

**Course Objectives**

The course is intended to:

1. Indicate the various industrial revolutions and need for industry 4.0
2. Illustrate the design architecture and components of IoT.
3. Provide knowledge on communication protocols used IoT based solutions
4. Realize the opportunities, challenges brought about by Industry 4.0 and how organizations and individuals should prepare to reap the benefits
5. Demonstrate the application of IIoT

**Unit I Introduction to IIoT 9 Hours**

The Various Industrial Revolutions - Digitalisation and the Networked Economy -Drivers, Enablers, Compelling Forces and Challenges for Industry 4.0- Comparison of Industry 4.0 Factory and Today's Factory - Trends of Industrial Big Data and Predictive Analytics for Smart Business Transformation

**Unit II IoT building blocks 9 Hours**

IoT Architecture, WoT and M2M - Physical & Logical IoT design Basics - IoT Enabling Technologies - IoT Levels and templates

System Design of Connected Devices: Embedded Devices, Embedded Hardware, Connected Sensors and Actuators, Controllers, Battery Life Conservation and designing with Energy Efficient Devices, SoCs, Single Chip Controllers with integrated Processing and Network Core with Hardware Crypto Engines.

**Unit III IoT Communication protocols 9 Hours**

Understanding Internet Protocols: Simplified OSI Model, Network Topologies, Standards, Types of Internet Networking - Ethernet, WiFi, Local Networking, Bluetooth, Bluetooth Low Energy (BLE), Zigbee, 6LoWPAN, Sub 1 GHz, RFID,NFC, Proprietary Protocols, Simplicity, Networking Design - Push, Pull and Polling, Network APIs.

**Unit IV Advanced design and challenges 9 Hours**

IOT Specific Challenges and Opportunities- Advances Design Concepts for IOT - Software UX Design Considerations, Machine Learning and Predictive Analysis, Interactions, Inter-usability and Inter-operability considerations, Understanding Security in IOT Design, Design requirements of IOT Security Issues and challenges, Privacy, Overview of Social Engineering.

**Unit V Case study 9 Hours**

Smart Manufacturing – IIoT in oil and gas industry - Smart Cities- Precision healthcare- Precision mining.

| **Course Outcomes** | | **Cognitive Level** |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Describe various industrial revolutions and role of industry4.0 | Understand |
| **CO2.** | Summarize various components required to build IoT based application | Understand |
| **CO3.** | Explain the communication protocols suitable for IOT | Understand |
| **CO4.** | Describe the opportunities, challenges brought about by Industry 4.0 and how organisations and individuals should prepare to reap the benefits | Understand |
| **CO5.** | Appreciate the smartness in Smart Factories, Smart cities, smart products and other smart services | Understand |

**Text Book(s):**


T1. Foundational Elements of an IOT Solution - The Edge, Cloud and Application Development,

T2. Designing Connected Products, 1st Edition, Elizabeth Goodman, Alfred Lui, Martin Charlier, Ann Light, Claire Rowland


**Reference Book(s):**


R1. The Internet of Things (A Look at Real World Use Cases and Concerns), Kindle Edition, 2016, Lucas Darnell

R2. From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence: By Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand,

R3. Vijay Madisetti, Arshdeep Bahga, “Internet of Things: A Hands-On Approach”

R4. Internet of Things (A Hands-on-Approach), by Vijay Madisetti and ArshdeepBahga, 1st

**Web References:**

1. https://nptel.ac.in/courses/117/105/117105079/
2. https://nptel.ac.in/courses/117/105/117105135/
3. https://nptel.ac.in/courses/117/104/117104020/

**Course Articulation Matrix**

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

High-3; Medium-2; Low-1

| | | | |
|---|---|---|---|
| **Course Code: 19EIEN1033** | **Course Title: Sensor for IoT Application** | | |
| **Course Category: Professional Elective** | | **Course Level: Mastery** | |
| **L:T:P(Hours/Week)**<br>**3: 0: 0** | **Credits:3** | **Total Contact Hours:45** | **Max Marks:100** |

**Pre-requisites**

- Nil

**COURSE OBJECTIVES:**

1. To introduce the basics of technology and its applications.
2. To understand the concept of M2M (machine to machine) interfacing with necessaryprotocols
3. To develop the Python Scripting Language for IoT devices
4. To familiarize with the Raspberry PI platform based IoT applications.
5. To provide the knowledge on web based services using IoT devices.

**UNIT - I INTRODUCTION TO INTERNET OF THINGS 9**

Definition and Characteristics of IoT, Sensors, Actuators, Physical Design of IoT — IoT Protocols, Logical design of IoT – IoT communication models, IoT Communication APIs, IoT enabled Technologies – Wireless Sensor Networks, Cloud Computing, Embedded Systems, IoT Levels and Templates, Domain Specific IoTs — Home Automation, City, Environment, Energy, Agriculture, Industry and Health & Life style.

**UNIT -II IoT AND M2M 9**

Introduction, M2M, Software defined networks, network function virtualization, difference between SDN and NFV for IoT, IoT System Management with NETCONF - YANG –Need for IoT System Management, SNMP, NETCONF, YANG, NETOPEER.

**UNIT - III IOT SYSTEMS AND IOT PHYSICAL DEVICES & ENDPOINTS 9**

Introduction to python, Introduction to Arduino and Raspberry Pi- Installation, Interfaces (serial,SPI, I2C), Programming – Python program with Raspberry PI with focus on interfacing externalgadgets, controlling output, and reading input from pins.

**UNIT – IV PREPARING OUR IoT PROJECTS AND HARDWARE DESIGN 9**

Creating the sensor project, Creating the actuator project, Connecting LED, Buzzer, Switching High Power devices with transistors, Light sensor, temperature sensor with thermistor, voltage sensor, ADC and DAC, Temperature and Humidity Sensor DHT11, Motion Detection Sensors, Wireless Bluetooth Sensors, Level Sensors, USB Sensors, Embedded Sensors, Distance Measurement with ultrasound sensor.

**UNIT - V IOT PHYSICAL SERVERS AND CLOUD OFFERINGS 9**

Introduction to Cloud Storage models and communication APIs Webserver – Web server for IoT, Cloud for IoT, Python web application framework, designing a RESTful web API, Amazon Web service for IoT

**TOTAL: 45 PERIODS**

| **Course Outcomes** | | **Cognitive Level** |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Relate IoT application areas and technologies involved. | Understand |
| **CO2.** | Explain IoT sensors and technological challenges. | Understand |
| **CO3.** | Apply Python program with Raspberry PI on IoT devices. | Understand |
| **CO4.** | Analyze Market forecast for IoT devices | Understand |
| **CO5.** | Design Internet of Things based projects using Raspberry Pi. | Understand |

**TEXT BOOKS:**


1. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015.
2. Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015.


**REFERENCES:**


1. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014.
2. Raspberry Pi Cookbook, Software and Hardware Problems and solutions, Simon Monk, O'Reilly (SPD), 2016.

## Course Articulation Matrix

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

High-3; Medium-2; Low-1

<table>
<tr><td colspan="2">Course Code: 19EIEN1034</td><td colspan="2">Course Title: IoT for Industry Automation</td></tr>
<tr><td colspan="2">Course Category: Professional Elective</td><td colspan="2">Course Level: Mastery</td></tr>
<tr><td>L:T:P(Hours/Week)<br>3: 0: 0</td><td>Credits:3</td><td>Total Contact Hours:45</td><td>Max Marks:100</td></tr>
</table>

**Pre-requisites**

- Nil

**COURSE OBJECTIVES:**

1. To understand the basics of sensors used for various applications
2. To develop the concept of signal conditioning circuits and implementation
3. To study the role IoT sensors for automotive industries
4. To familiarize about the functioning of IoT based sensors in healthcare industry
5. To knowledge on unmanned Arial vehicle

**UNIT I SENSORS & TRANSDUCERS 9**

Introduction to IoT Sensors- Temperature sensors, Proximity sensor, Pressure sensor, Water quality sensor, Chemical sensor, Gas sensor, Smoke sensor, IR sensors, Level sensors, Image sensors, motion sensor, Humidity sensor, Ultrasonic Sensor, MQ2 Sensor, Digital switch, Electro Mechanical switches.

**UNIT II SIGNAL CONDITION CIRCUITS 9**

Design of Signal conditioning circuit — Wheatstone Bridge, Deferential and Instrumentation amplifiers, Capacitive Sensors, Inductive Sensors, Electromagnetic Sensors, Thermocouples, Piezoelectric Sensors, Photovoltaic Sensors, Thermistor, RTD, Load cell, Torque, Strain gauge, Force Sensor, Accelerometer, Digital and Intelligent Sensors

**UNIT III INTERNET OF THINGS IN AUTOMOTIVE INDUSTRIES 9**

Role of IoT automotive industries, interfacing of digital and analog sensors in automotive industries, Biometric car door opening, accident monitoring, Engine management system, driver management system, real time vehicle tracking system, 5G advanced driver assistance systems (ADAS), Augmented road sign information, In-vehicle Infotainment and Telematics, Automotive Maintenance System, Truck’s performance statistics like fuel and mileage, Tracking traffic conditions on the road.

**UNIT IV INTERNET OF THINGS FOR THE HEALTHCARE INDUSTRY 9**

Emerging Technologies in Smart Healthcare, Fog Computing in Healthcare, Technologies Used in Software Defined Networking (SDN) and HealthCare, WSN and IoT Based Smart Surveillance Systems for Patients, Security and Privacy Issues in Smart Healthcare System, IoMT- Based Smart Remote Monitoring System.

**UNIT V IOT FOR UNMANNED AERIAL VEHICLES 9**

Introduction, Battery and Energy Management, Energy Efficient Communication Methods, Unmanned Aerial Vehicle (UAV) for Security Intelligence, Role of AI and Big Data Analytics inUAV, Blockchain-Based Solutions for Various Security Issues.

| Course Outcomes | | Cognitive Level |
|---|---|---|
| At the end of this course, students will be able to: | | |
| CO1. | Categorize sensors and transducers used in industry. | Understand |
| CO2. | Explain about signal conditioning circuits. | Understand |
| CO3. | Apply IoT design concept on automotive industry. | Understand |
| CO4. | Analyse used of IoT technology in health care industry. | Understand |
| CO5. | Design unmanned aerial vehicles. | Understand |

**TEXT BOOKS:**


1. A.K. Sawhney, "A Course in Electrical and Electronic Measurements and Instrumentation ", Dhanpat Rai & Co. (P) Limited, 2015.
2. Ramon pallas-areny, John G. Webster, sensors and signal Conditioning, A Wiley-Interscience Publication, **, 2001**
3. IoT-Enabled Smart Healthcare Systems, Services and Applications by Shalli Rani, Maheswar Rajagopal, Neeraj Kumar, Syed Hassan Ahmed Shah, John.Wiley & Sons,Inc, 2022.


**REFERENCES:**


1. Jerry Luecke, Analog and Digital Circuits for Electronic Control System Applications,Elsevier Inc., 2005
2. Chimata, Raghuveer, Singh, Rajesh, Singh, Bhupendra, Internet of Things in Automotive Industries and Road Safety, **River Publishers, 2018.**
3. Shalli Rani, Maheswar Rajagopal, Neeraj Kumar, Syed Hassan Ahmed Shah, IoT-Enabled Smart Healthcare Systems, Services and Applications, Wiley, 2022.
4. IoT in Automotive Industry: https://www.biz4intellia.com/blog/iot-applications-in-automotive-industry

## Course Articulation Matrix

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

High-3; Medium-2; Low-1

| Course Code: 19EIEN1035 | Course Title: Data Analytics for IoT | | |
|---|---|---|---|
| **Course Category: Professional Elective** | **Course Level: Mastery** | | |
| **L:T:P(Hours/Week) 3: 0: 0** | **Credits:3** | **Total Contact Hours:45** | **Max Marks:100** |

**Pre-requisites**

- Nil

**COURSE OBJECTIVES:**

1. To learn the concepts of big data analytics.
2. To get exposure on IoT cloud analytics environment.
3. To be familiar with general strategies on IoT analytics.
4. To get exposure on social impact of multimedia.
5. To identify applications that makes use of multimedia Big Data and IoT.

**UNIT - I INTRODUCTION TO TECHNOLOGICAL DEVELOPMENTS 9**

Defining IoT Analytics and Challenges- Defining IoT analytics, IoT analytics challenges, Business value concerns, IoT Devices and Networking Protocols- IoT devices, Networking basics, IoT networking connectivity protocols, Analyzing data, IoT Analytics for the Cloud- Building elastic analytics, Designing for scale, Cloud security and analytics, The AWS, Microsoft Azure, The ThingWorx overview.

**UNIT -II CLOUD ANALYTICS ENVIRONMENT 9**

The AWS Cloud Formation, The AWS Virtual Private Cloud (VPC), terminate and clean up the Environment, data processing for analytics, big data technology to storage, Apache Spark for data processing, Handling change, Exploring and visualizing data, Techniques to understand data quality Techniques to understand data quality, R and RStudio.

**UNIT - III GENERAL STRATEGIES ON EXTRACTING VALUE FROM DATASETS9**

Decorating Your Data, Communicating with Others Visualization and Dash boarding, Applying Geospatial Analytics to IoT Data, Data Science for IoT Analytics- Machine learning (ML), eeplearning.

**UNIT - IV SOCIETAL IMPACT OF MULTIMEDIA BIG DATA 9**

Multimedia Social Big Data Mining, Process Model, SWOT Analysis, Techniques for Social Big Data Analytics, Advertisement Prediction, MMBD Sharing on Data Analytics Platform, Legal/Regulatory Issues.

## UNIT - V APPLICATION ENVIRONMENTS 9

Big Data Computing for IoT Applications-Precision Agriculture, Machine Learning in Improving Learning Environment, Network-Based Applications of Multimedia Big Data Computing, Recent Trends in IoT-Based Analytics and Big Data, Future Directions and Challenges of Internet of Things.

| **Course Outcomes** | | **Cognitive Level** |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Describe big data and IoT. | Understand |
| **CO2.** | Define cloud based IoT analytic environment. | Understand |
| **CO3.** | Apply various Big data strategies. | Understand |
| **CO4.** | Analyse social impact of multimedia big data. | Understand |
| **CO5.** | Design smart IoT systems with big data. | Understand |

**TEXT BOOKS:**


1. Andrew Minteer, “Analytics for the Internet of Things (IoT): Intelligent analytics for yourintelligent devices”, Packt Publishing, first edition, July 2017.
2. Sudeep Tanwar, Sudhanshu Tyagi, Neeraj Kumar, “Multimedia Big Data Computing forIoT Applications: Concepts, Paradigms and Solutions”, Springer, 2020.


**REFERENCES:**


1. John Soldatos, “Building Blocks for IoT Analytics”, River Publishers Series In Signal, Image and Speech Processing, 2017.
2. Nilanjan Dey, Aboul Ella Hassanien, Chintan Bhatt, Amira S. Ashour, Suresh Chandra Satapathy, “Internet of Things and Big Data Analytics Toward Next-Generation Intelligence”, Springer International Publishing, 2018.
3. Stackowiak, R., Licht, A., Mantha, V., Nagode, L.,” Big Data and The Internet of ThingsEnterprise Information Architecture for A New Age”, Apress, 2015.


**Course Articulation Matrix**

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

High-3; Medium-2; Low-1

<table>
<tr><td colspan="2">Course Code: 19EIEN1036</td><td colspan="3">Course Title: IoT for Smart Agriculture</td></tr>
<tr><td colspan="3">Course Category: Professional Elective</td><td colspan="2">Course Level: Mastery</td></tr>
<tr><td>L:T:P(Hours/Week)<br>3: 0: 0</td><td colspan="2">Credits:3</td><td>Total Contact Hours:45</td><td>Max Marks:100</td></tr>
</table>

**Pre-requisites**

- Nil

**COURSE OBJECTIVES:**

1. To understand soil science and sensors used
2. To study about functions of actuators for automation and control.
3. To explain the role of telemetry system in agriculture
4. To impart knowledge on plant heath
5. To learn various technologies used in smart farming system.

**UNIT - I INTRODUCTION TO SOIL SCIENCE AND SENSORS 9**

**Soil Science:** Nature and origin of soil; soil minerals, classification and composition, soil reaction, soil properties including structure, pH, surface tension and soil nutrient.
**Sensors:** Classification and characteristics, Smart sensors, Colorimetry based detection, MEMS Electrochemical Sensors, Dielectric Soil Moisture Sensors, Weather Sensors, Proximity Sensors, Electromagnetic Sensors, Optical Sensors, Mechanical Sensors, Airflow Sensors, Acoustic Sensors, Signal conditioning and converters.

**UNIT -II ACTUATORS FOR AUTOMATION 9**

A.C.-D.C. Motors, Stepper motor, Solenoid actuators, Piezoelectric motors, Electric drives, Hydraulic and Pneumatic actuators. IoT based Automated Irrigation System-IoT based Smart Irrigation.

**UNIT - III TELEMETRY 9**

Wireless communication modules and topology, Zig-bee, Bluetooth, LORA, RFID, Zero power devices, Energy Harvesting technology.

**UNIT - IV PLANT HEALTH MONITORING 9**

Measurement of leaf health, chlorophyll detection, ripeness level, crop mapping, fertilizing, Drone technology for soil field analysis and assistive operations.

**UNIT - V TECHNOLOGIES FOR FARMING 9**

Water quality monitoring, micro-irrigation system, solar pump and lighting system, Fencing, Android based automation, Agricultural Robots, Climate Conditions, Precise Farming(livestock monitoring, vehicle tracking, field observation and inventory monitoring), Smart Greenhouses, Agricultural Drones, Automatic watering system.

| Course Outcomes | | Cognitive Level |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Express nature of soil science and the various sensors used. | Understand |
| **CO2.** | Explain Sensors and actuators used for farming tools. | Understand |
| **CO3.** | Analyse sensor data acquisition and telemetry system. | Understand |
| **CO4.** | Understand plant anatomy and health monitoring system. | Understand |
| **CO5.** | Design advanced technologies for smart farming. | Understand |

**TEXT BOOKS:**


1. Measurement Systems; Application and Design: Doeblin, D.O. McGraw Hill, 1984.
2. The nature and properties of Soils: Eurasia Publishing House Pvt Ltd, New Delhi Brady, Nyle C. (1988).
3. Agricultural Internet of Things and Decision Support for Precision Smart Farming 1st Edition: Annamaria Castrignano, Gabriele Buttafuoco, Raj Khosla, Abdul Mouazen, Dimitrios Moshou, Olivier Naud. Academic Press; 1st edition (January 28, 2020)
4. Cloud IoT Systems for Smart Agricultural Engineering: Saravanan Krishnan, J Bruce Ralphin Rose, N R Rajalakshmi, Narayanan Prasanth. Published February 14, 2022 by Chapman and Hall/CRC


**REFERENCES:**


1. Photo-voltaic energy systems: Design and Installation: Buresch, Mathew. 1983. McGraw-Hill Book Company, New York.
2. Brian Wahlin and Darell Zimbelman, Canal Automation for Irrigation Systems, American Society of Civil Engineers, 2014
3. Darell D.Zimbelman, Planning, Operation, Rehabilitation and Automation of Irrigation water delivery system, American Society of Agricultural Engineers, 1987
*4.* Davcev, D., Mitreski, K., Trajkovic, S., Nikolovski, V., & Koteli, N. (2018, June). IoT agriculture system based on LoRaWAN. In *2018.*
5. Farooq, M. S., Riaz, S., Abid, A., Abid, K., & Naeem, M. A.. A Survey on the Role of IoT in Agriculture for the Implementation of Smart Farming, 2019
6. Balaceanu, C. M., Marcu, I., & Suciu, G.. Telemetry system for smart agriculture, 2019.

## Course Articulation Matrix

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

High-3; Medium-2; Low-1

| | | | |
|---|---|---|---|
| **Course Code: 19EIEN1037** | **Course Title: IoT Security** | | |
| **Course Category: Professional Elective** | | **Course Level: Mastery** | |
| **L:T:P(Hours/Week) 3: 0: 0** | **Credits:3** | **Total Contact Hours:45** | **Max Marks:100** |

**Pre-requisites**

- Nil

**COURSE OBJECTIVES:**

1. To understand the security requirements in IoT.
2. To learn the fundamentals of cryptographic in IoT
3. To understand the working of embedded devices in the IoT
4. To familiarize with IoT protocols in security
5. To realize security issues for various applications using case studies

**UNIT I INTRODUCTION 9**

Introduction to IoT Security — Vulnerabilities, Attacks and Countermeasures. Information Assurance. Attack types. New security threats and vulnerabilities. Fault Trees and CPS. Threat Modeling. Attack, Defense, and Network Robustness of Internet of Things, A Solution-Based Analysis of Attack Vectors on Smart Home Systems.

**UNIT II SECURITY MANAGEMENT & CRYPTOLOGY 9**

Building security in to design and development, Safety and security design, Security Management & Cryptology- Security Controls - Authentication, Confidentiality, Integrity; Access Control, Key Management, Communication and messaging Protocols, Cipher — Symmetric Key Algorithms, Public Private Key Cryptography; Attacks – Dictionary and Brute Force, Lookup Tables, Reverse Look Tables, Rainbow Tables, Hashing – MDS, SHA256. SHA512, Ripe MD, WI, Data Mining.

**UNIT III EMBEDDED DEVICES 9**

Attack Surface and Threat Assessment — Embedded Devices — UART, SPI, I2C, JTAG, Attacks– Software and cloud components, Firmware devices, Web and Mobile Applications.

**UNIT IV IoT PROTOCOLS 9**

IoT Protocol Built-in Security Features – Transport Layer, COAP, UDP, TCP, MQTT,

SSL/TLS, DTLS, LIGHT WEIGHT M2M, XMPP, Zigbee, LoRa, BLE, Kerberos, Cloud security for IoT.

**UNIT V IoT APPLICATIONS 9**

Case Studies and Discussion: Smart Agriculture, Cities, Grid, Healthcare, Smart Homes, smartstreet lighting, Smart building, Smart parking, smart irrigation, Supply Chain, and Transportation, Application of Security Concepts to Create IoT system.

| **Course Outcomes** | | **Cognitive Level** |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Define the security requirements in IoT Architecture. | Understand |
| **CO2.** | Explain the different cryptographic techniques in IoT Security. | Understand |
| **CO3.** | Classify various embedded devices related to IoT. | Understand |
| **CO4.** | Analyze IoT protocols. | Understand |
| **CO5.** | Interpret IoT applications in several fields. | Understand |

**TEXT BOOKS:**


1. Brian Russell, Drew Van Duren, "Practical Internet of Things Security", Packt Publishing Limited, 2nd Edition,2018.
2. Fei Hu, "Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations," CRC Press (Taylor & Francis Group), 2016, ISBN:978-1-4987-23190.
3. Sunil Cheruvu, Anil Kumar, Ned Smith, David M. Wheeler, "Demystifying Internet of Things Security", 2020.


**REFERENCES:**


1. Shancang Li and Li Da Xu, "Securing the Internet of Things", Elsevier, 2017.
2. Sridipta Misra, Muthucumaru Maheswaran, Salman Hashmi, "Security Challenges and Approaches in Internet of Things," Springer, 2016.
3. Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A Hands-on approach," VPT Publishers, 2014, ISBN: 978-0996025515.
4. IoT PROTOCOLS - https://www.avsystem.com/blog/iot-protocols-and-standards/
5. IoT APPLICATIONS - https://www.jigsawacademy.com/top-uses-of-iot/

## Course Articulation Matrix

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

High-3; Medium-2; Low-1

| Course Code: 19EIEN1038 | Course Title: IoT for Smart Cities | | |
|---|---|---|---|
| Course Category: Professional Elective | | Course Level: Mastery | |
| L:T:P(Hours/Week) 3: 0: 0 | Credits:3 | Total Contact Hours:45 | Max Marks:100 |

**Pre-requisites**

- Nil

**COURSE OBJECTIVES:**

1. To know the concept of smart city and associated challenges.
2. To understand latest technologies used in intelligent building.
3. To get familiarization about the role of artificial intelligence for smart city.
4. To understand the importance of water management system.
5. To realize the importance of different smart system.

**UNIT I INTRODUCTION TO IOT FOR SMART CITIES 9**

Introduction-Characteristics of Smart Cities, IoT-Based Solutions for Smart Cities, SmartHome, Transport and Traffic Management, Challenges, Smart City Planning and Management,The Fundamentals of Smart Infrastructure, Role of Machine Learning and Deep Learning in Internet of Things enabled Smart Cities.

**UNIT II TECHNOLOGIES FOR INTERNET OF THINGS 9**

Introduction, Communication Technologies for IoT Networks, Recent Protocols for IoT, Overview OF Secure IoT Architectures, IoT-Based Services for Smart Cities, Cellular Mobile Networks, Cloud Internet of Things, Study of Communication Technologies: Intelligent Traffic System, Disaster Management, Implementation and Comparison of MQTT, WebSocket, and HTTP Protocols for Smart Room IoT Application in Node-RED.

**UNIT III AI FOR SMART CITIES 9**

Overview of Artificial Intelligence, Machine Learning and deep learning algorithms for smart cities, case study: smart street lighting, Smart building, Smart parking, smart irrigation, smart waste and storm water management, Vehicle Payload Monitoring System.

**UNIT IV TRANSPORTATION SYSTEM IN SMART CITY 9**

Traffic Management for Smart Cities , Sensors , Electric Vehicles in Smart Cities, EV

Charging Techniques, Renewable Energy, Smart Distribution Systems, Smart Grid, Traffic Control System for Smart City using Image Processing, An Interactive Analysis Platform for Bus Movement: A Case Study of One of the World's Largest Annual Gathering

**UNIT V SECURITY AND PRIVACY IN SMART CITY 9**

Privacy and Social Values in Smart Cities , Information Security in the Smart City , IoT Security Challenges , Blockchain Technology FOR IoT, Case Studies: Smart Homes, Food Supply Chain Traceability System, smart street lighting, Smart building, Smart parking, smart irrigation, Security and Privacy Threats in IoT-Enabled Smart Cities

| **Course Outcomes** | | **Cognitive Level** |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Relate the necessity of infrastructural development for smart cities | Understand |
| **CO2.** | Explain the components of infrastructure plan for smart city. | Understand |
| **CO3.** | Choose AI based intelligent system in smart city. | Understand |
| **CO4.** | Analyze water resources systems for smart city. | Understand |
| **CO5.** | Construct and work in the smart city projects. | Understand |

**TEXT BOOKS:**


1. Waleed Ejaz, Alagan Anpalagan, Internet of Things for Smart Cities: Technologies, Big Data and Security, 1st ed. Springer International Publishing, 2019.
2. Stimmel, Carol L, Building smart cities: analytics, ICT, and design thinking, Taylor & Francis, 2016.
3. Joel J. P. C. Rodrigues, Parul Agarwal, Kavita Khann, IoT for Sustainable Smart Cities and Society, 2022.


**REFERENCES:**


1. Vincenzo Piuri, Rabindra Nath Shaw, Ankush Ghosh, Rabiul Islam, AI and IoT for Smart City Applications, Springer, 2022.
2. Vincenzo Piuri, Rabindra Nath Shaw, Ankush Ghosh, Rabiul Islam, AI and IoT for Smart City Applications, Springer International Publishing, 2022.
3. Al-Turjman, Fadi, Intelligence in IoT-enabled smart cities, CRC Press, 2019.
4. Artificial Intelligence, Machine Learning, and Deep Learning, Oswald Campesato, Mercury Learning and Information, 2020.
5. Arpan Kumar Kar, M P Gupta, P. Vigneswara Ilavarasan, Yogesh K. Dwivedi, Advances in smart cities : smarter people, governance and solutions CRC Press, 2017.
6. Understanding IoT Security: https://iot-analytics.com/understanding-iot-security-part-1- iot-security-architecture/

7. Hammi, B., Khatoun, R., Zeadally, S., Fayad, A., & Khoukhi, L. IoT technologies forsmart cities, 2018.

**Course Articulation Matrix**

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

High-3; Medium-2; Low-1

| Course Code: 19EIEN1039 | Course Title: IoT and Edge Computing | | |
|---|---|---|---|
| Course Category: Professional Elective | | Course Level: Mastery | |
| L:T:P(Hours/Week)<br>3: 0: 0 | Credits:3 | Total Contact Hours:45 | Max Marks:100 |

**Pre-requisites**

- Nil

**COURSE OBJECTIVES:**

1. To discuss the fundamental concepts of IoT and Edge computing
2. To examine the concept of communication and information theory.
3. To understand edge routing and networking layers.
4. To describe the fog topologies in IoT
5. To Discuss the security issues of protocols in IoT

**UNIT - I IOT AND EDGE COMPUTING 9**

IoT- History, definition, IoT Architecture and Core IoT Modules- Sensing devices, High performance IoT endpoints, Energy sources and power management.

**UNIT -II COMMUNICATIONS AND INFORMATION THEORY 9**

**Communication** theory, Information Theory, The radio spectrum, Non-IP Based WPAN, IP- Based WPAN and WLAN, Long-Range Communication Systems and Edge to Cloud Protocols.

**UNIT - III EDGE COMPUTING 9**

Edge purpose and definition, Edge hardware architectures, Operating systems, Edge platforms Edge Routing and Networking, Edge to Cloud Protocols.

**UNIT - IV CLOUD AND FOG TOPOLOGIES 9**

Cloud services model, Public, private, and hybrid cloud, Constraints of cloud architectures for IoT, Fog computing- Open Fog reference architecture, Fog topologies, Data Analytics and Machine Learning- Basic data analytics, Machine learning- Convolutional neural networks, Recurrent neural networks, IoT data analytics and machine learning comparison

**UNIT - V IOT AND EDGE SECURITY 9**

Cyber security- Attack and threat terms, definitions of different cyber defense mechanisms and technologies, Anatomy of IoT cyber-attacks, Physical and hardware security, Cryptography, Block chain and crypto currencies in IoT, Consortiums and Communities

| Course Outcomes | | Cognitive Level |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Identify the evolving IoT Standards. | Understand |
| **CO2.** | Explain the functions of communication and information theory in IoT. | Understand |
| **CO3.** | Practice the concept of edge computing protocols. | Understand |
| **CO4.** | Analyze the purpose of machine learning in IoT. | Understand |
| **CO5.** | Construct hardware security for IoT applications. | Understand |

**TEXT BOOKS:**


1. Perry Lea, IoT and Edge Computing for Architects Implementing edge and IoT systems from sensors to clouds with communication systems, analytics, and security, 2nd Edition ,Packt Publishing, 2020.
2. Geng, Hwaiyu. "Internet of Things and Data Analytics in the Cloud with Innovation and Sustainability." The Internet of Things & Data Analytics Handbook, 2017.


**REFERENCES:**


1. K. Anitha Kumari, G. Sudha Sadasivam, D. Dharani, M. Niranjanamurthy, Edge Computing Fundamentals, Advances and Applications, CRC Press, 2021.
2. Rajkumar Buyya, Satish Narayana Srirama , Fog and Edge Computing: Principles and Paradigms , Wiley publication, 2019
3. David Jensen, “Beginning Azure IoT **Edge Computing**: Extending the Cloud to the Intelligent **Edge**, MICROSOFT AZURE.
4. Li, H., Ota, K., & Dong, M. Learning IoT in edge: Deep learning for the Internet of Things with edge computing, 2018.
5. Singh, J., Bello, Y., Hussein, A. R., Erbad, A., & Mohamed, A. Hierarchical security paradigm for IoT multi access edge computing, 2020.

**Course Articulation Matrix**

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

High-3; Medium-2; Low-1

## Diversified Electives

| Course Code:19EIEN1001 | Course Title: Industrial Data Communication Networks | | |
|---|---|---|---|
| Course Category: Professional Elective | | Course Level: Mastery | |
| L:T:P(Hours/Week) 3: 0: 0 | Credits:3 | Total Contact Hours:45 | Max Marks:100 |

**Pre-requisites**

- Digital Principles and Applications

**Course Objectives**

The course is intended to:

1. Enumerate the layers of the OSI model and TCP/IP.
2. Summarize the different types of industrial Ethernet.
3. Describe the different standards of industrial protocol.
4. Explain the different types of field bus technology.
5. Illustrate the wireless communication standards and Satellite networks.

**Unit I OSI REFERENCE MODEL 9 Hours**

ISO-OSI model – Layers in the OSI model – Peer to Peer Process –TCP/IP Protocol Suite– TCP/IP comparison with OSI model – Types of TCP/IP addressing

**Unit II INDUSTRIAL ETHERNET 9 Hours**

Introduction – IEEE Standards – Ethernet MAC layer – IEEE 802.2 and Ethernet SNAP – OSI and IEEE 802.3 standard. Ethernet transceivers, Ethernet types, switches and switching hubs, 10 Mbps Ethernet, 100 Mbps Ethernet, Gigabit Ethernet.

**Unit III INDUSTRIAL DATA COMMUNICATION PROTOCOL 9 Hours**

Serial communication Standards: RS232, 422 and 485 – Protocol Structure Overview – Example Function codes. ASCII based protocol - Modbus protocol – Overview. HART Protocol – Overview – Layers

**Unit IV FIELD BUS TRCHNOLOGY 9 Hours**

AS-i Bus - Protocol Stack - CAN bus – Overview – Layers - Profibus – Overview – Protocol Stack. FIP and World FIP - Foundation Field Bus – Layers – Error Detection and Diagnostics – Redundancy

**Unit V** **WIRELESS COMMUNICATION** **9 Hours**

Wireless LANs – IEEE 802.11 standard – Blue Tooth Communication - Wireless WANs – Cellular Telephony: 1G, 2G, 3G and 4G/LTEE,5G – Satellite Networks

| **Course Outcomes** | | **Cognitive Level** |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Understand industrial data communication protocol and standards | Understand |
| **CO2.** | Identify, prevent and troubleshoot industrial data communication problems | Understand |
| **CO3.** | Understand the fieldbus configuration in networking | Understand |
| **CO4.** | Understand the wired and wireless communications used in Process | Understand |
| **CO5.** | Understand industrial data communication protocol and standards | Understand |

**Text Book(s):**


T1. Behrouz A Forouzan, 'Data Communications and Networking', Tata McGraw-Hill, 2013.

T2. William Buchanan, 'Computer Buses- Design and Application', CRC Press, 2000.


**Reference Book(s):**


R1. Theodore S Rappaport, 'Wireless Communications: Principles and Practice', Prentice Hall PTR, Second Edition, 2010.

R2. Stallings,W., "wireless Communication and networks", second Edition, Prentice Hall of India, 2005.

R3. Steve Mackay, Edwin Wright and Deon Reynders, 'Practical Industrial data Networks: Design, Installation and Trouble Shooting', Elsevier International Projects Ltd., 2004.

R4. Nader. F. Mir, "Computer and Communication Networks", Pearson Prentice Hall Publishers, 2010.


**Web References:**


1. http://nptel.ac.in/courses/106105082/
2. http://nptel.ac.in/downloads/106105080/
3. http://sine.ni.com/nips/cds/view/p/lang/en/nid/208382

**Course Articulation Matrix**

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

High-3; Medium-2; Low-1

| Course Code:19EIEN1002 | Course Title: Digital Signal Processing | | |
|---|---|---|---|
| Course Category: Professional Elective | | Course Level: Mastery | |
| L:T:P(Hours/Week) 3: 0: 0 | Credits:3 | Total Contact Hours:45 | Max Marks:100 |

**Pre-requisites**

- Signals and Systems

**Course Objectives**

The course is intended to:

1. Apply DFT for the analysis of digital signals & systems.
2. Apply FFT algorithms for computing DFT.
3. Design IIR filters through analog filter design techniques.
4. Design FIR filters directly.
5. Understand basics of digital signal processors [TMS320X Family].

**Unit I DISCRETE FOURIER TRANSFORM 9 Hours**

Introduction to DTFT – Basic Problems using DTFT - Demerits in DTFT – Introduction to DFT – computational complexity comparison between DTFT & DFT - Properties of DFT - Twiddle factor & Matrix method to calculate DFT -magnitude and phase representations for DFT.

**Unit II FAST FOURIER TRANSFORMS 9 Hours**

FFT Algorithms –Decimation in time FFT Algorithms (DITFFT), Decimation in frequency FFT Algorithms (DIFFFT), IDFT Using FFT Algorithms.

**Unit III IIR FILTER DESIGN 9 Hours**

Introduction to Analog and Digital Filter – Analog filter design: Butterworth Filter and Chebyshev Filter – IIR filter design approximation using Impulse Invariance and Bilinear transformation – Frequency transformations from LPF design to HPF, BPF, BRFs - IIR Filter realizations

**Unit IV FIR FILTER DESIGN 9 Hours**

Introduction to Linear phase FIR filter – Filter design using Fourier series and windowing techniques (Rectangular, Triangular, Hamming, Hanning and Kaiser Windows) - FIR Filter realizations.

**Unit V DIGITAL SIGNAL PROCESSORS 9 Hours**

Introduction to programmable DSPs – Overview of TMS320X family - Architecture (TMS320X) – Features – Addressing Formats – Instruction set of TMS320X family processors.

| Course Outcomes | | Cognitive Level |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Apply DFT for the analysis of digital signals & systems | Understand |
| **CO2.** | Apply FFT algorithms for computing DFT. | Apply |
| **CO3.** | Design IIR filters through analog filter design techniques. | Understand |
| **CO4.** | Design FIR filters directly. | Apply |
| **CO5.** | Understand basics of digital signal processors. | Understand |

**Text Book(s):**


T1. John G. Proakis&Dimitris, G. Manolakis, "Digital Signal Processing – Principles, Algorithms & Applications", Fourth Edition, Pearson Education / Prentice Hall, 2014.

T2. A.V.Oppenheim, R.W. Schafer and J.R. Buck, "Discrete-Time Signal Processing", Third Edition, Pearson, 2011

T3. A.AnandKumar ,"Digital Signal Processing", Second Edition, PHI, 2014.


**Reference Book(s):**


R1. Emmanuel C..Ifeachor, &Barrie.W.Jervis, "Digital Signal Processing", Second Edition, Pearson , 2012

R2. Sanjit K. Mitra, "Digital Signal Processing – A Computer Based Approach", Tata McGraw Hill, 2007

R3. Andreas Antoniou, "Digital Signal Processing", Tata McGraw Hill, 2006


**Web References:**

1. http://nptel.ac.in/courses/117102060/
2. http://www.analog.com/en/design-center/landing-pages/001/beginners-guide-to-dsp.html

**Course Articulation Matrix**

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

High-3; Medium-2; Low-1

<table>
<tr><td colspan="2">Course Code:19EIEN1003</td><td colspan="3">Course Title: VLSI Design</td></tr>
<tr><td colspan="3">Course Category: Professional Elective</td><td colspan="2">Course Level: Mastery</td></tr>
<tr><td>L:T:P(Hours/Week)<br>3: 0: 0</td><td colspan="2">Credits:3</td><td>Total Contact Hours:45</td><td>Max Marks:100</td></tr>
</table>

**Pre-requisites**

- Linear Integrated Circuits
- Digital Electronics

**Course Objectives**

The course is intended to:

1. Describe the VLSI design flow and fabrication Techniques.
2. Explain the characteristics and operation.
3. Design digital circuits.
4. Develop VHDL programs.
5. Explain the different types of fault and testing principles.

**Unit I INTRODUCTION 9 Hours**

VLSI Design process: Design specification- design entry – functional simulation – planning, placement and routing – timing simulation, fabricating into chip- CMOS processing technologies - nWell - pWell - Twin tub - Silicon on insulator.

**Unit II MOS TRANSISTORS AND INVERTERS 9 Hours**

Basic MOS Transistors & Operation: NMOS enhancement transistor - PMOS enhancement transistor - Threshold Voltage-Derivation of Drain Current- Channel length modulation- Body Effect –Trans conductance –MOSFETS as Switches - CMOS Inverter – Latch-up in CMOS Circuit - Power Dissipation in CMOS Circuits.

**Unit III LOGIC DESIGN WITH CMOS 9 Hours**

Combinational Circuit Design: Logic Gates in Static CMOS - Transistor sizing – Stick diagram, Layout diagrams & Design Rules – Ratioed circuits: Pseudo NMOS – cascade voltage switch logic - Dynamic CMOS logic: domino logic, Dual rail Domino Logic –Transmission gate - pass-transistor circuits - Scaling of MOSFETs & its effects.

**Unit IV VHDL PROGRAMMING FOR SUBSYSTEM DESIGN 9 Hours**

Introduction to VHDL: entities, architectures, signals, variables and constants – inertial and transport delay - arrays–operators - functions – procedures – packages and libraries - types of modelling: Structural, dataflow and behavioral modelling –VHDL Programs for simple adders and multipliers –Test Bench - FPGA: Architecture and Programming Technologies

**Unit V TESTING OF DIGITAL CIRCUITS 9 Hours**

Need for testing-Failures and fault-Modelling of fault: Stuck at faults-Bridging faults-Break and transistor stuck on/open faults-Delay faults-temporary Faults-design of testability: Ad-hoc testing, scan design, BIST, IDDQ testing, Boundary scan.

| **Course Outcomes** | | **Cognitive Level** |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Explain the VLSI design flow and CMOS design processes with appropriate fabrication technologies. | Understand |
| **CO2.** | Describe MOS transistors and CMOS inverter with relevant characteristics | Understand |
| **CO3.** | Design various digital circuits using appropriate CMOS logic styles | Understand |
| **CO4.** | Develop VHDL programs for various digital logic circuits using data path elements | Understand |
| **CO5.** | Categorize the faults in VLSI circuits using suitable testing methods. | Understand |

**Text Book(s):**

T1. Neil H. E. Weste, David Harris, “CMOS VLSI Design” (4th edition) Pearson Education, 2015.

T2. Charles H. Roth, Jr., Lizy K. John, “Digital System design using VHDL”,(3rd edition) Cengage Learning, 2016.

T3. Neil H.E. Weste and Kamran Eshraghian, “Principles of CMOS VLSI Design”, Pearson Education ASIS 2nd Edition, 2011.

**Reference Book(s):**

R1. John P. Uyemura J.P, “Introduction to VLSI circuits and systems”, John Wiley and Sons, Inc., 2002.

R2. Eugene D. Fabricius , “Introduction to VLSI design” , McGraw-Hill International Edition, 2011

R3. Douglas A. Pucknell and Kamran Eshraghian, "Basic VLSI Design", Prentice Hall of India Publication, 1995.

R4. Wayne Wolf, “ Modern VLSI Design System on chip”, Pearson Education, 2002

R5. P.K.Lala, “Digital Circuit Testing and Testability”, Academic Press, 2002

**Web References:**

1. http://nptel.ac.in/courses/117106093/
2. http://www.vlsi-expert.com/p/vlsi-basic.html

**Course Articulation Matrix**

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

High-3; Medium-2; Low-1

| Course Code:19EIEN1004 | Course Title: Automotive Electronics | | |
|---|---|---|---|
| Course Category: Professional Elective | | Course Level: Mastery | |
| L:T:P(Hours/Week) 3: 0: 0 | Credits:3 | Total Contact Hours:45 | Max Marks:100 |

**Pre-requisites**

- Electronic devices and circuits
- Embedded system design

**Course Objectives**

The course is intended to:

1. Inculcate knowledge of mechanical system in automotive systems.
2. Understand the electronic system in automobiles.
3. Know the X-by-wire concepts in automobiles.
4. Understand the embedded system applications in automobiles.
5. Disseminate the knowledge of communication protocols used in automobiles.

**Unit I AUTOMOTIVE MECHANICAL SYSTEMS 9 Hours**

Vehicle Systems: Power Train System (Air System, Fuel System (Carburetor& Diesel Fuel Injection, Ignition System, Exhaust System and other Auxiliary Systems (Cooling, Lubrications & Electrical Systems)), Transmission System (Front, Rear & 4-wheel Drive, Manual, Automatic Transmission, Differential). Braking System (Drum, Disc, Hydraulic, Pneumatic), Steering System (Rack and Pinion, Power Steering).

**Unit II ELECTRONICS IN AUTOMOTIVE SYSTEMS 9 Hours**

Performance (Speed, Power, and Torque), Control (Emission, Fuel Economy, Drivability, and Safety) & Legislation (Environmental legislation for pollution & Safety Norms). Overview of Chassis subsystem (ABS, TCS, & ESP) – Comfort and safety subsystems (Night Vision, Airbags, Seatbelt Tensioners, Cruise Control-Lane-departure-warning, Parking).

**Unit III DRIVE BY WIRE 9 Hours**

Challenges and opportunities of X-by-wire: system & design requirements, steer-by-wire, brake-by-wire, suspension-by wire, gas-by-wire, power-by-wire, shift by wire- Future of Automotive Electronics

**Unit IV EMBEDDED SYSTEM IN AUTOMOTIVE APPLICATIONS 9 Hours**

Gasoline / Diesel systems Sensors – Nox sensor, Knock Sensor, MAP Sensor, Oxygen sensor, Throttle Position Sensor- Actuators - Idle speed control valves, Exhaust gas recirculation valves Thermal actuators - Body electronics – Body electronics domain- Central locking and electric windows, Climatic Control - On-Board Diagnostics (OBD). Introduction to electric vehicles- Types of electric vehicles.

**Unit V VEHICLE COMMUNICATION PROTOCOLS 9 Hours**

SPI, I2C, USB communication protocols - Introduction to CAN, LIN, FLEXRAY, MOST, KWP2000. Introduction to AUTOSAR

| **Course Outcomes** | | **Cognitive Level** |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Explain the mechanical systems of automobiles | Understand |
| **CO2.** | Describe the electronic system in automobiles | Understand |
| **CO3.** | Summarize the X-by-wire concepts in automobile | Understand |
| **CO4.** | Outline the embedded system applications in automobiles | Understand |
| **CO5.** | Explain the different communication protocols in embedded system for automobile | Understand |

**Text Book(s):**


T1. Robert Bosch GmbH, "Bosch Automotive Handbook", 10th Edition, Wiley Publishers, 2019

T2. William B. Ribbens, “Understanding Automotive Electronics”, 7th Edition, SAMS/Elsevier Publishing, 2012


**Reference Book(s):**


R1. Robert Bosch Gmbh, Automotive Electrics and Automotive Electronics, Systems and Components, Networking and Hybrid drive, 5th edition, Springer Vieweg, Wiesbaden 2014

R2. Knowles.D, Automotive Electronic and Computer Controlled Ignition Systems, Reston Pub Co,1990

R3. Denton.T , Automobile Electrical and Electronic Systems: Automotive Technology: Vehicle Maintenance and Repair, 2012

R4. JoergSchaeuffele, Thomas Zurawka – Automotive Software Engineering – Principles,

**Web References:**

1. http://nptel.ac.in/courses/117106093/
2. http://www.vlsi-expert.com/p/vlsi-basic.html

**Course Articulation Matrix**

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

High-3; Medium-2; Low-1

| Course Code:19EIEN1005 | Course Title: Image and Video Processing | | |
|---|---|---|---|
| Course Category: Professional Elective | | Course Level: Mastery | |
| L:T:P(Hours/Week) 3: 0: 0 | Credits:3 | Total Contact Hours:45 | Max Marks:100 |

**Pre-requisites**

- Digital Signal Processing

**Course Objectives**

The course is intended to:

1. Explain the basics of Image processing system.
2. Outline the basics of filtering & Demonstrate image segmentation.
3. Elucidate the Image compressing procedure
4. Explain the basics of video processing.
5. Apply various techniques for video processing.

**Unit I Fundamentals of Image processing & Transforms 9 Hours**

Basic steps of Image processing system sampling and quantization of an Image – Basic relationship between pixels Image Transforms: 2 – D Discrete Fourier Transform, Discrete Cosine Transform (DCT), Discrete Wavelet transforms

**Unit II Image Processing Techniques 9 Hours**

Image Enhancement: Spatial Domain methods: Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial filters, Sharpening Spatial filters Frequency Domain methods: Basics of filtering in frequency domain, image smoothing, image sharpening, selective filtering Image Segmentation: Segmentation concepts, point, line and Edge detection, Thresholding, region-based segmentation

**Unit III Image Compression 9 Hours**

Image compression fundamentals – coding Redundancy, spatial and temporal redundancy. Compression models : Lossy and Lossless, Huffmann coding, Arithmetic coding, LZW coding, run length coding, Bit Plane coding, transform coding, predictive coding , wavelet coding, JPEG standards

**Unit IV Basic Steps of Video Processing 9 Hours**

Analog video, Digital Video, Time varying Image Formation models : 3D motion models, Geometric Image formation, Photometric Image formation, sampling of video signals, filtering operations.

**Unit V 2-D Motion Estimation 9 Hours**

Optical flow, general methodologies, pixel based motion estimation, Block matching algorithm, Mesh based motion Estimation, global Motion Estimation, Region based motion estimation, multi resolution motion estimation. Waveform based coding, Block based transform coding, predictive coding, Application of motion estimation in video coding.

| **Course Outcomes** | | **Cognitive Level** |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Apply histogram equalization to images. | Understand |
| **CO2.** | Outline the basics of filtering in the frequency domain &Illustrate the image segmentation of images. | Understand |
| **CO3.** | Summarize the procedure for compressing images. | Understand |
| **CO4.** | Outline the basic steps of video processing | Understand |
| **CO5.** | Describe the operation of video processing | Understand |

**Text Book(s):**


T1. R.C. Gonzalez and R.E. Woods, "Digital Image Processing", Third edition, Prentice Hall,2009.

T2. Yao Wang, JoemOstarmann and Ya-quin Zhang, "Video Processing and Communication", 1st Edition PHI.

T3. T3.William Bolton, "Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering", 5th Edition, PHI, 2013.


**Reference Book(s):**


R1. M. Tekalp," Digital video Processing", Prentice Hall International

R2. William K Pratt, "Digital Image Processing", John Willey, 2001.

R3. A.K. Jain, "Fundamentals of Digital Image Processing", PHI, New Delhi, 2003.

R4. R.C. Gonzalez, R.E. Woods and S.Eddins, "Digital Image Processing using MATLAB",

R5. Peter D symes, "Digital Video Compression", McGraw Hill Professional, 2004.


**Web References:**

1. https://nptel.ac.in/courses/117/105/117105079/
2. https://nptel.ac.in/courses/117/105/117105135/
3. https://nptel.ac.in/courses/117/104/117104020/

## Course Articulation Matrix

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

High-3; Medium-2; Low-1

| Course Code:19EIEN1006 | Course Title: Modern Electronic Instrumentation | | |
|---|---|---|---|
| Course Category: Professional Elective | | Course Level: Mastery | |
| L:T:P(Hours/Week)<br>3: 0: 0 | Credits:3 | Total Contact Hours:45 | Max Marks:100 |

**Pre-requisites**

- Electric Circuits

**Course Objectives**

The course is intended to:

1. Introduce different types of electronic instruments and their applications.
2. Provide knowledge on various types of cathode ray oscilloscopes, their applications and different types of signal analyzers.
3. Introduce different types of waveform generators and analyzers and their applications.
4. Educate on virtual instrumentation, its applications, programming and DAQ cards and modules.
5. Provide exposure to telemetry, modulation techniques and multiplexing.

**Unit I ELECTRONIC INSTRUMENTS 9 Hours**

Introduction – DC Voltmeter – AC Voltmeter using rectifiers – True RMS responding voltmeter – Electronic multimeter – Considerations in choosing an analog voltmeter – Digital Voltmeter - Microprocessor based ramp type DVM – Q Meter – Vector Impedance Meter.

**Unit II CATHODE RAY OSCILLOSCOPE & SIGNAL ANALYZERS 9 Hours**

General purpose cathode ray oscilloscope – Dual trace, dual beam and sampling oscilloscopes– Digital storage oscilloscope – Basic Wave Analyzer – Frequency selective and Heterodyne wave analyzer – Harmonic distortion wave analyzer – Spectrum analyzer.

**Unit III WAVEFORM GENERATORS 9 Hours**

Standard Signal Wave Generator – AF Sine and Square wave generator – Function Generator – Square wave and pulse wave generators – Sweep Generator – Electronic Counters – Light Emitting Diodes – Liquid Crystal Display – Segmental Displays using LED's – Dot Matrix Displays & 3 Digit Alphanumeric Displays.

**Unit IV DATA ACQUISITION SYSTEM 9 Hours**

Introduction to DAS – Signal Conditioning of Inputs – Single Channel DAS – Multi Channel DAS – Computer Based DAS – Data Logger – DAS Applications.

**Unit V TELEMETRY 9 Hours**

General telemetry system – Landline telemetry systems, voltage, current and position telemetry systems – Radio frequency telemetry – Modulation Techniques in Telemetry System – Multiple Access techniques in Telemetry system

| Course Outcomes | | Cognitive Level |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Describe different types of electronic instruments and their applications. | Understand |
| **CO2.** | Explain various types of cathode ray oscilloscopes, their applications and different types of signal analyzers. | Understand |
| **CO3.** | Compare different types of waveform generators and analyzers and their applications. | Understand |
| **CO4.** | Explain the concept of virtual instrumentation, its applications, programming and DAQ cards and modules. | Understand |
| **CO5.** | Explain different types of telemetry system, modulation techniques and multiplexing. | Understand |

**Text Book(s):**


T1. A.D. Helfrick and W.D. Cooper, Modern Electronic Instrumentation and Measurement Techniques, Prentice Hall India Private Ltd., New Delhi, 2015.

T2. H.S. Kalsi, Electronic Instrumentation, 4th edition, Tata McGraw-Hill, New Delhi, 2019.


**Reference Book(s):**


R1. A.K. Sawhney, A Course in Electrical & Electronic Measurements and Instrumentation, DhanpatRai and Co, New Delhi, 2015.

R2. Jerome J., Virtual Instrumentation using Lab VIEW, Prentice Hall India Private Ltd., New Delhi, 2010.

R3. David A Bell, "Electronic Instrumentation and Measurements", Ox for University Press, 2013.

R4. PrithwirajPurkait, B Biswas, S Das, C Koley., "Electrical and Electronics Measurements and Instrumentation", Tata McGraw-Hill, New Delhi, 2017.

R5. J.J. Carr, Elements of Electronic Instrumentation and Measurement, 3rd edition, Pearson Education India, New Delhi, 2011.

R6. M.M.S. Anand, Electronics Instruments and Instrumentation Technology, Prentice Hall India, New Delhi, 2009.

R7. Sanjay Gupta, Virtual Instrumentation using Lab view, Tata McGraw-Hill Education, 2010.

**Web References:**

1. http://iitg.vlab.co.in/?sub=61&brch=174
2. http://nptel.iitg.ernet.in/couses/Elec_Engg/IIT%20Bombay/Electrical%20and%20Electronic%20Measurements.html

**Course Articulation Matrix**

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

High-3; Medium-2; Low-1

| | | | |
|---|---|---|---|
| **Course Code:19EIEN1008** | **Course Title: Smart and Wireless Instrumentation** | | |
| **Course Category: Professional Elective** | | **Course Level: Mastery** | |
| **L:T:P(Hours/Week) 3: 0: 0** | **Credits:3** | **Total Contact Hours:45** | **Max Marks:100** |

**Pre-requisites**

- Industrial Instrumentation
- Microprocessor and Microcontroller

**Course Objectives**

The course is intended to:

1. Provide knowledge on various sensors.
2. Provide knowledge on the project development procedure with communicating devices.
3. Introduce various power harvesting methodologies and power management techniques in WSN.
4. Provide introduction to configure, receive, test and transmit the data using GUI.
5. Provide knowledge on the hardware and software involved in developing the project.

**Unit I SENSORS FUNDAMENTAL 9 Hours**

Sensor Classification -Sensors Parameters - Thermal Sensors-Humidity Sensors-Capacitive Sensors-Planar Inter digital Sensors - Planar Electromagnetic Sensors- Light Sensing Technology - Moisture Sensing Technology - Carbon Dioxide ($CO_2$) Sensing Technology –Smart Sensors - TEDS.

**Unit II WIRELESS SENSORS AND SENSORS NETWORK 9 Hours**

Frequency of Wireless Communication - Development of Wireless Sensor Network Based Project - Wireless Sensor Based on Microcontroller and Communicating device like Zigbee and Bluetooth - ISA 100, Wireless HART.

**Unit III POWER SUPPLIES FOR SENSORS 9 Hours**

Power Sources-Energy Harvesting-Solar and Lead Acid Batteries-RF Energy Harvesting-Energy Harvesting from Vibration-Thermal Energy Harvesting-Energy Management Techniques-Calculation for Battery Selection.

**Unit IV SOFTWARE DESIGN FOR DATA RECEPTION AND ANALYSIS 9 Hours**

Brief Description of API Mode Data Transmission-Testing the Communication between Coordinator and Remote XBee-Design and Development of Graphical User Interface for Receiving Sensor Data Using LabVIEW/C++.

**Unit V WIRELESS SENSOR AND INSTRUMENT APPLICATIONS 9 Hours**

A Brief Review of Signal Processing Techniques for Structural Health Monitoring - WSN Based Physiological Parameters Monitoring System-Intelligent Sensing System for Emotion Recognition-WSN Based Smart Power Monitoring System.

| **Course Outcomes** | | **Cognitive Level** |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Explain the classification of sensors with its operation. | Understand |
| **CO2.** | Describe the project development procedure with communicating devices like Zigbee, ISA100, Wireless HART. | Understand |
| **CO3.** | Analyze the power harvesting methodologies and power management techniques in WSN. | Understand |
| **CO4.** | Illustrate the steps to configure, receive, test and transmit the data using GUI. | Understand |
| **CO5.** | Elucidate the hardware and software involved in developing the project for applications like structural health, physiological, smart power and emotion monitoring. | Understand |

**Text Book(s):**


T1. Subhas Chandra Mukhopadhyay “Smart Sensors, Measurement and Instrumentation”, Springer Heidelberg New York Dordrecht London, 2013

T2. HalitEren, “Wireless Sensors and Instruments: Networks, Design, and Applications”, CRC Press, Taylor and Francis Group, 2006.


**Reference Book(s):**


R1. UvaisQidwai “Smart Instrumentation: A Data Flow Approach to Interfacing” Chapman & Hall; 1 edition December 2013.


**Web References:**

1. http://nptel.ac.in/courses/112103174
2. http://nptel.ac.in/courses/108105064
3. http://nptel.ac.in/courses/112106140

## Course Articulation Matrix

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

High-3; Medium-2; Low-1

| Course Code:19EIEN1011 | Course Title: Automobile and Aircraft Instrumentation | | |
|---|---|---|---|
| Course Category: Professional Elective | Course Level: Mastery | | |
| L:T:P(Hours/Week) 3: 0: 0 | Credits:3 | Total Contact Hours:45 | Max Marks:100 |

**Pre-requisites**

- Engineering Chemistry

**Course Objectives**

The course is intended to:

1. Provide the knowledge on Automobile measuring devices
2. Provide the knowledge on sensors and actuators used in Automobiles
3. Understand the instrumentation for emission system
4. Provide the knowledge on gyroscopic theory for aircraft
5. Impart the knowledge on Aircraft Navigation system

**Unit I MEASURING DEVICES IN AUTOMOBILES 9 Hours**

Selection of measuring instrument, requirements of measurement such as precision, accuracy, errors, sensitivity, readability and reliability – Devices to measure temperature and pressure of the working fluid, coolant, air and fuel flow into the engine - Indicating and integrating instruments – Vibrometer, Accelerometer, vibration and pressure pick-ups, vibration test methods and counters.

**Unit II SENSORS AND ACTUATORS 9 Hours**

Introduction to basic sensor arrangement – types of sensors – Oxygen sensors, crank angle position sensors – Fuel metering / vehicle speed sensor and detonation sensor – Altitude sensor – Flow sensors – Throttle position sensors – Solenoids, stepper motors, relays – Electronic dash board systems – GPS.

**Unit III INSTRUMENTATION FOR EMISSION MEASUREMENT 9 Hours**

Test procedures – NDIR analyzers – Flame ionization detectors – Chemiluminescent analyzers – Gas chromatograph – Smoke meters – Emission – Standards.

**Unit IV FLIGHT INSTRUMENTATION AND GYROSCOPIC INSTRUMENTS 9 Hours**

Classification of aircraft instruments – Instrument displays, panels, cockpit layout – Altimeters – Airspeed indicators – Machmeters – Accelerometers – Gyroscopic theory – Directional gyro indictor – Artificial horizon – Turn and slip indicators.

**Unit V AIRCRAFT COMPUTER SYSTEMS 9 Hours**

Terrestrial magnetism – Aircraft magnetism- Direct reading magnetic components – Compass errors – Gyromagnetic compass – Performance margin indicators – Safe take off indicators - Aircraft take off monitoring systems – Autopilot and navigation systems.

| **Course Outcomes** | | **Cognitive Level** |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Contrast between different automobile measuring devices | Understand |
| **CO2.** | Summarize different sensors and actuators used in automobiles | Understand |
| **CO3.** | Explain the instruments used for emission measurement | Understand |
| **CO4.** | Describe on gyroscopic theory for aircraft | Understand |
| **CO5.** | Recognize the aircraft navigation system | Understand |

**Text Book(s):**

T1. Riddens.B, "Understanding Automotive Electronics", 5th Edition, Butterworth, Heinemann Woburn, 2008

T2. Robert C. Nelson, "Flight stability and Automatic control", 2nd Edition, McGraw Hill International, 1998.

**Reference Book(s):**

R1. Springer and Patterson, "Engine Emission", Plenum Press, 2000.

R2. Pallett E.H.J, "Aircraft Instruments – Principles and Applications", Pitman and sons, 2001.

**Web References:**

1. www.nptel.ac.in

## Course Articulation Matrix

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

High-3; Medium-2; Low-1

| Course Code:19EIEN1014 | Course Title: Thermal and Fluid Mechanics | | |
|---|---|---|---|
| Course Category: Professional Elective | | Course Level: Mastery | |
| L:T:P(Hours/Week)<br>3: 0: 0 | Credits:3 | Total Contact Hours:45 | Max Marks:100 |

**Pre-requisites**

- Nil

**Course Objectives**

The course is intended to:

1. Explain the fundamentals of fluid mechanics thermodynamics
2. Understand basic concepts into various fluid and thermal applications
3. Understand the mechanics of fluids and its properties
4. Describe the transport of mass, momentum and energy
5. Explain the conservation laws of flow through pipes and hydraulic machines.

**Unit I BASIC CONCEPTS AND LAWS OF THERMODYNAMICS 9 Hours**

Classical approach: Thermodynamic systems – Control volume – System and surroundings – Universe – Properties – State–Process – Cycle – Equilibrium – Work and heat transfer – Point and path functions – First law of thermodynamics for open and closed systems – First law applied to a control volume – SFEE equations [steady flow energy equation] – Second law of thermodynamics– Heat engines – Refrigerators and heat pumps – Carnot cycle – Carnot theorem (Qualitative).

**Unit II IC ENGINES & STEAM TURBINE 9 Hours**

Air standard cycles: Otto, diesel and dual cycles and comparison of efficiency – Application of IC engines. Formation of steam – Properties of steam – Use of steam tables and charts – Steam power cycle (Rankine) – Steam turbines: Impulse and reaction principle.

**Unit III COMPRESSORS, REFRIGERATION AND AIR CONDITIONING 9 Hours**

Positive displacement compressors – Reciprocating compressors – Indicated power – Clearance volume – Various efficiencies – Clearance ratio – Volume rate – Conditions for perfect and imperfect inter cooling – Multi stage with inter cooling (Qualitative) – Construction and working principle of centrifugal and axial flow compressors.Refrigeration – Various methods of producing refrigerating effects (RE) – Vapour compression cycle: P–H and T–S diagram – Saturation cycles

– Air–conditioning systems, Types of air conditioning systems – Selection criteria for a particular application.

**Unit IV FLUID PROPERTIES & FLOW THROUGH PIPES 9 Hours**

Dimensions. Properties of fluids – Specific gravity, specific weight, viscosity, compressibility, vapour pressure and gas laws – capillarity and surface tension. Flow characteristics – concepts of system and control volume. Application of control volume to continuity equation, Momentum Equation, Darcy – Weisbach equation. Friction factor. Minor losses. Flow through pipes in series and in parallel.

**Unit V TURBINE & PUMPS 9 Hours**

Homologous units – Specific speed. Theory of turbo machines. Euler"s equation. Hydraulic efficiency. Velocity components at the entry and exit of the rotor – Velocity triangle for single stage radial flow and axial flow machines – Centrifugal pumps, turbines, performance curves for pumps and turbines. Reciprocating pumps – Indicator diagrams, Work saved by air vessels – Rotary pumps – Classification. Working and performance curves

| **Course Outcomes** | | **Cognitive Level** |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Expose the fundamentals of fluid mechanics thermodynamics and to be able to use it in accounting for the bulk behavior of the sample physical systems | Understand |
| **CO2.** | Integrate the basic concepts into various fluid and thermal applications like pumps, turbines, IC engines, steam boiler, steam turbine, compressors, refrigeration and air conditioning. | Understand |
| **CO3.** | Understand the mechanics of fluids through by understanding the properties of fluids. | Understand |
| **CO4.** | Understand the transport of mass, momentum and energy | Understand |
| **CO5.** | Explain the conservation laws of flow through pipes and hydraulic machines. | Understand |

**Text Book(s):**

T1. 1.Khurmi. R.S.& Gupta. J.K., “Thermal Engineering”, S.Chand& Co. Ltd., 2012.

T2. 2.Bansal, R.K., “Fluid Mechanics and Hydraulics Machines”, Laxmi Publications (P) Ltd., New Delhi, 2010

**Reference Book(s):**

R1. 1.Rogers and Mayhew, “Engineering Thermodynamics – Work and Heat Transfer”, Pearson Education Pvt. Ltd., 2006.

R2. Eastop and McConkey, “Applied Thermodynamics”, Pearson Education Pvt. Ltd, 2002.

R3. Nag. P.K., “Engineering Thermodynamics” Tata McGraw Hill, 2003.

R4. Rajput, B.K. Sankaar, “Thermal Engineering”, S.Chand& Co. Ltd., 2003.

R5. Kumar. K.L., “Engineering Fluid Mechanics” Eurasia Publishing House (P) Ltd., 7th edition, 1995.

**Web References:**

1. 1.http://nptel.ac.in/video.php

**Course Articulation Matrix**

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

High-3; Medium-2; Low-1

| Course Code:19EIEN1015 | Course Title: Power Electronics and Drives | | |
|---|---|---|---|
| Course Category: Professional Elective | | Course Level: Mastery | |
| L:T:P(Hours/Week)<br>3: 0: 0 | Credits:3 | Total Contact Hours:45 | Max Marks:100 |

**Pre-requisites**

- Electron Devices
- Electrical Machines and Measurements

**Course Objectives**

The course is intended to:

1. Summarize the characteristics of various power semiconductor devices.
2. Analyze the performance of AC/DC rectifier and DC/DC converter circuits.
3. Describe the various PWM techniques of Inverter and AC/AC converter circuits.
4. Demonstrate the speed control methods of D.C and A.C drives
5. Explain the concept of special Electric Drives

**Unit I POWER SEMI-CONDUCTOR DEVICES 9 Hours**

Study of switching devices: Diode, SCR, TRIAC, MOSFET, IGBT-Static and Dynamic characteristics –Turn ON and OFF characteristics - protection circuit.

**Unit II DC POWER CONVERTER 9 Hours**

Single phase and three phase controlled rectifiers (half and full converters) with R and RL load -estimation of rms load voltage, current and input power factor - Effect of source inductance - Dual Converter.

**Unit III AC POWER CONVERTER 9 Hours**

Inverters: voltage source inverters (120 and180 degree mode) - current source inverters - Harmonic reduction.AC voltage controller: Single phase R and RL load. Cycloconverter: Three phase to single phase and three phase to three phase cycloconverter.

**Unit IV CONTROL OF DC &AC DRIVES 9 Hours**

Selection of drives – Factors influencing the choice of drive – Braking methods –Chopper fed drives – Four quadrant drives –. Voltage control, V/F control of induction motor – VSI and CSI fed drives – Open loop and closed loop control of drives.

**Unit V CONTROL OF SPECIAL DRIVES 9 Hours**

Stepper motor: Driver circuit – Digital Implementation- BLDC motor: Principle of operation- Types - Control of BLDC motor -Microprocessor and DSP based control schemes -Sensor less Control- servomotor: AC and DC control.

| Course Outcomes | | Cognitive Level |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Classify the characteristics of various power semiconductor devices. | Understand |
| **CO2.** | Design AC/DC rectifier and DC/DC converter circuits. | Apply |
| **CO3.** | Compare the different PWM techniques of Inverter and AC/AC converter circuits. | Understand |
| **CO4.** | Illustrate different speed control methods in D.C and A.C drives using thyristor based control schemes. | Understand |
| **CO5.** | Explain Microprocessor based control of Electric Drives | Understand |

**Text Book(s):**

T1. Muhammad H. Rashid, "Power Electronics: Circuits, Devices and Applications", Pearson Education, 3rd Edition, 2013.

T2. M.D.Singh and K.B.Khanchandani, “Power Electronics”, Tata McGraw-Hill, New Delhi,

T3. E.G.Janardanan, ‘Special Electrical Machines’, Prentice Hall of India, 2014.

**Reference Book(s):**

R1. Ned Mohan, T.M.Undeland, W.P.Robbins, "Power Electronics: Converters, applications and design", 3rd Edition, John wiley and Sons, 2006.

R2. Bimal K Bose, “Modern Power Electronics& AC Drives”, PHI Learning PVT. LTD New Delhi,2002.

R3. R. Krishnan, ‘Electric Motor and Drives: Modelling Analysis and Control’, Pearson Education, 2001.

**Web References:**

1. http://www.nptel.ac.in/courses
2. https://onlinelibrary.wiley.com/doi/book/10.1002/9780470547113

**Course Articulation Matrix**

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

High-3; Medium-2; Low-1

<table>
<tr><td colspan="2">Course Code:19EIEN1016</td><td colspan="3">Course Title: Non-Linear Control System</td></tr>
<tr><td colspan="3">Course Category: Professional Elective</td><td colspan="2">Course Level: Mastery</td></tr>
<tr><td>L:T:P(Hours/Week)<br>3: 0: 0</td><td colspan="2">Credits:3</td><td>Total Contact Hours:45</td><td>Max Marks:100</td></tr>
</table>

**Pre-requisites**

- Control Systems

**Course Objectives**

The course is intended to:

1. Understand different nonlinearities and analyse the stability of nonlinear system using phase plane analysis.
2. Derive describing functions for static nonlinearities and predict the stability.
3. Infer the stability properties of nonlinear systems.
4. Acquire knowledge of state feedback and state observer based nonlinear control system design.
5. Describe sliding mode controller

**Unit I PHASE PLANE ANALYSIS 9 Hours**

Features of linear and non-linear systems - Common physical non-linearities – Methods of linearising non-linear systems - Concept of phase portraits – Singular points – Limit cycles – Construction of phase portraits – Phase plane analysis of linear and non-linear systems – Isocline method.

**Unit II DESCRIBING FUNCTION ANALYSIS 9 Hours**

Basic concepts, derivation of describing functions for common non-linearities – Describing function analysis of non-linear systems – Conditions for stability – Stability of oscillations.

**Unit III STABILITY ANALYSIS 9 Hours**

Introduction – Liapunov’s stability concept – Liapunov’s direct method – Lure’s transformation – Aizerman’s and Kalman’s conjecture – Popov’s criterion – Circle criterion.

**Unit IV STATE FEEDBACK AND STATE OBSERVERS 9 Hours**

State Feedback - Gain Matrix - Pole Placement design using State feedback system – State observer Full order Observer-Reduced order observer – Design of state observer system.

**Unit V SLIDING MODE CONTROL 9 Hours**

Variable structure systems - Basic concepts - Sliding modes in variable structure system conditions for existence of sliding regions – Case Study - Sliding mode approach to speed control of dc motors.

| Course Outcomes | | Cognitive Level |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Explain the non-linear system behaviour by phase plane method | Understand |
| **CO2.** | Describe the stability and existence of periodic solutions of nonlinear system through describing functions. | Understand |
| **CO3.** | Apply the stability properties of non-linear system using Liapunov's direct and indirect methods. | Apply |
| **CO4.** | Design the non-linear controller using state feedback and state observer | Apply |
| **CO5.** | Design sliding motor controller for given system | Apply |

**Text Book(s):**


T1. M.Gopal, 'Modern control system theory', New Age International Publishers, Second Edition,2005

T2. Ogata, 'Modern control Design with Matlab and Simulink', John Wiley, New Delhi, 2002


**Reference Book(s):**


R1. Gene F. Franklin, J. David Powell and Abbasemami-Naeini, "Feedback Control of Dynamic Systems", Fourth edition, Pearson Education, Low price edition.2008

R2. J. Nagrath and M. Gopal, 'Control Systems Engineering', New Age International Publishers, 2010.

R3. VadimUtkin, JurgenGuldner, Jingxin Shi, "Sliding Mode Control in Electromechanical System", Taylor and Francis, 1999.

R4. George J. Thaler, 'Automatic Control Systems', Jaico Publishers, 1993.


**Web References:**


1. http://www.nptel.ac.in/courses

## Course Articulation Matrix

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

High-3; Medium-2; Low-1

| Course Code:19EIEN1017 | | Course Title: Digital Control Engineering | |
|---|---|---|---|
| Course Category: Professional Elective | | Course Level: Mastery | |
| L:T:P(Hours/Week) 3: 0: 0 | Credits:3 | Total Contact Hours:45 | Max Marks:100 |

**Pre-requisites**

- Control Systems

**Course Objectives**

The course is intended to:

1. Study the importance of sample data control system.
2. Give adequate knowledge about signal processing in digital control.
3. Study the importance of modeling of discrete systems and stability analysis of discrete data system.
4. Study the importance of state space representation for discrete data system.
5. Introduce the design concept for digital controllers.

**Unit I INTRODUCTION 9 Hours**

Introduction to digital control – Sampling Process – Sample and Hold Circuit – Zero and First Order hold – Z-Transform – Inverse Z- Transform – Region of convergence – Initial and Final Value Theorem.

**Unit II PULSE TRANSFER FUNCTION AND TIME RESPONSE 9 Hours**

Block diagram reduction methods – Reduction Rules- Multi-loop – MIMO Systems – Signal Flow Graph- steady state error – error transfer functions- Error Constants-Time-Domain Analysis of Second Order Systems-Time Response

**Unit III STABILITY ANALYSIS 9 Hours**

Introduction-Jury Stability Test- Schur-Cohn stability Test- Bilinear transformation- Stability by Pole Location – Root locus method- Bode Plot- Nyquist Plot

**Unit IV STATE VARIABLE ANALYSIS 9 Hours**

Review of state space techniques to continuous data systems, state space representation of discrete time systems- Transfer function from state space model-various canonical forms-conversion of transfer function model to state space model-characteristics equation- solution to discrete state equations

**Unit V STATE FEEDBACK CONTROLLER DESIGN 9 Hours**

Controllability and Observability - Response between sampling instants using state variable approach-Pole placement using state feedback. Dynamic output feedback- Effects of finite word length on controllability and closed loop pole placement.

| **Course Outcomes** | | **Cognitive Level** |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Analyze signals in both time domain and Z domain. | Apply |
| **CO2.** | Solve the problems on discrete systems. | Apply |
| **CO3.** | Analyze the real time problems using discrete data system. | Apply |
| **CO4.** | Distinguish the conventional and state variable approaches. | Apply |
| **CO5.** | Design the discrete-date control systems. | Apply |

**Text Book(s):**

T1. Gopal M, “Digital Control and State Variable Methods”, Tata McGraw-Hill Publishing Company Limited, New Delhi, India, Second Edition, 2012.

T2. Katsuhiko Ogata, "Modern Control Engineering", Prentice Hall of India Private Ltd., New

**Reference Book(s):**

R1. Nagrath I J and Gopal M, "Control Systems Engineering", New Age International Publisher, New Delhi, 2010.

R2. Nise S Norman, “Control Systems Engineering”, John Wiley & Sons, Inc, Delhi, Third edition, 2010.

R3. Benjamin C Kuo, “Automatic Control Systems”,John Wiley & Sons, Inc., Delhi, 2009.

R4. Thomas Kailath, “Linear Systems”, Prentice Hall, 1980.

**Web References:**

1. www.gcebargur.ac.in
2. www.goodreads.com/59581
3. nptel.ac.in/courses/108103008/25
4. web.mit.edu/2.14/StateSpace.pdf
5. www.nptelvideos.in/control-engineering.htm

**Course Articulation Matrix**

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

High-3; Medium-2; Low-1

| | | | |
|---|---|---|---|
| **Course Code:19EIEC1001** | **Course Title: Robotics and Automation (Common to EE & EI)** | | |
| **Course Category: Professional Elective** | | **Course Level: Mastery** | |
| **L:T:P(Hours/Week) 3: 0: 0** | **Credits:3** | **Total Contact Hours:45** | **Max Marks:100** |

**Pre-requisites**

- Control Systems

**Course Objectives**

The course is intended to:

1. Describe the anatomy of Robot
2. Explain the sources used to rum the Robot
3. Analyze kinematics and dynamic of robot
4. Develop the program to smooth run of Robot
5. Understand Robot operation used in various Industry application

**Unit I Basic Concepts 9 Hours**

Automation and Robotics – Asimov's laws of Robotics – Robot Anatomy – Basic components of Robot System – classification of Robots by configuration – Robot Motion – Precision of movements – End effectors.

**Unit II Power Sources, Sensors and Drive system 9 Hours**

Actuators – Hydraulic, Pneumatic and Electric drives – Mechanical power transmission system: Bearings, Gears, Belt and Chains – Sensors: Position, Velocity, tactile sensors, Proximity and range sensor – Machine vision: Sensing and digitizing, Image processing and application

**Unit III Kinematics and Dynamics 9 Hours**

Solution for direct and inverse kinematic problem – Robot dynamics – Jacobian work envelops – Robot trajectories – Manipulator path control – Robot cycle time analysis.

**Unit IV Robot Programming 9 Hours**

Methods of Robot programming – lead through programming methods – Robot program as a path in space – Motion interpolation – Wait, signal and delay commands – Branching – Capabilities and limitations – Robot programming examples for pick and place application using VAL.

**Unit V Case studies 9 Hours**

Robots in manufacturing and non-manufacturing application – Robot Cell layout – Selection of Robot – Applications – Material handling, Processing operation, assembly and inspection.

| Course Outcomes | | Cognitive Level |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Explain the various parts of robotics and its automation | Understand |
| **CO2.** | Identify the sensors and systems for developing a robot | Understand |
| **CO3.** | Derive kinematics and dynamic equation for functioning the robot | Understand |
| **CO4.** | Program a Robot using lead through methods. | Understand |
| **CO5.** | Describe the operations of Robot used in industrial automation | Understand |

**Text Book(s):**


T1. MikellP.Groover, Nichols G.Ordy, “Industrial Robotics, Technology, Programming and Applications” McGraw hill, 2005

T2. Fu K.S, Gonzalez and Lee C.S.G, “Robotics Control, Sensing, vision and Intelligence”,


**Reference Book(s):**


R1. Deb.S.R, “Robotics Technology and Flexible Machine Design”, Tata McGraw Hill, 2012


**Web References:**

1. www.nptel.ac.in

**Course Articulation Matrix**

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

High-3; Medium-2; Low-1

| Course Code:19EIEN1021 | Course Title: Instrumentation in Process Industries | | |
|---|---|---|---|
| Course Category: Professional Elective | | Course Level: Mastery | |
| L:T:P(Hours/Week) 3: 0: 0 | Credits:3 | Total Contact Hours:45 | Max Marks:100 |

**Pre-requisites**

- Engineering Chemistry
- Process Control
- Logic and Distributed Control System

**Course Objectives**

The course is intended to:

1. Explain about Petroleum production and the various equipments involved in the petrochemical industries.
2. Describe the chemical reactors and heat exchangers.
3. Illustrate the performance of the pumps and various control loops in Petrochemical Industry.
4. Explain about the Cement manufacturing process.
5. Elaborate the various instrumentation and control loops in Cement industry.

**Unit I INTRODUCTION TO PETROLEUM 9 Hours**

Petroleum exploration – production and refining – constituents of crude oil – P &I diagram of petroleum refinery – atmospheric distillation of crude oil – vacuum distillation process – thermal conversion process – control of distillation column – temperature control.

**Unit II CHEMICAL REACTORS AND HEAT EXCHANGERS 9 Hours**

Temperature control– pressure control – control of dryers – batch dryers – atmospheric and vacuum – continuous dryers – liquid to liquid heat exchangers – steam heaters – condensers – reboilers and vaporizers – evaporators– types of evaporators.

**Unit III EFFLUENT AND WATER TREATMENT CONTROL 9 Hours**

Centrifugal pump – On– Off control – pressure control – flow control – throttling control , rotary pumps – On– Off control – pressure control, reciprocating pump – On– Off control and throttling control – chemical oxidation – chemical reduction – naturalization – precipitation – biological control.

**Unit IV INTRODUCTION TO CEMENT AND BINDING MATERIALS 9 Hours**

History of binding materials and Cement-Classification of Cement Binders- Lime as Binder, cement and its importance in construction- Cement and its Raw Mill Composition- History of Cement manufacturing process- material composition of cement- various unit operation of cement manufacture- the present status and future of cement industry in India.

**Unit V INSTRUMENTATION AND CONTROL IN CEMENT KILNS – CONVEYOR BELT INSTRUMENTATION 9 Hours**

Automatic bagging and bottling – preheater – kiln feed control – kiln speed control – kiln draught control – combustion control – cooler control.

| **Course Outcomes** | | **Cognitive Level** |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Explain about Petroleum production and the various equipments involved in the petrochemical industries. | Understand |
| **CO2.** | Describe the distillation column, reactor, heat exchangers and evaporators. | Understand |
| **CO3.** | Illustrate the performance of the pumps and various control loops in Petrochemical Industry. | Understand |
| **CO4.** | Familiarize with the Cement manufacturing process | Understand |
| **CO5.** | Explain the various instrumentation and control loops in Cement Industry. | Understand |

**Text Book(s):**


T1. Dr. Ram Prasad, “Petroleum Refining Technology”, Khanna Publisher, 1stEdition, 2000.

T2. Liptak B.G, “Instrument Engineers Handbook”, Volume III, 2006.

T3. Waddams A.L., Chemicals from Petroleum, Butter and Janner Ltd., 1968

T4. F M Lea, Arnold, London “Chemistry of Cement and Concrete” 3rd Edition, 1970

**Reference Book(s):**


R1. Liptak. B. G, “Process Control” , Third edition , Chilton Book Company, Pennsylvania, 1995.

R2. Considine. D. M, “Process/Industrial Instruments and control Handbook”, McGraw Hill, 4th edition,1993.

R3. Robert. H, Perry, Green. D.W, and J.O. Maloney, Perry's – “Chemical Engineers Handbook”, McGraw Hill Inc, New York, 7th edition, 1998.


**Web References:**

1. www.nptel.ac.in
2. www.scribd.com/doc/2336259/ABB-Oil-Gas-production-Hand-Book.
3. Norms for limestone exploration for cement manufacture: NCCBM

**Course Articulation Matrix**

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

High-3; Medium-2; Low-1

| | | | |
|---|---|---|---|
| **Course Code:19CSEC1001** | **Course Title: Programming using JAVA (Common to EE,EC & EI)** | | |
| **Course Category: Professional Elective** | **Course Level: Mastery** | | |
| **L:T:P(Hours/Week) 3: 0: 0** | **Credits:3** | **Total Contact Hours:45** | **Max Marks:100** |

**Pre-requisites** The student should have undergone the course(s):

- C Programming
- Data Structures and Algorithms

**Course Objectives**

The course is intended to:

1. Describe the distinct properties and features of Java.
2. Implement name spaces, concurrency and handle exceptional conditions.
3. Employ Java standard library functions.
4. Apply Java utility, input/output functions and file manipulators.
5. Develop Java applications using user interfaces and database connectivity.

**Unit I Introduction** **9 Hours**

Overview of Java – Data types, operators, control flows –Class fundamentals, objects and constructors –Method overloading- argument passing, Returning objects, recursion – Method Overriding and Dynamic Method dispatch- Abstract class.

**Unit II Packages, Exceptions and Threads** **9 Hours**

Packages and access protection – Interfaces and extending interfaces – Exception fundamentals and types – Try, catch, throw, throws and finally; Chained Exceptions – Thread model, Creating threads and thread priorities – Synchronization –Inter thread communication.

**Unit III JAVA Utilities** **9 Hours**

String Handling –String Buffer class and functions – Library Functions – Math – Process – Clone – System Functions.

**Unit IV Collections and I/O Streams** **9 Hours**

Collections – Classes and Interfaces – Iterators and User defined collections – String Tokenizer – Java I/O classes and Interfaces - Streams – Byte Streams - Character Streams – File concepts.

**Unit V Exploring Swing**

**9 Hours**

Java Swing – Features –Components and Containers – Event handling – Exploring Swing – Menus – Java Database Connectivity.

| **Course Outcomes** | **Cognitive Level** |
|---|---|
| At the end of this course, students will be able to: | |
| CO1: Describe the distinct properties and features of Java. | Understand |
| CO2: Implement name spaces, concurrency and handle exceptional conditions inprograms. | Apply |
| CO3: Employ Java standard library functions for solving complex problems. | Apply |
| CO4: Apply Java utility, input/output functions and file manipulators | Apply |
| CO5: Develop Java applications using user interfaces and database connectivity | Apply |

**Text Book(s):**

T1. Herbert Schildt, "Java the Complete Reference", Mcgraw Hill EducationNinth Edition, 2014

T2. Mahmoud Parsian, "JDBC Metada, MySQL and Oracle Recipes: A Problem-Solution Approach", Apress Publications, 2006

**Reference Book(s):**

R1. Bart Baesens, Aimee Backiel, SeppeVandenBrocke, "Beginning JavaProgramming: The Object Oriented Approach", John Wiley & Sons, 2015.

R2. Daniel Liang, "Introduction to Java Programming, Comprehensive Version", Pearson Education, 9th Edition, 2014.

R3. James M Slack, Programming and Problem solving with JAVA, ThomsonLearning, 2002.

R4. C Thomas Wu, An Introduction to Object Oriented programming with Java, Tata McGrawHill, 2005.

R5. Cay S. Horstmann and Gary Cornell, "Core Java: Volume I – Fundamentals", 8th Edition, Sun Microsystems Press, 2008.

**Web References:**

1. https://docs.oracle.com/javase/tutorial/java/index.html
2. http://javabeginnerstutorial.com/core-java/
3. http://www.w3schools.in/java/

**Course Articulation Matrix**

| CO | PO 1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO1 0 | PO1 1 | PO1 2 | PSO 1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 1 | - | - | - | - | - | 1 | - | 1 | - | - | 1 | - |
| **CO2** | 3 | 2 | 1 | 1 | - | - | - | 1 | - | 1 | - | - | 1 | - |
| **CO3** | 3 | 2 | 1 | 1 | - | - | - | 1 | - | 1 | - | - | 1 | - |
| **CO4** | 3 | 2 | 1 | 1 | - | - | - | 1 | - | 1 | - | - | 1 | - |
| **CO5** | 3 | 2 | 1 | 1 | - | - | - | 1 | - | 1 | - | - | 1 | - |

High-3; Medium-2;Low-1

| | | | |
|---|---|---|---|
| **Course Code:19CSEC1002** | **Course Title :Data Mining And Analytics (Common to EE,EC & EI)** | | |
| **Course Category: Professional Elective** | | **Course Level: Mastery** | |
| **L:T:P(Hours/Week) 3: 0: 0** | **Credits:3** | **Total Contact Hours:45** | **Max Marks:100** |

**Pre-requisites:** The student should have undergone the course(s):

- C Programming
- Data Structures and Algorithms

**Course Objectives**

The course is intended to:

1. Select the appropriate pre-processing technique.
2. Relate the techniques of association rule.
3. Evaluate the classification algorithms.
4. Apply the clustering algorithms.
5. Analyze the requirements for a big data analytics.

**Unit I Data Preprocessing** **9 Hours**

Data Mining Overview – Data Objects and Attribute Types – Data Visualization. Data Pre-processing: Data Cleaning – Data Integration – Data Reduction – Data Transformation and Data Discretization.

**Unit II Association** **9 Hours**

Mining Frequent Patterns, Associations, and Correlations: Basic Concepts and Methods –Basic Concepts – Frequent Item set Mining Methods – Pattern Evaluation Methods. Advanced Pattern Mining: Pattern Mining: A Road Map – Pattern Mining in Multilevel, Multidimensional Space.

**Unit III Classification** **9 Hours**

Basic Concepts: Decision Tree Induction – Bayes Classification Methods – Rule Based Classification – Model Evaluation and Selection – Techniques to Improve Classification Accuracy.

**Unit IV Clustering** **9 Hours**

Cluster Analysis: Partitioning Methods – Hierarchical Methods – Density Based Methods – Grid Based Methods – Evaluation of Clustering.

**Unit V Introduction to Big Data** **9 Hours**

Introduction to Big Data: Classification of Digital Data – Characteristics, Evolution and Definition of Big data - Challenges with Big Data – Traditional Business Intelligence (BI) vs Big Data – The Big Data Technology Landscape: Hadoop. Introduction to Hadoop: Hadoop Overview – Hadoop Distributors - Hadoop Distributed File System.

| **Course Outcomes** | **Cognitive Level** |
|---|---|
| At the end of this course, students will be able to: | |
| CO 1.Choose the appropriate pre-processing technique to solve the given problem. | Apply |
| CO 2.Apply the techniques of association rule to real world data. | Apply |
| CO 3.Evaluate the classification algorithms with respect to their accuracy. | Apply |
| CO 4.Apply the clustering algorithms to group the real world data. | Apply |
| CO 5.Analyze the requirements for a big data analytics system for the organization. | Apply |

**Text Book(s):**


T1. Jiawei Han, MichelineKamber, Jian Pei, "Data Mining: Concepts and Techniques", 3rd Edition, Elsevier, 2012.

T2. SeemaAcharya, SubhashiniChellappan, "Big Data and Analytics", 1st Edition, Wiley India, 2015.


**Reference Book(s):**


R1. Jure Leskovec, AnandRajaraman, Jeffery David Ullman, "Mining of Massive Datasets", 2nd Edition, Cambridge University Press, 2014.

R2. Ian H.Witten, Eibe Frank, Mark A.Hall, "Data Mining: Practical Machine Learning Tools and Techniques", 3rd Edition, Elsevier, 2011.

R3. EMC Education Services, "Data Science and Big Data Analytics", Wiley, 2015.

R4. DT Editorial Services, "Black Book- Big Data (Covers Hadoop 2, MapReduce, Hive, Yarn, PIG, R, Data visualization)", Dream tech Press edition 2016

R5. G. K. Gupta, "Introduction to Data Mining with Case Studies", Eastern Economy Edition, Prentice Hall of India, 2006.


**Web References:**


1. http://hanj.cs.illinois.edu/bk3/bk3_slidesindex.html
2. http://www.mmds.org/
3. http://www.kdnuggets.com/tutorials/index.html

**Course Articulation Matrix**

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

High-3; Medium-2;Low-1

| | | | |
|---|---|---|---|
| Course Code:19CSEC1003 | Course Title: Software Testing (Common to EE,EC & EI) | | |
| Course Category: Professional Elective | | Course Level: Mastery | |
| L:T:P(Hours/Week) 3: 0: 0 | Credits:3 | Total Contact Hours:45 | Max Marks:100 |

**Pre-requisites** The student should have undergone the course(s):

- C Programming
- Data Structures and Algorithms

**Course Objectives**

The course is intended to:

1. Describe the software testing principles and its characteristics.
2. Choose the appropriate testing for software development.
3. Design Test cases suitable for a software development in various domains.
4. Justify the importance of planning, documenting and validating the test plan.
5. Illustrate the need for automatic testing tools.

**Unit I Testing Fundamentals** **9 Hours**

Introduction to testing as Engineering Activity –Testing Fundamentals: Basic Definitions- Testing principles-Tester's role –Defects, Hypotheses and Tests.

**Unit II Levels of Testing** **9 Hours**

The need for levels of Testing- Unit Test: Functions, Procedures, Classes, and Methods as Units- Unit Test: The Need for Preparation- Unit Test Planning- Designing the Unit Tests- Running the Unit Tests and Recording Results- Integration Test: Goals- Integration Strategies for Procedures and Functions- Integration Strategies for Classes- Designing Integration Tests- Integration Test Planning- System Test: The Different Types- Regression Testing- Alpha, Beta, and Acceptance Tests.

**Unit III Designing Test Cases** **9 Hours**

Test case design strategies-Using Black Box approach to Test Case design-Random Testing –Equivalence class partitioning –Boundary value Analysis-Cause effect testing and state transition testing-Error Guessing - Using White Box Approach to Test case design – Test Adequacy Criteria –Coverage and Control Flow Graphs – Covering Code Logic – Paths –Additional test design approaches- code complexity testing – Evaluating Test Adequacy Criteria.

**Unit IV Test Management** **9 Hours**

Test Planning: Preparing a plan – scope management – deciding test strategy – responsibilities –resource requirements – test deliverables –testing tasks – Test management: standards – infrastructure management- People management – product release - Test Process – Test Reporting.

**Unit V Test Automation** **9 Hours**

Test Automation – Terms – Skills required – Scope of automation- Design and Architecture for Automation – Process Model – Selecting Test tools – automation for extreme Programming- Test Metrics and Measurements.

| **Course Outcomes** | **Cognitive Level** |
|---|---|
| At the end of this course, students will be able to: | |
| CO1: Describe the software testing principles and its characteristics. | Understand |
| CO2: Choose the appropriate testing during the phases of software development. | Apply |
| CO3: Design Test cases suitable for a software development in various domains. | Apply |
| CO4: Justify the importance of planning, documenting and validating the test plan. | Apply |
| CO5: Illustrate the need for automatic testing tools. | Apply |

**Text Book(s):**


T1.Ilene Burnstein,"Practical Software Testing: A Process-Oriented Approach", Springer International Edition, 2013

T2.Srinivasan Desikan and Gopalaswamy Ramesh, "Software Testing – Principles and Practices", Pearson Education, 2006.


**Reference Book(s):**


R1.Ron Patton, "Software Testing", Sams Publishing, Pearson Education, 2ndEdition, 2009

R2.Boris Bezier, "Software Testing Techniques",Dreamtech,2nd Edition, Reprint 2009

R3.Aditya P. Mathur, "Foundations of Software Testing: Fundamental Algorithms and Techniques",Pearson Education, 2008.

R4.Edward Kit," Software Testing in the Real World – Improving the Process", Pearson Education, 1995.

R5.RenuRajani, Pradeep Oak, "Software Testing – Effective Methods, Tools and Techniques", Tata McGraw Hill, 2004.


**Web References:**

1. 1.http://nptel.ac.in/courses/106105150/
2. Lecturehttps://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-00-introduction-to-computer-science-and-programming-fall-2008/video-lectures/lecture-11/
3. http://www.testingtools.com/

**Course Articulation Matrix**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 2 | 1 | - | - | - | - | - | 1 | - | 1 | - | - | 1 | 1 |
| CO 2 | 3 | 2 | 1 | 1 | - | - | - | 1 | - | 1 | - | - | 1 | 1 |
| CO 3 | 3 | 2 | 1 | 1 | - | - | - | 1 | - | 1 | - | - | 1 | 1 |
| CO 4 | 3 | 2 | 1 | 1 | - | - | - | 1 | - | 1 | - | - | 1 | 1 |
| CO 5 | 3 | 2 | 1 | 1 | - | - | - | 1 | - | 1 | - | - | 1 | 1 |

High-3; Medium-2;Low-1

| | | | |
|---|---|---|---|
| **Course Code:19CSEC1004** | **Course Title: Database Management System Concepts (Common to EE,EC & EI)** | | |
| **Course Category: Professional Elective** | | **Course Level: Mastery** | |
| **L:T:P(Hours/Week)3: 0: 0** | **Credits:3** | **Total Contact Hours:45** | **Max Marks:100** |

**Pre-requisites:** The student should have undergone the course(s):

- C Programming
- Data Structures and Algorithms

**Course Objectives**

The course is intended to:

1. Construct the Entity Relationship Model.
2. Convert ER diagram to relational database schema.
3. Relate the normalization technique to obtain the relational database design.
4. Choose a query evaluation and optimization technique.
5. Execute the online transactions and control concurrency.

**Unit I An Overview of Database Systems 9 Hours**

Introduction – Database system applications, Database versus file systems, View of data, Data models, Database languages, Database users and administrators, Database system structure, Entity – Relationship Model – Basic concepts, Constraints, Keys, Design issues, ER diagram, Weak entity sets, Design of an ER database schema.

**Unit II Data Models 9 Hours**

Relational model - Structure of relational databases – The relational algebra –Tuple relational calculus, Domain relational calculus, SQL – Background, Basic structure, Set operations, Aggregate functions, Null values, Nested sub queries, Views, Joined relations, DDL, Embedded SQL, Dynamic SQL, Integrity and security – Domain constraints, Referential integrity, Assertions, Triggers.

**Unit III Relational Databases Design 9Hours**

Relational database design – First normal form, Second normal form - Pitfalls in relational database design, Functional dependencies, Decomposition, Desirable properties of decomposition, BCNF, Third normal form, Fourth normal form.

**Unit IV Indexing and Querying 9 Hours**

Indexing and hashing – Basic concepts, Ordered indices, B+ tree index files, B tree index files – Static hashing, Dynamic hashing, Comparison of ordered indexing and hashing, Multiple key access - Query Processing – Overview, Measures of query cost, Selection operation, Sorting, Join operation - Query Optimization – Overview, Estimating statistics of expression results, Transformation of relational expressions

**Unit V Transaction and Concurrency Control** **9 Hours**

Transactions – Transaction concept, Transaction state, Implementation of atomicity and durability, Concurrent executions, Serializability, Recoverability, Testing for serializability - Concurrency control – Lock based protocols, Timestamp based protocols, Validation based protocols, Multiple granularity, Multiversion schemes.

| **Course Outcomes** | **Cognitive Level** |
|---|---|
| At the end of this course, students will be able to: | |
| CO1: Construct the Entity Relationship Model for obtaining the structure of a database | Apply |
| CO2: Convert ER diagram to relational database schema | Apply |
| CO3: Apply the normalization technique to obtain the relational database design. | Apply |
| CO4: Select a query evaluation and optimization technique for a given query. | Apply |
| CO5: Implement online transactions and control concurrency | Apply |

**Text Book(s):**

T1. Silberschatz, Korth, Sudarshan, “Database System Concepts”, 6th Edition, McGrawHill International Edition, New Delhi 2010

T2. Date C.J., Kannan A, Swaminathan S, “An introduction to database systems”, 8th Edition, Pearson Education, New Delhi, 2009.

**Reference Book(s):**

R1. Elmasri, R., Navathe, S.B., “Fundamentals of database systems”, 6th Edition, Pearson Education, New Delhi, 2010.

R2. Raghu Ramakrishnan, Johannes Gehrke. “Database Management Systems”, 3rd Edition, McGrawHill International Edition, New Delhi 2007.

R3. Bipin C Desai, “An Introduction to Database Systems”, Eleventh Edition, Galgotia Publications Pvt. Ltd., New Delhi, 2001.

R4. Bipin C Desai, “An Introduction to Database Systems”, 11th Edition, Galgotia Publications Pvt. Ltd., New Delhi, 2001.

R5. JefreyD.Ulman and Jenifer Widom, “A First Course in Database Systems”, 3rd Edition, Prentice-Hall, New Delhi, 2007.

R6. C.J.Date, A.Kannan and S.Swamynathan, “An Introduction to Database Systems”, 8th Edition, Pearson Education, 2006.

**Web References:**

1. https://onlinecourses.nptel.ac.in/noc16_ma05
2. http://codex.cs.yale.edu/avi/db-book/db6/slide-dir/
3. www.nptelvideos.in/2012/11/database-management-system.html

**Course Articulation Matrix**

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

High-3; Medium-2;Low-1

<table>
<tr><td colspan="2">Course Code:19CSEN1001</td><td colspan="2">Course Title: Introduction to Python Programming</td></tr>
<tr><td colspan="2">Course Category: Professional Elective</td><td colspan="2">Course Level: Mastery</td></tr>
<tr><td>L:T:P(Hours/Week)<br>3: 0: 0</td><td>Credits:3</td><td>Total Contact Hours:45</td><td>Max Marks:100</td></tr>
</table>

**Pre-requisites** The student should have undergone the course(s):

- C Programming
- Data Structures and Algorithms

**Course Objectives**

The course is intended to:

6. Identify various syntax and operators in python programming.
7. Illustrate control flow, library functions and file operations.
8. Implement object oriented features in python.
9. Apply database connectivity technique.
10. Design user interfaces.

**Unit I Programming Constructs** **9 Hours**

Basics: Data Types – Declaring variables - Usage of Operators- Special functions - Python standards in Coding. Sequential Statements - Control statements - Performing Iterations – Strings - Tuples-Sets - Dictionary.

**Unit II Functions** **9 Hours**

Functions: Defining & Calling function- Passing arguments to functions: Mutable & Immutable Data Types - Different types of arguments-Recursion-Scope of variables. Standard Library: Math, String, List, Date & Time Modules. Files: Open- Close- Write- Read.

**Unit III OOP in python** **9 Hours**

Classes - Objects – Modifiers - Method Invocation – Inheritance – Polymorphism - Packages - Scopes and Namespaces - Interface - Exception Handling.

**Unit IV Database Programming** **9 Hours**

DBM files - Pickled objects - Shelve files - Object Oriented Database - SQL Database interfaces

**Unit V GUI Programming** **9 Hours**

GUI basics-Working with TKinter library- Adding widgets-Binding Events- Message and Entry-Check and Radio button- Menus and list-Canvas

| Course Outcomes | Cognitive Level |
|---|---|
| At the end of this course, students will be able to: | |
| CO6: Identify various syntax and operators in python programming for writing simpleprograms. | Apply |
| CO7: Illustrate control flow, library functions and file operations using user-defined and pre-defined functions. | Apply |
| CO8: Implement object oriented features in python for writing reusable codes. | Apply |
| CO9: Apply database connectivity technique for real time applications. | Apply |
| CO10: Design user interfaces using python based GUI components | Apply |

**Text Book(s):**

T1. Peter Wentworth, Jeffrey Elkner, Allen B. Downey, and Chris Meyers, "How to ThinkLike a Computer Scientist: Learning with Python", 3rd Edition, O'Reilly, 2014.

T2. MarkLutz,"Powerful Object Oriented Programming Python", 4th Edition, O'Reilly2012.

**Reference Book(s):**

R1. Mark Lutz, "Learning Python, Powerful OOPs", O'Reilly, 2011.

R2. Zelle, John M, "Python Programming: An Introduction to Computer Science", Franklin Beedle& Associates, 2003.

R3. Budd, Timothy, "Exploring Python", McGraw-Hill Science, 2009.

R4. Matplotlib for Python Developers: Effective techniques for data visualization with Python, 2nd Edition, Kindle Edition.

**Web References:**

1. 1.Python tutorial URL:https://docs.python.org/3/tutorial/
2. Advanced Python URL:https://www.learnpython.org/
3. Python basic tutorial URL:www.pyschools.com/
4. 4.Data Visualization https://www.datacamp.com/courses/introduction-to-data-visualization-with-python/

**Course Articulation Matrix**

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

High-3; Medium-2;Low-1

<table>
<tr><td colspan="2">**Course Code:19EEEC1004**</td><td colspan="2">**Course Title: Disaster Management (Common to EE,EC & EI)**</td></tr>
<tr><td colspan="2">**Course Category: Professional Elective**</td><td colspan="2">**Course Level: Mastery**</td></tr>
<tr><td>**L:T:P(Hours/Week) 3: 0: 0**</td><td>**Credits:3**</td><td>**Total Contact Hours:45**</td><td>**Max Marks:100**</td></tr>
</table>

**Pre-requisites**

- Communication Skills - I
- Communication Skills - II

**Course Objectives**

The course is intended to:

1. Understand the natural and manmade disasters
2. Illustrate the environment hazards and level of toxicology
3. Describe the causes and effects of Earthquake and Tsunami formation
4. Elucidate the causes and effects of Cyclone formation
5. Explain about modern technological tools in disaster management

**Unit I IINTRODUCTION 9 Hours**

Disaster- Disaster management- Disaster prevention and preparedness measures-Types of Disaster – Causal factor of Disaster – Natural, Manmade, creeping disaster-Disaster in the Indian context various measures – Disaster related policy goals – United Nations Development Program (UNDP) – United Nations Disaster Relief Organization (UNDRO) – Govt. of India.

**Unit II ENVIRONMENTAL DISASTER 9 Hours**

Environmental hazards – Typology – Assessment and response – the strategies– the scale of disaster – Vulnerability – Disaster trends – Paradigms towards a balanced view – Chemical hazards and Toxicology – Biological hazards –Hazard caused by world climate change – Risk analysis – other technological disasters.

**Unit III EARTHQUAKE AND TSUNAMI 9 Hours**

Earthquake – Causes of earthquake – Earthquake scales – Measures of earth –quake – Magnitude and Intensity – Earthquake Recurrence hazard assessment –Seismic zoning – Earthquake disaster mitigation – Component research focus –Forecasting techniques and Risk analysis – Tsunami – Causes of Tsunami –Effects of Tsunami – Tsunami warning system – Tsunami warning system in India – International status of Tsunami warning and communication system –Tsunami warning centers – Pacific Tsunami Warning Center (PTWC) – Pacific Tsunami Warning System (PTWS) components – Institutional arrangements and design criteria for Tsunami mitigation.

**Unit IV CYCLONE 9 Hours**

Tropical cyclone - Warning system – Protection of buildings from cyclones - Precaution before and during cyclones – Tropical cyclone warning strategy in India – Cyclone related problems – aerial survey – Management strategy – risk reduction by public awareness and education.

**Unit V APPLICATION OF TECHNOLOGY IN DISASTER MANAGEMENT 9 Hours**

Hazard map – Multi hazard mapping – Application of satellites in Disaster Management – Application of remote sensing in forecasting and disaster relief –Use of digital image processing in disaster management – GIS in disaster management – Spatial data – GIS data base design – Convention mapping concepts and Coordinate system – Methods of spatial Interpolation in GIS.

| **Course Outcomes** | | **Cognitive Level** |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Distinguish the natural and manmade disasters | Understand |
| **CO2.** | Explain the environment hazards and level of toxicology | Understand |
| **CO3.** | Explain the causes and effects of Earthquake and Tsunami formation | Understand |
| **CO4.** | Elucidate the causes and effects of Cyclone formation | Understand |
| **CO5.** | Describe about modern technological tools in disaster management | Understand |

**Text Book(s):**


T1. PardeepSahni, Madhavimalalgoda and Ariyabandu, “Disaster risk reduction in south Asia”, PHI 2010.

T2. AmitaSinhal, “Understanding earthquake disasters” TMH, 2010.


**Reference Book(s):**


R1. Jeff Groman, “The atlas of Natural Disasters”, Friedman/Fairfax publishing, 2002

R2. 3.Jaikrishna and Chandrasekar, Elements of Earthquake Engineering, 2007


**Web References:**


1. www.nptel.ac.in

## Course Articulation Matrix

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

High-3; Medium-2; Low-1

<table>
<tr><td colspan="2">Course Code:19MEEC1014</td><td colspan="2">Course Title: Engineering Economics and Cost Analysis (Common to EE,EC,AU.ME & EI)</td></tr>
<tr><td colspan="2">Course Category: Professional Elective</td><td colspan="2">Course Level: Mastery</td></tr>
<tr><td>L:T:P(Hours/Week)<br>3: 0: 0</td><td>Credits:3</td><td>Total Contact Hours:45</td><td>Max Marks:100</td></tr>
</table>

**Pre-requisites**

- Engineering Mathematics - I
- Engineering Mathematics - II

**Course Objectives**

The course is intended to:

1. Explain different cost and calculate the breakeven point for a given business situation
2. Understand different interest formulae and their application in decision making process.
3. Evaluate present value, future value and annual worth analysis on one or more economic alternatives.
4. Determine the economic value of an asset and develop a better replacement policy for a given equipment.
5. Evaluate the depreciation of equipment per period.

**Unit I INTRODUCTION TO ECONOMICS 9 Hours**

Introduction to Economics- Flow in an economy, Law of supply and demand, Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics - Elements of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis- V ratio, Elementary economic Analysis

**Unit II VALUE ENGINEERING 9 Hours**

Make or buy decision, Value engineering – Function, aims, and Value engineering procedure. Interest formulae and their applications –Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series payment Present worth factor- equal payment series capital recovery factor-Uniform gradient series annual equivalent factor, Effective interest rate, Examples in all the methods with problems.

**Unit III CASH FLOW 9 Hours**

Methods of comparison of alternatives – present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), rate of return method, Examples in all the methods.

**Unit IV REPLACEMENT AND MAINTENANCE ANALYSIS 9 Hours**

Replacement and Maintenance analysis – Types of maintenance, types of replacement problem, determination of economic life of an asset, Replacement of an asset with a new asset – capital recovery with return and concept of challenger and defender, Simple probabilistic model for items which fail completely.

**Unit V DEPRECIATION 9 Hours**

Depreciation- Straight line method of depreciation, declining balance method of depreciation-Sum of the years digits method of depreciation, sinking fund method of depreciation/ Annuity method of depreciation, service output method of depreciation- Evaluation of public alternatives-introduction, Examples, Inflation adjusted decisions – procedure to adjust inflation, Examples on comparison of alternatives and determination of economic life of asset. Case study

| **Course Outcomes** | | **Cognitive Level** |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Categorize different cost and calculate the breakeven point for a given business situation | Understand |
| **CO2.** | Apply different interest formulae and their application in decision making process. | Apply |
| **CO3.** | Evaluate present value, future value and annual worth analysis on one or more economic alternatives. | Evaluate |
| **CO4.** | Determine the economic value of an asset and develop a better replacement policy for a given equipment. | Understand |
| **CO5.** | Evaluate the depreciation of equipment per period. | Evaluate |

**Text Book(s):**


T1. Panneerselvam R, "Engineering Economics", Prentice Hall of India Ltd, NewDelhi, 2014

T2. Chan S.Park, "Contemporary Engineering Economics", Prentice Hall of India, 2010.


**Reference Book(s):**


R1. Donald.G. Newman, Jerome.P.Lavelle, "Engineering Economics and analysis" Engg. Press, Texas, 2010.

R2. Degarmo, E.P., Sullivan, W.G and Canada, J.R, "Engineering Economy", Macmillan, New York, 2010.

<table>
<tr><td colspan="2">Course Code:19MEEC1015</td><td colspan="3">Course Title: Principles of Management (Common to ME,EE,EC & EI)</td></tr>
<tr><td colspan="3">Course Category: Professional Elective</td><td colspan="2">Course Level: Mastery</td></tr>
<tr><td>L:T:P(Hours/Week)<br>3: 0: 0</td><td colspan="2">Credits:3</td><td>Total Contact Hours:45</td><td>Max Marks:100</td></tr>
</table>

**Pre-requisites**

- Communication Skills - I
- Communication Skills - II

**Course Objectives**

The course is intended to:

1. Describe the overview of management
2. Explain the planning process, policy and decision making
3. Explain the human resource structure and policy
4. Explain the motivational theories for management
5. Explain the control techniques for operations

**Unit I OVERVIEWOFMANAGEMENT 9 Hours**

Organization – Management – Role of managers – Evolution of Management thought – Organization and the environmental factors – Managing globally – Strategies for International Business.

**Unit II PLANNING 9 Hours**

Nature and Purpose planning – Planning process – Types of plans – Objectives – Managing by objective (MBO) Strategies – Types of strategies – Policies – Decision Making – Types of decision –Decision Making Process - Rational Decision making Process – Decision Making under different conditions

**Unit III ORGANISING 9 Hours**

Nature and purpose of organizing – Organization structure – Formal and informal groups / organization – Line and Staff authority – Departmentation – Span of Control – Centralization and Decentralization – Delegation of authority – Staffing – Selection and Recruitment – Orientation Career Development – Career stages – Training – Performance Appraisal.

**Unit IV DIRECTING 9 Hours**

Creativity and Innovation – Motivation and Satisfaction – Motivation Theories Leadership – Leadership theories – Communication – Hurdles to effective communication – Organization Culture – Elements and types of culture – Managing cultural diversity.

**Unit V CONTROLLING 9 Hours**

Process of controlling – Types of control – Budgetary and non-budgetary control techniques – Managing Productivity – Cost Control – Purchase Control – Maintenance Control – Quality Control – Planning operations.

| **Course Outcomes** | | **Cognitive Level** |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Describe the overview of management | Understand |
| **CO2.** | Explain the planning process, policy and decision making | Understand |
| **CO3.** | Explain the human resource structure and policy | Understand |
| **CO4.** | Explain the motivational theories for management | Understand |
| **CO5.** | Explain the control techniques for operations | Understand |

**Text Book(s):**


T1. Stephen P. Robbins and Mary Coulter, “Management”, Prentice Hall of India, 8th edition, 2009.

T2. 2.Charles W.L Hill, Steven L McShane, “Principles of Management”, Mcgraw Hill Education, 2007.


**Reference Book(s):**


R1. Hellriegel, Slocum & Jackson, “Management – A Competency Based Approach”, Thomson South Western, 10th edition,2007.

R2. Harold Koontz, Heinz Weihrich and mark V Cannice, “Management – A global & Entrepreneurial Perspective”, Tata Mcgraw Hill, 12th edition, 2007..

R3. Andrew J. Dubrin, “Essentials of Management”, Thomson Southwestern, 7th edition, 2007.


**Web References:**


1. http://www.managementstudyguide.com/all-subjects.htm

## Course Articulation Matrix

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

High-3; Medium-2; Low-1

<table>
<tr><td colspan="2">Course Code:19EIEN1024</td><td colspan="2">Course Title: Introduction to Total Quality Management</td></tr>
<tr><td colspan="2">Course Category: Professional Elective</td><td colspan="2">Course Level: Mastery</td></tr>
<tr><td>L:T:P(Hours/Week)<br>3: 0: 0</td><td>Credits:3</td><td>Total Contact Hours:45</td><td>Max Marks:100</td></tr>
</table>

**Pre-requisites**

- Engineering Mathematics - I
- Engineering Mathematics - II

**Course Objectives**

The course is intended to:

1. Understand the breakeven point for a given business situation
2. Explain the application in decision making process.
3. Understand annual worth analysis on one or more economic alternatives.
4. Elucidate asset and develop a better replacement policy for a given equipment.
5. Evaluate the depreciation of equipment per period.

**Unit I INTRODUCTION TO ECONOMICS 9 Hours**

Introduction to Economics- Flow in an economy, Law of supply and demand, Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics - Elements of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis- V ratio, Elementary economic Analysis

**Unit II VALUE ENGINEERING 9 Hours**

Make or buy decision, Value engineering – Function, aims, and Value engineering procedure. Interest formulae and their applications –Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series payment Present worth factor- equal payment series capital recovery factor-Uniform gradient series annual equivalent factor, Effective interest rate, Examples in all the methods with problems.

**Unit III CASH FLOW 9 Hours**

Methods of comparison of alternatives – present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), rate of return method, Examples in all the methods.

**Unit IV REPLACEMENT AND MAINTENANCE ANALYSIS 9 Hours**

Replacement and Maintenance analysis – Types of maintenance, types of replacement problem, determination of economic life of an asset, Replacement of an asset with a new asset – capital recovery with return and concept of challenger and defender, Simple probabilistic model for items which fail completely.

**Unit V DEPRECIATION 9 Hours**

Depreciation- Straight line method of depreciation, declining balance method of depreciation-Sum of the years digits method of depreciation, sinking fund method of depreciation/ Annuity method of depreciation, service output method of depreciation- Evaluation of public alternatives-introduction, Examples, Inflation adjusted decisions – procedure to adjust inflation, Examples on comparison of alternatives and determination of economic life of asset. Case stud

| **Course Outcomes** | | **Cognitive Level** |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Categorize different cost and calculate the breakeven point for a given business situation | Understand |
| **CO2.** | Apply different interest formulae and their application in decision making process. | Apply |
| **CO3.** | Evaluate present value, future value and annual worth analysis on one or more economic alternatives. | Evaluate |
| **CO4.** | Determine the economic value of an asset and develop a better replacement policy for a given equipment. | Understand |
| **CO5.** | Evaluate the depreciation of equipment per period. | Understand |

**Text Book(s):**


T1. Panneerselvam R, “Engineering Economics”, Prentice Hall of India Ltd, NewDelhi, 2014

T2. Chan S.Park, “Contemporary Engineering Economics”, Prentice Hall of India, 2010.


**Reference Book(s):**


R1. Donald.G. Newman, Jerome.P.Lavelle, “Engineering Economics and analysis” Engg. Press, Texas, 2010.

R2. Degarmo, E.P., Sullivan, W.G and Canada, J.R, “Engineering Economy”, Macmillan, New

R3. Grant.E.L.,Ireson.W.G., and Leavenworth, R.S, “Principles of Engineering Economy”, Ronald Press, New York,1990.

**Web References:**

1. https://en.wikipedia.org/wiki/Engineering_economics
2. https://en.wikipedia.org/wiki/Cost%E2%80%93benefit_analysis

**Course Articulation Matrix**

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

High-3; Medium-2; Low-1

<table>
<tr><td colspan="2">Course Code: 19SCEC2001</td><td colspan="2">Course Title: Cyber Security<br>(Common to all)</td></tr>
<tr><td colspan="2">Course Category: Professional Elective</td><td colspan="2">Course Level: Introductory</td></tr>
<tr><td>L:T:P (Hours/Week)<br>2: 0: 2</td><td>Credits:3</td><td>Total Contact Hours:60</td><td>Max Marks:100</td></tr>
</table>

**Pre-requisites**

- NIL

**Course Objectives**

The course is intended to:

1. Discuss the various concepts in Cyber security and infrastructures involved.
2. Describe the cyber-crimes, reporting procedures and legal remedies.
3. Explain various social media related security issues and reporting flaws.
4. Explain various settings related to E-Commerce and digital payments.
5. Demonstrate the security aspects related to digital devices and technology.

**Unit I Introduction to Cyber Security 6 Hours**

Defining Cyberspace and Overview of Computer and Web-technology - Architecture of cyberspace, Communication and web technology, Internet, World wide web, Advent of internet, Internet infrastructure for data transfer and governance, Internet society, Regulation of cyberspace, Concept of cyber security, Issues and challenges of cyber security

**Unit II Cyber crime and Cyber law 6 Hours**

Classification of cyber crimes, Common cyber crimes- cyber crime targeting computers and mobiles, cyber crime against women and children, financial frauds, social engineering attacks, malware and ransomware attacks, zero day and zero click attacks, Cybercriminals modus-operandi , Reporting of cyber crimes, Remedial and mitigation measures, Legal perspective of cyber crime, IT Act 2000 and its amendments, Cyber crime and offences, Organisations dealing with Cyber crime and Cyber security in India, Case studies

**Unit III Social Media Overview and Security 6 Hours**

Introduction to Social networks. Types of Social media, Social media platforms, Social media monitoring, Hashtag, Viral content, Social media marketing, Social media privacy, Challenges, opportunities and pitfalls in online social network, Security issues related to social media, Flagging and reporting of inappropriate content, Laws regarding posting of inappropriate content, Best practices for the use of Social media, Case studies.

**Unit IV E-Commerce and Digital Payments 6 Hours**

Definition of E- Commerce, Main components of E-Commerce, Elements of E-Commerce security, E-Commerce threats, E-Commerce security best practices, Introduction to digital payments, Components of digital payment and stake holders, Modes of digital payments- Banking Cards, Unified Payment Interface (UPI), e-Wallets, Unstructured Supplementary Service Data (USSD), Aadhar enabled payments, Digital payments related common frauds and preventive measures. RBI guidelines on digital payments and customer protection in unauthorised banking transactions. Relevant provisions of Payment Settlement Act,2007.

**Unit V Digital Devices Security, Tools and Technologies for Cyber Security 6 Hours**

End Point device and Mobile phone security, Password policy, Security patch management, Data backup, Downloading and management of third party software, Device security policy, Cyber Security best practices, Significance of host firewall and Ant-virus, Management of host firewall and Anti-virus, Wi-Fi security, Configuration of basic security policy and permissions

**List of Exercises 30 Hours**

1. Prepare checklist for following scenarios :
   a) Reporting cybercrime at Cybercrime Police Station.
   b) Reporting cybercrime online.
   c) Using popular social media platforms.
   d) Secure net banking.
2. Demonstrate the following:
   a) Reporting phishing emails, email phishing attack and preventive measures.
   b) Reporting and redressal mechanism for violations and misuse of Social media platforms.
3. Manage the following activities:
   a) Privacy and security settings for popular Social media platforms, Mobile Wallets and UPIs.
   b) Application permissions in mobile phone.
4. Perform the following activities:
   a) Setting, configuring and managing three password policy in the computer (BIOS, Administrator and Standard User).
   b) Setting and configuring two factor authentication in the Mobile phone.
5. Demonstrate the following:
   a) Security patch management and updates in computer and mobiles.
   b) Wi-Fi security management in computer and mobile.
6. Install and configure computer Anti-virus & Computer Host Firewall.

| Course Outcomes | Cognitive Level |
|---|---|
| At the end of this course, students will be able to: | |
| CO1: Describe the concept of Cyber Security and infrastructure involved. | Understand |
| CO2: Develop procedures for reporting various cyber-crimes through available platforms. | Apply |
| CO3: Demonstrate various social media related security issues and reporting flaws. | Apply |
| CO4: Illustrate various settings in e-commerce and digital payment applications. | Apply |
| CO5: Demonstrate the digital devices security, tools and technologies for cyber security. | Apply |

**Text Book(s):**


T1. Cyber Crime Impact in the New Millennium, R. C Mishra. Auther Press.T2, 2010

T2. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Sumit Belapure and Nina Godbole, 1st Edition, Wiley India Pvt. Ltd, 2011.

T3. Security in the Digital Age: Social Media Security Threats and Vulnerabilities by Henry A. Oliver, Create Space Independent Publishing Platform, Pearson Education, 2001.


**Reference Book(s):**


R1. Network Security Bible, Eric Cole, Ronald Krutz, James W. Conley, 2nd Edition, Wiley India Pvt. Ltd, 2001

R2. Security Fundamentals of Network by E. Maiwald, McGraw Hill ,2014

R3. Cyber Laws: Intellectual Property & E-Commerce Security by Kumar K, Dominant Publishers, 2011.


**Web Reference(s):**


1. https://unacademy.com/content/upsc/study-material/science-and- technology/initiatives-taken-by-indian-government-for-cyber-security/
2. https://cybercrime.gov.in/
3. https://www.meity.gov.in/cyber-security-division
4. https://intellipaat.com/blog/what-is-cyber-security/

**Course Articulation Matrix:**

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

High-3; Medium-2;Low-1

| Course Code: 19MEEC1025 | Course Title: Fundamentals of Entrepreneurship (Common to all) | | |
|---|---|---|---|
| Course Category: Professional Elective | | Course Level : Introductory | |
| L: T: P(Hours/Week)<br>3: 0: 0 | Credits:3 | Total Contact Hours:45 | Max. Marks:100 |

**Pre-requisites**

- Nil

**Course Objectives**

The course is intended to:

1. Describe the types, characteristics of entrepreneurship and its role in economic development.
2. Define the types of entrepreneurship.
3. Explain the appropriate form of business ownership in setting up an enterprise.
4. Disseminate the support and management to entrepreneurs in the growth strategies in enterprise.

5.Explain the techniques involved in development of industries

**Unit I Entrepreneurship 9 Hours**

Entrepreneur – Characteristics – Entrepreneurial Decision Process-Types of Entrepreneurs – Difference between Entrepreneur and a manager-Intrapreneur-Social Entrepreneur –Entrepreneurial Growth- Role of Entrepreneurship in Economic Development.

**Unit II Types of Entrepreneurship 9 Hours**

Women Entrepreneurship-Rural Entrepreneurship-Tourism Enterprise, Entrepreneurship-Policy Measure of Tourism Entrepreneurship-Eco-Tourism/Nature Tourism/Rural Tourism-Need, Opportunities, Challenges for Developing Agri-preneurship-Social Entrepreneurship.

**Unit III Start-Up 9 Hours**

Small Enterprises-Micro and Macro Units-Essentials, Features and Characteristics-Relationship between Micro and Macro Enterprises-Scope of Micro and Small Enterprises-Enterprise and Society-Package for Promotion of Micro and Small-Scale Enterprises-Problems of Micro and Small Enterprises- Identification of Business Opportunity-Steps in Setting Up of a Small Business Enterprise – Content of Business Plan- Significance of Business Plan, Formulation of Business Plan – Guidelines for Formulating Project Report–Project Appraisal.

**Unit IV Support and Management 9 Hours**

Institutional Finance-Types of Lease Agreements-Lease Financing-Concept and Procedure for Hire-Purchase-Institutional Support to Small Entrepreneurs-Tax Benefits-Depreciation, Rehabilitation Allowance- Investment Allowance-Expenditure to Scientific Research-Tax Concession in Rural and Backward Areas-Difference between Management and Administration-Management of Working Capital-Methods of Inventory Management-Production Design-Market Segmentation-Marketing Mix

**Unit V Development 9 Hours**

Accounting for Small Enterprise-Types of Growth Strategies-Signal and Symptoms, Causes and Consequences of Industrial Sickness-Forms of Export Business-Types of Documents-E-Commerce Suitability for Small Enterprises-Types of Franchising-Evaluation of Franchise Arrangement-Corporate Citizenship.

| **Course Outcomes** | **Cognitive Level** |
|---|---|
| At the end of this course, students will be able to: | |
| CO1: Explain the types, characteristics of entrepreneurship and its role in economic development. | Apply |
| CO2: Classify various types of entrepreneurship and highlight the opportunities to improve the economy of India. | Apply |
| CO3: Select the appropriate form of business ownership in setting up an enterprise. | Apply |
| CO4: Determine the financial planning to become an entrepreneur and manage tax benefits that can be provided to the small Entrepreneurs | Analyze |
| CO5: Identify the techniques involved in the development of the small enterprise for the growth of industries. | Apply |

**Text Book(s):**

T1. S.S.Khanka, “Entrepreneurial Development” S.Chand & Co. Ltd. Ram Nagar New

Delhi, 2020.

**Reference Book(s):**

R1. Charantimath, P. M., “Entrepreneurship Development and Small Business Enterprises”, Pearson, 2006.

R2. Mathew J Manimala,” Entrepreneurship theory at cross roads: paradigms and praxis” Dream tech, 2nd edition 2006.

R3. Rabindra N. Kanungo, “Entrepreneurship and innovation”, Sage Publications, New Delhi, 2003.

R4. Singh, A. K., “Entrepreneurship Development and Management”, University Science Press, 2009.

**Web References:**


1. https://nptel.ac.in/courses/127105007
2. https://ncert.nic.in/ncerts/l/lebs213.pdf


**Course Articulation Matrix**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | | | | | | | | | | | 3 |
| CO2 | | 2 | | | | 3 | 3 | | | | | |
| CO3 | | | | 2 | | | | | | 2 | | |
| CO4 | | | | | 3 | | | 3 | | | 3 | |
| CO5 | | | 2 | | | | | | 2 | | | |

High-3; Medium-2; Low-1

<table>
<tr><td colspan="2">Course Code: 19MEEC1026</td><td colspan="2">Course Title: Design Thinking and Innovation (Common to all)</td></tr>
<tr><td colspan="2">Course Category: Professional Elective</td><td colspan="2">Course Level: Introductory</td></tr>
<tr><td>L: T: P(Hours/Week)<br>3: 0: 0</td><td>Credits:3</td><td>Total Contact Hours:45</td><td>Max Marks:100</td></tr>
</table>

**Pre-requisites**

- Nil

**Course Objectives**

The course is intended to:

1. Disseminate the fundamental concepts and principles of design thinking
2. Explain the design thinking methods in each stage of the problem
3. Conceptualize innovative ideas using prototypes
4. Explain the significance of Evaluating and Testing Ideas
5. Describe the design thinking approach to real world problems

**Unit I INTRODUCTION TO DESIGN THINKING 9 Hours**

Design thinking overview - Impact of Design Thinking - Design Process – Principles of Design Thinking – Creating Ideal Conditions – Case Study: Identify problem in AI

**Unit II UNDERSTAND THE PROBLEM 9 Hours**

Information Gathering – Analysis – Storytelling tool- Innovation- Ideation Finding and Evaluating Ideas –Mind Mapping Tool. Case Study: Analysis of the Identified Problem.

**Unit III DEFINING PROTOTYPES 8 Hours**

Tasks in Prototyping – Understanding Different Prototypes - Developing different prototypes – Demonstration – Prototyping Tools. Case Study: Prototype the solution.

**Unit IV EVALUATING AND TESTING IDEAS 10 Hours**

Finding Ideas – Developing Ideas Intuitively and Creatively - Selecting Evaluation method – Evaluating Ideas with checklist –Testing Ideas and Assumptions – Tasks in the Test Phase – Testing with Interviews – Testing with Online Studies – Case Study: Evaluate the solution.

**Unit V APPLICATIONS 9 Hours**

Politics and Society – Business – Strategic technology Plan – Creativity – Visioning, Listening and Diagramming - HealthCare and Science – Approach to treat Cancer – Law – Problem Definition – Alternatives.

| Course Outcomes | Cognitive Level |
|---|---|
| At the end of this course, students will be able to: | |
| CO1: Apply the key concepts of design thinking | Apply |
| CO2: Relate design thinking in all stages of problem solving | Apply |
| CO3: Identify the diverse methods employed in design thinking and establish a workable design thinking framework to use in their practices | Analyze |
| CO4: Determine the significance of testing and evaluating the solution | Analyze |
| CO5: Apply design thinking skills to solve real time user experience problems | Apply |

**Text Book(s):**

1. Muller-Roterberg "Design thinking for dummies" John Wiley & Sons,2020.(Unit-I,III & IV)

2. Andrew Pressman "Design Thinking A Guide to Creative Problem Solving for Everyone", Routledge Publication, 2019.(Unit-II & V)

**Reference Book(s):**

1. Robert Curedale, "Design Thinking Process & Methods" Design Community College, 5th Edition, 2019.
2. Alyssa Gallagher and Kami Thordarson, "Design Thinking in Play: An Action Guide for Educators", ASCD Book, 2020
3.Brown.T, "Change by design: How design thinking transforms organizations and inspires innovation", HarperCollins,2009.

**Web References:**

1. https://www.open.edu/openlearn/science-maths-technology/design-innovation/design-thinking/content-section-6
2. https://www.interaction-design.org/literature/topics/design-thinking
3. https://venturewell.org/class-exercises/

**Course Articulation Matrix**

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

High-3; Medium-2; Low-1

| | | | |
|---|---|---|---|
| **Course Code: 19ITEN1029** | **Course Title: Intellectual Property Rights (Common to all)** | | |
| **Course Category: Professional Elective** | | **Course Level : Introductory** | |
| **L: T: P(Hours/Week) 3: 0: 0** | **Credits:3** | **Total Contact Hours:45** | **Max. Marks:100** |

**Pre-requisites**

- Nil

**Course Objectives**

The course is intended to:

1. Describe the basic concepts of Intellectual Property Law.

2. Explain the classification of Patents and its Rights and Limitations.

3. Explain the Patent Searching Process and Application Filling Process.

4. Describe the concepts and principles of Trademark.

5. Explain the principles of copyright and its sources.

**Unit I Intellectual Property: An Introduction 9 Hours**

Intellectual Property Law: Patent Law-Copyright Law-Trademark Law- Trade secret Law-Right of Publicity-Paralegal tasks in Intellectual Property Law-Ethical obligations of the paralegal in Intellectual Property Law-Trade secrets: Protectible as a trade secret-Maintaining trade secrets-Protecting an Idea

**Unit II Patents: Rights and Limitations 9 Hours**

Sources of patent law-Subject matter of Patents: Utility Patents-Plant Patents-Design Patents-Design Patents and copyright-Design Patents and trademarks-Computer Software, Business methods and Patent Protection-Rights under Patent Law-Patent Requirements-Limitations on Patent Rights-Patent Ownership

**Unit III Patents: Research, Applications, Disputes, and International Considerations 9 Hours**

**Unit IV Principles of Trademark 9 Hours**

Trademarks and Unfair Competition-Acquiring Trademark Rights-Types of Marks, Strong Marks Versus Weak Marks-Selecting and Evaluating a Trademark-International Trademark Laws

**Unit V Principles of Copyrights** **9 Hours**

Sources of Copyright Law- The Eight Categories of Works of Authorship-Derivative Works and Compilations- Rights and Limitations :Grant of Exclusive Rights–Copyrights Ownership-International Copyright Laws

| **Course Outcomes** At the end of this course, students will be able to: | **Cognitive Level** |
|---|---|
| CO1: Describe the basics of Intellectual Property Law | Apply |
| CO2: Identify the Rights and Limitations of various patents | Apply |
| CO3: Apply the process of patent search and application filling process | Apply |
| CO4: Explain the concept of trademark and its types | Apply |
| CO5: Classify the concepts of copyrights and its limitations | Apply |

**Text Book(s):**


T1. Richard Stim, “Intellectual Property: Copyrights, Trademark and Patents”, Cengage learning, 2nd edition 2012.


**Reference Book(s):**


R1. Deborah E. Bouchoux, “Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets”, Cengage Learning, Third Edition, 2013.

R2. Prabuddha Ganguli,”Intellectual Property Rights: Unleashing the Knowledge Economy”, McGraw Hill Education, 2017.


**Web References:**

https://ipindia.gov.in/writereaddata/Portal/ev/sections-index.html

**Course Articulation Matrix**

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

High-3; Medium-2; Low-1

## Open Electives

| Course Code: 19EIOC1001 | Course Title: Industrial Measurement Systems | | |
|---|---|---|---|
| Course Category: Open Elective | | Course Level: Mastery | |
| L:T:P(Hours/Week)<br>3: 0: 0 | Credits:3 | Total Contact Hours:45 | Max Marks:100 |

**Pre-requisites**

- Nil

**Course Objectives**

The course is intended to:

1. Summarize the types, static and dynamic characteristics of Transducers.
2. Explain the principle of various types of special transducers.
3. Explain the various techniques for pressure and temperature measurement.
4. Describe the different systems for load, speed and torque measurement.
5. Explain the various techniques for flow measurement.

**Unit I Transducers 9 Hours**

Block diagram of measurement system - Units and standards - Classification of errors – Classification of transducers – Static and Dynamic characteristics of transducers – Concept of Resistive, Capacitive and Inductive transducer.

**Unit II Special Transducers 9 Hours**

Piezoelectric transducer – Strain gauge - Hall Effect transducer – Magneto elastic load cell - Digital transducers : linear and rotary type – Fibre optic sensors – magnetometer – Nano sensor – MEMS - Smart Sensor

**Unit III Pressure and Temperature Measurement 9 Hours**

Elastic type pressure gauges, Bourdon tube and diaphragms with strain gauge- Capacitive type pressure gauge - Measurement of vacuum - -Thermal conductivity gauge - Ionization gauges - Resistance Thermometer – 3 wire & 4 wire RTD - Bimetallic thermometers – Thermocouples - Optical pyrometers - Fiber optic sensor for temperature measurement.

**Unit IV Level, Load and Speed Measurement 9 Hours**

Float gauges - Displacer type –D/P methods - Boiler drum level measurement: – Capacitive sensors – Nucleonic gauge - Ultrasonic gauge –RADAR measurement – Speed & Torque Measurement: Magnetic and Optical Method – Strain gauge type load cell, torque sensor, accelerometer.

**Unit V Flow Measurement 9 Hours**

Expression for flow rate through restriction - Orifice plate -Venturi tube – Flow nozzle –– Positive displacement flow meters – Nutating disc and Oval gear flow meters – Rotameter - Mass flow meters: Thermal and Coriolis type – Electromagnetic flow meter – Ultrasonic flow meters.

| **Course Outcomes** | | **Cognitive Level** |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Summarize the types, static and dynamic characteristics of Transducers. | Understand |
| **CO2.** | Explain the principle of various types of special transducers. | Understand |
| **CO3.** | Select a suitable pressure and temperature measuring instruments for the given application. | Understand |
| **CO4.** | Explain the different methods of measurement of Load, speed, torque, measuring instruments. | Understand |
| **CO5.** | Select a suitable flow measuring instruments for the given application. | Understand |

**Text Book(s):**


T1. John P. Bentley, Principles of Measurement Systems, III Edition, Pearson Education, 2015.

T2. Doebelin E.O. and Manik D.N., Measurement Systems – Applications and Design, Special Indian Edition, Tata McGraw Hill Education Pvt. Ltd., 2017.


**Reference Book(s)**


R1. D. Patranabis, Sensors and Transducers, 2nd edition, Prentice Hall of India, 2013.

R2. B.C. Nakra and K.K.Chaudhary, “Instrumentation, Measurement and Analysis”, McGraw Hill Education India Private Limited, 4th edition,2016

R3. W.Bolton, Engineering Science, Elsevier Newnes, 5th Edition, 2006


**Web References:**

1. nptel.ac.in/courses/112103174
2. http://nptel.ac.in/courses/108105064
3. http://nptel.ac.in/courses/112106140

**Course Articulation Matrix**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 1 | - | 1 | 1 | - | - | 1 | - | 1 | - | - |
| **CO2** | 2 | 1 | - | 1 | 1 | - | - | 1 | - | 1 | - | - |
| **CO3** | 2 | 1 | - | 1 | 1 | - | - | 1 | - | 1 | - | - |
| **CO4** | 2 | 1 | - | 1 | 1 | - | - | 1 | - | 1 | - | - |
| **CO5** | 2 | 1 | - | 1 | 1 | - | - | 1 | - | 1 | - | - |

High-3; Medium-2; Low-1

<table>
<tr><td colspan="2">Course Code: 19EIOC1002</td><td colspan="2">Course Title: Electronics System Design</td></tr>
<tr><td colspan="2">Course Category: Open Elective</td><td colspan="2">Course Level: Mastery</td></tr>
<tr><td>L:T:P(Hours/Week)<br>3: 0: 0</td><td>Credits:3</td><td>Total Contact Hours:45</td><td>Max Marks:100</td></tr>
</table>

**Pre-requisites**

- Nil

**Course Objectives**

The course is intended to:

1. Provide knowledge about special diode from PN junction diodes.
2. To learn the construction and characteristics of BJT.
3. To learn the construction and characteristics of Op-amp.
4. To understand the working of 555 timer IC and Voltage regulator IC.
5. To learn the system architecture using existing product design.

**Unit I Basic Diodes 9 Hours**

PN junction –forward and reverse bias conditions-ideal diode, practical diode-V-I characteristics of a diode- diode specifications – Diode equivalent circuits -zener diode- Schottky Diode-Light Emitting Diodes-Photo diodes- Diode numbers and Lead identification-Diode testing.

**Unit II Bipolar junction transistor 9 Hours**

Bipolar junction transistor and its types- NPN and PNP Transistor – Transistor operation – Configuration of BJT – Input and output characteristics of CE, CB and CC configurations-Transistor as a switch – Transistor specifications- lead identification – package types- transistor testing.

**Unit III Operational Amplifier 9 Hours**

Introduction to Integrated Circuits – Types of IC packages - OPAMP Internal blocks, Ideal OPAMP characteristics,IC741 - Inverting amplifier, Non Inverting amplifier- design of Comparators, Zero Crossing Detector- Voltage follower.

**Unit IV special function IC 9 Hours**

Timer IC555, Implementing a MonostableMultivibrator and AstableMulti vibrator -voltage regulator IC78XX, IC79xx, IC317- Application using IC555 and voltage regulator.

**Unit V System Design Techniques 9 Hours**

LED interfacing – Relay interfacing using transistor driver circuit- Opto-isolator- LCD interfacing, stepper motor interfacing, DC motor interfacing- Design Methodologies, Requirement Analysis, Specification, System Analysis and Architecture Design.

| Course Outcomes | | Cognitive Level |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Differentiate special diode from PN junction diodes. | Understand |
| **CO2.** | Explain the construction and characteristics of BJT. | Understand |
| **CO3.** | Explain the construction and characteristics of Op-amp. | Understand |
| **CO4.** | Describe the working of 555 timer IC and Voltage regulator IC. | Understand |
| **CO5.** | Describe the system architecture using existing product design. | Understand |

**Text Book(s):**


T1. V.Jegatheesan, K.VInothkumar and R Saravanakumar, "Basics of electrical and Electronics Engineering", Wiley India, 1st Edition, 2011.

T2. Muhammad Ali Mazidi, RolinD.Mckinlay, Danny Causery, "PIC Microcontroller and Embedded systems using assembly and C PIC18", 2nd edition, Micro Digital Ed, 2016.


**Reference Book(s):**


R1. Wayne Wolf, "Computers as Components: Principles of Embedded Computing System Design", Morgan Kaufman Publishers, First Indian Reprint 2001

R2. John B Peatman, "Designing with PIC Micro Controller", 1 st Edition, Pearson, 2003

R3. MykePredko, "Programming and Customizing the PIC Microcontroller" 3rd edition Tata McGraw Hill Publishing Company Ltd, 2011


**Web References:**

1. NPTEL Video: https://www.youtube.com/watch?v=WUYAjxnwjU4
2. 2.https://www.youtube.com/watch?v=z3VEZPwl5gA&list=PLE7VH8RC_N3bpVn-e8QzOAHziEgmjQ2qE&index=3

## Course Articulation Matrix

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 1 | - | 1 | 1 | - | - | 1 | - | 1 | - | - |
| **CO2** | 2 | 1 | - | 1 | 1 | - | - | 1 | - | 1 | - | - |
| **CO3** | 2 | 1 | - | 1 | 1 | - | - | 1 | - | 1 | - | - |
| **CO4** | 2 | 1 | - | 1 | 1 | - | - | 1 | - | 1 | - | - |
| **CO5** | 2 | 1 | - | 1 | 1 | - | - | 1 | - | 1 | - | - |

High-3; Medium-2; Low-1

<table>
<tr><td colspan="2">Course Code:19EIOC1003</td><td colspan="3">Course Title: Industrial Internet of Things</td></tr>
<tr><td colspan="3">Course Category: Open Elective</td><td colspan="2">Course Level: Mastery</td></tr>
<tr><td>L:T:P(Hours/Week)<br>3: 0: 0</td><td colspan="2">Credits:3</td><td>Total Contact Hours:45</td><td>Max Marks:100</td></tr>
</table>

**Pre-requisites**

- Embedded systems

**Course Objectives**

The course is intended to:

1. Indicate the various industrial revolutions and need for industry 4.0
2. Illustrate the design architecture and components of IoT.
3. Provide knowledge on communication protocols used IoT based solutions
4. Realize the opportunities, challenges brought about by Industry 4.0 and how organisations and individuals should prepare to reap the benefits
5. Demonstrate the application of IIoT

**Unit I Introduction to IIoT 9 Hours**

The Various Industrial Revolutions - Digitalisation and the Networked Economy -Drivers, Enablers, Compelling Forces and Challenges for Industry 4.0- Comparison of Industry 4.0 Factory and Today's Factory - Trends of Industrial Big Data and Predictive Analytics for Smart Business Transformation

**Unit II IoT building blocks 9 Hours**

IoT Architecture, WoT and M2M - Physical & Logical IoT design Basics - IoT Enabling Technologies - IoT Levels and templates

System Design of Connected Devices: Embedded Devices, Embedded Hardware, Connected Sensors and Actuators, Controllers, Battery Life Conservation and designing with Energy Efficient Devices, SoCs, Single Chip Controllers with integrated Processing and Network Core with Hardware Crypto Engines.

**Unit III IoT Communication protocols 9 Hours**

Understanding Internet Protocols: Simplified OSI Model, Network Topologies, Standards, Types of Internet Networking - Ethernet, WiFi, Local Networking, Bluetooth, Bluetooth Low Energy (BLE), Zigbee, 6LoWPAN, Sub 1 GHz, RFID,NFC, Proprietary Protocols, Simplicity, Networking Design - Push, Pull and Polling, Network APIs

**Unit IV Advanced design and challenges 9 Hours**

IOT Specific Challenges and Opportunities- Advances Design Concepts for IOT - Software UX Design Considerations, Machine Learning and Predictive Analysis, Interactions, Inter-usability and Inter-operability considerations, Understanding Security in IOT Design, Design requirements of IOT Security Issues and challenges, Privacy, Overview of Social Engineering.

**Unit V Case study 9 Hours**

Smart Manufacturing – IIoT in oil and gas industry - Smart Cities- Precision healthcare- Precision mining

| **Course Outcomes** | | **Cognitive Level** |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Describe various industrial revolutions and role of industry4.0 | Understand |
| **CO2.** | Analyse various components required to build IoT based application | Understand |
| **CO3.** | Analyse the communication protocols suitable for IOT | Understand |
| **CO4.** | Describe the opportunities, challenges brought about by Industry 4.0 and how organisations and individuals should prepare to reap the benefits | Understand |
| **CO5.** | Appreciate the smartness in Smart Factories, Smart cities, smart products and other smart services | Understand |

**Text Book(s):**

T1 Foundational Elements of an IOT Solution - The Edge, Cloud and Application Development, Joe Biron& Jonathan Follett, Oreilly, First Edition, March 2016

T2 Designing Connected Products, 1st Edition, Elizabeth Goodman, Alfred Lui, Martin Charlier, Ann Light, Claire Rowland

**Reference Book(s):**

R1 The Internet of Things (A Look at Real World Use Cases and Concerns), Kindle Edition, 2016, Lucas Darnell

R2 From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence: By Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand,

R3 Vijay Madisetti, ArshdeepBahga, “Internet of Things: A Hands-On Approach”

R4. Internet of Things (A Hands-on-Approach), by Vijay Madisetti and ArshdeepBahga, 1st

**Web References:**

1. https://nptel.ac.in/courses/117/105/117105079/
2. https://nptel.ac.in/courses/117/105/117105135/
3. https://nptel.ac.in/courses/117/104/117104020/

**Course Articulation Matrix**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 1 | - | 1 | 1 | - | - | 1 | - | 1 | - | - |
| **CO2** | 2 | 1 | - | 1 | 1 | - | - | 1 | - | 1 | - | - |
| **CO3** | 2 | 1 | - | 1 | 1 | - | - | 1 | - | 1 | - | - |
| **CO4** | 2 | 1 | - | 1 | 1 | - | - | 1 | - | 1 | - | - |
| **CO5** | 2 | 1 | - | 1 | 1 | - | - | 1 | - | 1 | - | - |

High-3; Medium-2; Low-1

| Course Code:19EIOC1004 | Course Title: Smart Sensor Technology | | |
|---|---|---|---|
| **Course Category: Open Elective** | | **Course Level: Mastery** | |
| **L:T:P(Hours/Week)<br>3: 0: 0** | **Credits:3** | **Total Contact Hours:45** | **Max Marks:100** |

**Pre-requisites**

- Nil

**Course Objectives**

The course is intended to:

6. Explain the structure of Smart Sensors
7. Describe the data acquisition through the sensor
8. Summarize the various communication protocol used for data processing
9. Elucidate wireless technology used in sensor system.
10. Provide knowledge on inbuilt sensors in Smart devices

**Unit I INTRODUCTION TO SMART SENSORS 9 Hours**

Mechanical to Electronic transition in Sensing – Nature of Sensor – Integration of Micromachining and Microelectronics - Evolution of Smart Sensors - Components of Smart Sensors – General Architecture of Smart Sensors

**Unit II DATA ACQUISITION THROUGH SENSOR 9 Hours**

Amplification and Signal Conditioning: Instrumentation amplifier – Sleep mode operational amplifier - Rail to Rail operational amplifier - 4-20ma Signal transmitter – Digital conversion: sampling, Quantizing and encoding – MCU control and sensor interface – Techniques and system integration: Linearization – PWM Control – Auto zero and Auto range – Diagnostics – Reducing EMC and RFI

**Unit III COMMUNICATION FOR SMART SENSOR 9 Hours**

Overview of Communication Organization and standards – Automotive protocols: CAN – LIN – Media Oriented Systems Transport – Flex ray - Industrial usage of CAN – MCU with integrated CAN – LonTalk Protocol – MI bus – Other aspects of Network communications

**Unit IV WIRELESS SENSING 9 Hours**

Introduction of RF and Spread spectrum – Wireless data and communication – Zigbee – ANT+ - 6LoWPAN – NFC – Zwave – Dust networks – RF Sensing: Surface acoustic waves - RADAR – LIDAR – GPS – Remote emission sensing – Intelligent transportation system - RFID –

Telemetry.

**Unit V SMART SENSOR DEVICES 9 Hours**

Case Study: Sensors in Mobile phones: Touch sensor, Proximity Sensor, Ambient light sensor, Hall sensor and Finger print sensor – Sensors in Automotive vehicles: Air flow sensor, Engine speed sensor, Manifold Absolute Pressure Sensor, Spark Knock Sensor, Fuel Temperature Sensor and Voltage Sensor - Sensors in Wearables: Electro-chemical Bio Sensor, Wearable electrodes, Stain, temperature and pressure sensors

| **Course Outcomes** | | **Cognitive Level** |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Explicate the Structure of Smart Sensors and build the sensor | Understand |
| **CO2.** | Describe the data acquisition from sensor to other devices | Understand |
| **CO3.** | Summarize the various communication protocol used for data processing | Understand |
| **CO4.** | Elucidate wireless technology used in sensor system | Understand |
| **CO5.** | Explain the sensors used in various smart devices | Understand |

**Text Book(s):**


T3. Randy Frank “Understanding Smart Sensors” 3rd Edition, CRC Press, 2014

T4. Krzysztof Iniewski “Smart Sensors for Industrial applications” CRC Press, 2013


**Reference Book(s):**


R4. Kevin Yallup, Krzysztof Iniewski “Technologies for Smart Sensors and Smart fusion” CRC Press, 2014

R5. Gerard Meijer, Kofi Makinwa, MichielPertijs “Smart Sensor Systems: Emerging Technologies and applications” John wiley and Sons Ltd, 2014

R6. S.C.Mukhopadhyay, G.S.Gupta “Smart Sensors and Sensing Technology” Springer, 2008


**Web References:**


4. https://new.abb.com/motors-generators/service/advanced-services/smart-sensor
5. https://www.intersil.com/en/applications/industrial/smart-sensor.html
6. http://www.smartsensors.com/

## Course Articulation Matrix

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 1 | - | 1 | 1 | - | - | 1 | - | 1 | - | - |
| **CO2** | 2 | 1 | - | 1 | 1 | - | - | 1 | - | 1 | - | - |
| **CO3** | 2 | 1 | - | 1 | 1 | - | - | 1 | - | 1 | - | - |
| **CO4** | 2 | 1 | - | 1 | 1 | - | - | 1 | - | 1 | - | - |
| **CO5** | 2 | 1 | - | 1 | 1 | - | - | 1 | - | 1 | - | - |

High-3; Medium-2; Low-1

| Course Code:19EIOC1005 | Course Title: Factory Automation | | |
|---|---|---|---|
| **Course Category: Open Elective** | | **Course Level: Mastery** | |
| **L:T:P(Hours/Week)**<br>**3: 0: 0** | **Credits:3** | **Total Contact Hours:45** | **Max Marks:100** |

**Pre-requisites**

- Nil

**Course Objectives**

The course is intended to:

1. Understand the hydraulics, electro hydraulics and its circuits
2. Understand the pneumatics, electro pneumatics and its circuits
3. Design an automation system with suitable sensors
4. Explain Industrial based controller and developing S/W solution for the specific automation system
5. Explain the electrical drives and sensors with PLC using SCADA & IoT.

**Unit I Hydraulics 9 Hours**

Basics of Hydraulics - Components of hydraulics - Types of valves – DCVs - operations - hydraulic Circuits – Electro hydraulics - Solenoids - Relays - Electrical logic circuits - Applications of electro hydraulics – simulation on hydraulic circuits.

**Unit II Pneumatics 9 Hours**

Basics of Pneumatics - Components of Pneumatics - Types of valves - DCVs - operations - Pneumatic circuits – Electro pneumatics - Electrical Logic circuit – Relay ladder logic - Applications of electro pneumatics – simulation on pneumatic circuits.

**Unit III Sensorics 9 Hours**

Introduction to sensorics - Types of Proximity sensors (Inductive, Capacitive, Magnetic, Photo electric and ultrasonic)- construction, principle of operation and Applications – Advanced Sensor for Industry application

**Unit IV PLC and HMI 9 Hours**

Over view of Automation System – Introduction to PLC - Architectural evolution - Role of PLC in Automation - Ladder Logic - Basics of digital logic - Latching - Selections of PLC - HMI Screen Development for various applications – Interfacing PLC and HMI - Automation system interconnect between HMI and PLC.

**Unit V SCADA and IoT 9 Hours**

Remote panel development: Data acquisition between PLC and SCADA system – Remote panel development – Screen development – Real monitoring and control through PLC and SCADA - IoT Architecture, and M2M - Physical & Logical IoT design Basics - IoT Enabling Technologies - IoT Levels and templates.

| **Course Outcomes** | | **Cognitive Level** |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Expertise on hydraulics, electro hydraulics and its circuits | Understand |
| **CO2.** | Expertise on pneumatics, electro pneumatics and its circuits | Understand |
| **CO3.** | Explain an automation system with suitable sensors | Understand |
| **CO4.** | Understanding of Industrial based controller and developing S/W solution for the specific automation system | Understand |
| **CO5.** | Interfacing of electrical drives and sensors with PLC using SCADA & IoT. | Understand |

**Text Book(s):**


T1. Esposito Anthony, “Fluid Power with Applications”, Pearson Education Inc., New York, 2003
T2. Frank D Petruzella, “Programmable Logic Controllers” , Tata Mcgraw hill, 4th edition, 2011


**Reference Book(s):**


R1. T3.W. Bolton, “Mechatronics”, Person Education Inc., 2010


**Web References:**

1. https://new.abb.com/motors-generators/service/advanced-services/smart-sensor
2. https://www.intersil.com/en/applications/industrial/smart-sensor.html
3. http://www.smartsensors.com/

**Course Articulation Matrix**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 1 | - | 1 | 1 | - | - | 1 | - | 1 | - | - |
| CO2 | 2 | 1 | - | 1 | 1 | - | - | 1 | - | 1 | - | - |
| CO3 | 2 | 1 | - | 1 | 1 | - | - | 1 | - | 1 | - | - |
| CO4 | 2 | 1 | - | 1 | 1 | - | - | 1 | - | 1 | - | - |
| CO5 | 2 | 1 | - | 1 | 1 | - | - | 1 | - | 1 | - | - |

High-3; Medium-2; Low-1

| Course Code:19EIOC1006 | Course Title: Internet of Medical Things | | |
|---|---|---|---|
| Course Category: Open Elective | | Course Level: Mastery | |
| L:T:P(Hours/Week) 3: 0: 0 | Credits:3 | Total Contact Hours:45 | Max Marks:100 |

**Pre-requisites**

- Nil

**Course Objectives**

The course is intended to:

1. Interpret the role of biomedical engineering in society
2. Demonstrate the principles of various diagnostic devices.
3. Identify the importance of Biotelemetry devices.
4. Provide knowledge on role of IoT in portable medical devices
5. Understand about various sensors and peripherals in wearable IoTs

**Unit I FUNDAMENTALS OF MEDICAL INSTRUMENTATION 9 Hours**

Evolution of modern healthcare system - Role of Biomedical engineers in various domain - Recent Advances in Biomedical Engineering - Professional status of biomedical engineering- Professional Societies - Intelligent Medical Instrumentation Systems - Implantable Medical Devices

**Unit II DIAGNOSTIC IMAGING 9 Hours**

X-ray computed tomography - Nuclear Medical Imaging Systems-Magnetic Resonance Imaging – Ultrasonic Imaging Systems – Thermal Imaging Systems.

**Unit III BIOMEDICAL TELEMETRY 9 Hours**

Biotelemetry - Single Channel Telemetry Systems - Multi-Channel Wireless Telemetry Systems - Multi-Patient Telemetry - Implantable Telemetry Systems - Biotelemetry Application On Wimax Networks - Transmission Of Analog Physiological Signals Over Telephone.

**Unit IV INTERNET OF HEALTH THINGS (IOHT) 9 Hours**

Introduction to IoHT – IoT enabled technology in health care – Applications and services of IoHT – Topologies – Prototype for forthcoming systems in IoHT – Wearable health care system – Challenges of IoHT - Security requirements & Challenges of IoHT - Various technologies to revolutionize the services of healthcare in IoT – Future trends

**Unit V WEARABLE DEVICES 9 Hours**

Introduction to Sensors and Wearable hardware – Wearable devices in Medical field – Monitoring used for wearable health devices – wearable health device technologies for different body parts – Applications – Challenges

| **Course Outcomes** | | **Cognitive Level** |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Understand the role of biomedical engineering in society | Understand |
| **CO2.** | Understand the principles of various diagnostic devices. | Understand |
| **CO3.** | Identify the importance of Biotelemetry devices. | Understand |
| **CO4.** | Obtain knowledge on role of IoT in portable medical devices | Understand |
| **CO5.** | Identify various sensors and peripherals in wearable IoTs | Understand |

**Text Book(s):**

T1. Enderle, John D, Bronzino, Joseph D, Blanchard, Susan M- Introduction to

T2. R. S. Khandpur, Handbook of Biomedical Instrumentation, McGraw-Hill Publishing

T3. Chakraborty, C., Banerjee, A., Kolekar, M.H., Garg, L., Chakraborty, B. (Eds.), Internet of Things for Healthcare Technologies, Springer, 2021

**Reference Book(s):**

R1. Manuel Cardona, Vijender Kumar Solanki, Cecilia E. GarcíaCena, Internet of Medical Things

R2. Paradigm of Wearable Devices, Routledge, taylor&francis group, 2021

R3. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, Biomedical Instrumentation and Measurement, Prentice Hall of India, New Delhi,2nd edition, 2002.

R4. John G Webster, Medical Instrumentation: Application and Design, John Wiley andsons, New York,4thedition,2010. Daniel A Vallero, Biomedical ethics for Engineers, Elsevier

**Web References:**

1. https://www.accessengineeringlibrary.com/content/book/9789339205430
2. https://www.elsevier.com/books/introduction-to-biomedical-engineering/enderle/978-0-12-374979-6

**Course Articulation Matrix**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 1 | - | 1 | 1 | - | - | 1 | - | 1 | - | - |
| **CO2** | 2 | 1 | - | 1 | 1 | - | - | 1 | - | 1 | - | - |
| **CO3** | 2 | 1 | - | 1 | 1 | - | - | 1 | - | 1 | - | - |
| **CO4** | 2 | 1 | - | 1 | 1 | - | - | 1 | - | 1 | - | - |
| **CO5** | 2 | 1 | - | 1 | 1 | - | - | 1 | - | 1 | - | - |

High-3; Medium-2; Low-1

| Course Code:19EIOC1007 | Course Title: Virtual Instrumentation | | |
|---|---|---|---|
| Course Category: Open Elective | | Course Level: Mastery | |
| L:T:P(Hours/Week) 3: 0: 0 | Credits:3 | Total Contact Hours:45 | Max Marks:100 |

**Pre-requisites**

- Nil

**Course Objectives**

The course is intended to:

6. Discuss the importance of virtual instrumentation
7. Develop virtual instruments
8. Apply the concept of Arrays, Strings and File I/O tasks
9. Select suitable Data acquisition system interfaces
10. Examine DAQ hardware's and LabVIEW

**Unit I GRAPHICAL SYSTEM DESIGN 9 Hours**

Graphical System Design Model – Virtual Instrumentation – Virtual Instrument and Traditional Instrument – Hardware and software in virtual instrumentation – Virtual instrumentation for test, control and Design – Conventional and Graphical programming

**Unit II LabVIEW BASICS I 9 Hours**

Front Panel and Block Diagram – Tools, Controls and Functions palette. Modular programming – Sub VI. Structures – FOR, WHILE Loops, Case, Sequence, event structures, Formula node.

**Unit III LabVIEW BASICS II 9 Hours**

Arrays, Clusters, Strings, File I/O, Time and Dialog controls, Waveform chart, Graph, XY Graph and operations Report generation, Web Publishing tool.

**Unit IV DATA ACQUISITION SYSTEM 9 Hours**

Instrument control: GPIB – VISA – Instrument drivers – Serial Port communication. Data Acquisition: Review of Transducers and signal conditioning, DAQ hardware – AI, AO, DIO. DAQ Assistant and configuration.

**Unit V LabVIEW APPLICATIONS 9 Hours**

LabVIEW RT, Process control applications, Physical applications, Speed control, Data visualization, Imaging and Sound. Level, flow, temperature process, biomedical application - Pulse rate

| Course Outcomes | | Cognitive Level |
|---|---|---|
| At the end of this course, students will be able to: | | |
| **CO1.** | Discuss the importance of virtual instrumentation using LabVIEW | Understand |
| **CO2.** | Develop virtual instruments using LabVIEW graphical programming tools | Understand |
| **CO3.** | Apply the concept of Arrays, Strings and File I/O tasks in Data acquisition | Understand |
| **CO4.** | Select suitable Data acquisition system interfaces based on the requirement | Understand |
| **CO5.** | Examine DAQ hardware's and LabVIEW in various real time environments | Understand |

**Text Book(s):**

T3. Jovitha Jerome, 'Virtual Instrumentation using LabVIEW' PHI Learning Private Limited, New Delhi, Second Printing, 2011.

T4. Gary W Johnson, Richard Jennings, 'LabVIEW Graphical Programming' Fourth Edition, McGraw Hill, 2006

**Reference Book(s):**

R3. Sanjay Gupta, Joseph John, 'Virtual Instrumentation using LabVIEW' Tata McGraw Hill, 5th Reprint, 2010

R4. 2.Robert H Bishop. 'Learning with LabVIEW 2009' Pearson Education, 2010

**Web References:**

4. http://www.av.it.pt/conftele2009/Papers/125.pdf

5. https://www.researchgate.net/publication/3420671_What_is_virtual_instrumentation

6. http://www.ni.com/pdf/manuals/374629c.pdf

## Course Articulation Matrix

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 1 | 1 | - | 1 | 1 | - | - | 1 | 1 | 1 | - | - |
| **CO2** | 1 | 1 | - | 1 | 1 | - | - | 1 | 1 | 1 | - | - |
| **CO3** | 1 | 1 | - | 1 | 1 | - | - | 1 | 1 | 1 | - | - |
| **CO4** | 1 | 1 | - | 1 | 1 | - | - | 1 | 1 | 1 | - | - |
| **CO5** | 1 | 1 | - | 1 | 1 | - | - | 1 | 1 | 1 | - | - |

High-3; Medium-2; Low-1