# KUMARAGURU COLLEGE OF TECHNOLOGY

**An Autonomous Institution Affiliated to Anna University, Chennai**

## COIMBATORE – 641 049

# B.E. ELECTRONICS & INSTRUMENTATION ENGINEERING

# REGULATIONS 2024

## I - VIII SEMESTER Syllabus

## 2024 Batch onwards

## Department of

## Electronics & Instrumentation Engineering

## VISION

The Department of Electronics & Instrumentation Engineering (E&I) envisions a holistic education that transforms the learners into responsible engineers, enabling them to identify significant problems in industry and society to arrive at creative and sustainable solutions through collaborative team efforts.

## MISSION

The Department of Electronics & Instrumentation Engineering (E&I) aims to

- Implement a modern pedagogical approach in academics, innovative research initiatives, and collaborative projects that ethically address societal needs.
- Develop knowledge and skills required to excel in manufacturing, automation and allied industries on a global platform.
- Expand the knowledge for higher studies and get inspired for lifelong learning.

## PROGRAMME EDUCATIONAL OBJECTIVES

After a few years of graduation, Graduates of B.E. (Electronics & Instrumentation Engineering) will

**PEO 1:** Excel in a technical and professional career with core competence in automation.
**PEO 2:** Possess the passion for professional development by continuous learning in allied Engineering and Management fields.
**PEO 3:** Engage in resolving industrial and social issues using contemporary tools.
**PEO 4:** Exhibit professionalism and ethical attitude towards resolving automation issues to society at large.

## PROGRAMME SPECIFIC OUTCOMES

Graduates of B.E. (Electronics & Instrumentation Engineering) will be able to:

**PSO 1:** Develop, analyse and calibrate Instruments and electronic systems for various real-world applications, adhering to ISA ethical codes.

**PSO 2 :** Integrate programmable logic controllers (PLC), distributed control systems (DCS) for manufacturing and processing systems and gain proficiency in relevant software tools.

## PROGRAMME OUTCOMES

Graduates of B.E. (Electronics & Instrumentation Engineering) will be able to:

**PO1: Engineering Knowledge:** Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

**PO2: Problem Analysis:** Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

**PO3: Design/Development of Solutions:** Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

**PO4: Conduct Investigations of Complex Problems:** Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

**PO5: Engineering Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

**PO6: The Engineer and The World:** Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

**PO7: Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

**PO8: Individual and Collaborative Team work:** Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

**PO9: Communication:** Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

**PO10: Project Management and Finance:** Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

**PO11: Life-Long Learning:** Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

## KNOWLEDGE AND ATTITUDE PROFILE (WK)

**WK1:** A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.

**WK2:** Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.

**WK3:** A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.

**WK4:** Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.

**WK5:** Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.

**WK6:** Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.

**WK7:** Knowledge of the role of engineering insociety and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.

**WK8:** Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.

**WK9:** Ethics, inclusive behaviour and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

# KUMARAGURU COLLEGE OF TECHNOLOGY

## DEPARTMENT OF ELECTRONICS & INSTRUMENTATION ENGINEERING

## REGULATION 2024

## B.E. Electronics & Instrumentation Engineering – Curriculum

**Semester I**

| S. No. | Course Code | Course Title | Course Mode | Course Category | L | T | P | J | C |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 24HST101 | Heritage of Tamil | Theory | HS | 1 | 0 | 0 | 0 | 1 |
| 2 | 24MAI113 | Linear Algebra and Multivariate Calculus | Embedded | BS | 3 | 0 | 2 | 0 | 4 |
| 3 | 24CYI101 | Electronic Materials Chemistry | Embedded | BS | 3 | 0 | 2 | 0 | 4 |
| 4 | 24MEI103 | Computer-Aided Engineering Graphics | Embedded | ES | 2 | 0 | 2 | 0 | 3 |
| 5 | 24MET105 | Basics of Engineering Mechanics | Theory | ES | 3 | 0 | 0 | 0 | 3 |
| 6 | 24ADP001 | Basics of Artificial Intelligence | Practical | ES | 0 | 0 | 2 | 0 | 1 |
| 7 | 24INP102 | Innovation Practicum - 1 | Practical | ES | 0 | 0 | 2 | 0 | 1 |
| 8 | 24HSP111 | Holistic Wellness - 1 | Practical | HS | 0 | 0 | 2 | 0 | 1 |
| 9 | 24INP101 | Design Thinking | Practical | ES | 0 | 0 | 2 | 0 | 1 |
| 10 | 24INO1-- | FCLF General Stack - 1 | FPractical | OE | 0 | 0 | 2 | 0 | 1 |
| | | | | | | | | **Total Credits** | **20** |
| | | | | | | | | **Total Contact Hours/Week** | **28** |

**Semester II**

| S. No. | Course Code | Course Title | Course Mode | Course Category | L | T | P | J | C |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 24HST102 | Tamils and Technology | Theory | HS | 1 | 0 | 0 | 0 | 1 |
| 2 | 24HST103/ 24HST104 | Effective Communication / Professional Communication | Theory | HS | 2 | 0 | 0 | 0 | 2 |
| 3 | 24MAI123 | Computational Differential Equations | Embedded | BS | 3 | 0 | 2 | 0 | 4 |
| 4 | 24PHI102 | Applied Physics for Circuit Engineering | Embedded | BS | 3 | 0 | 2 | 0 | 4 |
| 5 | 24CSI101 | Logical Thinking and Problem Solving | Embedded | ES | 3 | 0 | 2 | 0 | 4 |
| 6 | 24BTT001 | Biology for Engineers | Theory | BS | 1 | 0 | 0 | 0 | 1 |
| 7 | 24EII101 | Semiconductor Devices and Applications | Embedded | PC | 3 | 0 | 2 | 0 | 4 |
| 8 | 24INP103 | Innovative Practicum - 2 | Practical | ES | 0 | 0 | 2 | 0 | 1 |
| 9 | 24HSP112 | Holistic Wellness - 2 | Practical | HS | 0 | 0 | 2 | 0 | 1 |
| 10 | 24INO1--- | FCLF General Stack - 2 | Practical | OE | 0 | 0 | 2 | 0 | 1 |
| | | | | | | | | **Total Credits** | **23** |
| | | | | | | | | **Total Contact Hours/Week** | **30** |

| Semester III | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **S. No.** | **Course Code** | **Course Title** | **Course Type** | **Course Category** | **L** | **T** | **P** | **J** | **C** |
| 1 | 24HSP005 | Mastering Conversations | Theory | HS | 0 | 0 | 2 | 0 | 1 |
| 2 | 24MAI233 | Probability and Applied Statistics | Embedded | BS | 3 | 0 | 2 | 0 | 4 |
| 3 | 24MET205 | Thermodynamics & Fluid Mechanics | Theory | ES | 3 | 0 | 0 | 0 | 3 |
| 4 | 24EII201 | Electronic Circuit Design | Embedded | PC | 3 | 0 | 2 | 0 | 4 |
| 5 | 24EII202 | Sensors and Transducers | Embedded | PC | 3 | 0 | 2 | 0 | 4 |
| 6 | 24EII203 | Electrical Machines and Measurement Systems | Embedded | ES | 2 | 0 | 2 | 0 | 3 |
| 7 | 24INP201 | Innovation Practicum -3 | Practical | ES | 0 | 0 | 2 | 0 | 1 |
| 8 | 24INO--- | FCLF – General Stack - 3 | Practical | OE | 0 | 0 | 2 | 0 | 1 |
| 9 | 24INM201 | Universal Human Values – II Understanding Harmony | Theory | HS | 1 | 0 | 0 | 0 | 1 |
| 10 | 24EIJ204 | Internship- I | Project | PRJ | 0 | 0 | 0 | 0 | 1 |
| **Total Credits** | | | | | | | | | **23** |
| **Total Contact Hours/Week** | | | | | | | | | **27** |

| Semester IV | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **S. No.** | **Course Code** | **Course Title** | **Course Type** | **Course Category** | **L** | **T** | **P** | **J** | **C** |
| 1 | 24HSP006 | Mastering Group Discussion and Presentation Skills | Theory | HS | 0 | 0 | 2 | 0 | 1 |
| 2 | 24ECI204 | Linear Integrated Circuits | Embedded | PC | 3 | 0 | 2 | 0 | 4 |
| 3 | 24EEI203 | Digital System Design | Embedded | PC | 3 | 0 | 2 | 0 | 4 |
| 4 | 24EII204 | Signal Processing Techniques | Embedded | PC | 3 | 0 | 2 | 0 | 4 |
| 5 | 24EII205 | Control panel Design and Relay logic System | Embedded | PC | 2 | 0 | 2 | 0 | 3 |
| 6 | 24INO--- | FCLF – Tech. Stack - 1 | Theory | OE | 0 | 0 | 2 | 0 | 1 |
| 7 | 24INO--- | FCLF – Emerging Tech Stack - 1 | Theory | OE | 0 | 0 | 2 | 0 | 1 |
| 8 | 24INP202 | Innovation Practicum - 4 | Practical | ES | 0 | 0 | 2 | 0 | 1 |
| 9 | 24INM202 | Environmental Science & Sustainability | Theory | BS | 1 | 0 | 2 | 0 | 2 |
| 10 | 24INM102 | Indian Knowledge System | Theory | HS | 1 | 0 | 0 | 0 | 1 |
| **Total Credits** | | | | | | | | | **22** |
| **Total Contact Hours/Week** | | | | | | | | | **31** |

| Semester V | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **S. No.** | **Course code** | **Course Title** | **Course Type** | **Course Category** | **L** | **T** | **P** | **J** | **C** |
| 1 | 24HSTP007 | Building Professional Readiness | Theory | HS | 0 | 0 | 2 | 0 | 1 |
| 2 | 24EII301 | Field Instrumentation | Embedded | PC | 3 | 0 | 2 | 0 | 4 |
| 3 | 24EII302 | Embedded Systems Design and Development | Embedded | PC | 3 | 0 | 2 | 0 | 4 |
| 4 | 24EII303 | Control Engineering | Embedded | PC | 3 | 0 | 2 | 0 | 4 |
| 5 | 24EII304 | Data Structures & Algorithms for Intelligent Systems | Embedded | PC | 2 | 0 | 2 | 0 | 3 |
| 6 | 24INO--- | FCLF – Tech. Stack - 2 | Theory | OE | 1 | 0 | 0 | 0 | 1 |
| 7 | 24INO--- | FCLF – Emerging Tech Stack - 2 | Theory | OE | 1 | 0 | 0 | 0 | 1 |
| 8 | 24EIE--- | Professional Elective - 1 | Theory | PE | 3 | 0 | 0 | 0 | 3 |
| 9 | 24EIJ305 | Internships/Mini Projects - 2 | Project | PC | 0 | 0 | 0 | 4 | 2 |
| 10 | 24HS---- | Indian Constitution | | HS | 2 | 0 | 0 | 0 | 0 |
| | | | | | | | | **Total Credits** | **23** |
| | | | | | | | | **Total Contact Hours/Week** | **33** |

| Semester VI* | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **S. No.** | **Course Code** | **Course Title** | **Course Type** | **Course Category** | **L** | **T** | **P** | **J** | **C** |
| 1 | 24EII306 | Industrial Automation | Embedded | PC | 3 | 0 | 2 | 0 | 4 |
| 2 | 24EII307 | VLSI Design | Embedded | PC | 2 | 0 | 2 | 0 | 3 |
| 3 | 24EII308 | Process Dynamics and Control | Embedded | PC | 3 | 0 | 2 | 0 | 4 |
| 4 | 24EIT310 | Industrial Communication & Networking | Theory | HS | 3 | 0 | 0 | 0 | 3 |
| 5 | 24EIE--- | Professional Elective - 2 | Theory | PC | 3 | 0 | 0 | 0 | 3 |
| 6 | 24EIE--- | Professional Elective - 3 | Theory | PC | 3 | 0 | 0 | 0 | 3 |
| 7 | 24INO--- | FCLF – Tech Stack - 3 | Theory | OE | 1 | 0 | 0 | 0 | 1 |
| 8 | 24INO--- | FCLF – Emerging Tech Stack - 3 | Theory | OE | 1 | 0 | 0 | 0 | 1 |
| 09 | | Indian/Foreign Languages | Theory | HS | 2 | 0 | 2 | 0 | 2 |
| | | | | | | | | **Total Credits** | **24** |
| | | | | | | | | **Total Contact Hours/Week** | **30** |

| Semester VII | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **S. No.** | **Course Code** | **Course Title** | **Course Type** | **Course Category** | **L** | **T** | **P** | **J** | **C** |
| 1 | 24EII401 | Advanced Control Systems | Embedded | PC | 3 | 0 | 2 | 0 | 4 |
| 2 | 24HS---- | Project Management and Finance | Theory | HS | 3 | 0 | 0 | 0 | 3 |
| 3 | 24EIE--- | Professional Elective - 4 | Theory | PE | 3 | 0 | 0 | 0 | 3 |
| 4 | 24EIE--- | Professional Elective - 5 | Theory | PE | 3 | 0 | 0 | 0 | 3 |
| 5 | 24EIE--- | Professional Elective - 6 | Theory | PE | 3 | 0 | 0 | 0 | 3 |
| 6 | 24EIJ401 | Capstone Project Phase-1I / Industrial Internship | Project | PJ | 0 | 0 | 0 | 6 | 3 |
| 1 | 24EII401 | Advanced Control Systems | Embedded | PC | 3 | 0 | 2 | 0 | 4 |
| | | | | | | | | **Total Credits** | **19** |
| | | | | | | | | **Total Contact Hours/Week** | **23** |
| **Semester VIII** | | | | | | | | | |
| **S. No.** | **Course Code** | **Course Title** | **Course Type** | **Course Category** | **L** | **T** | **P** | **J** | **C** |
| 1 | 24EIJ402 | Capstone Project Phase -2/ Industrial Internship | Project | PJ | 0 | 0 | 0 | 24 | 12 |
| | | | | | | | | **Total Credits** | **12** |
| | | | | | | | | **Total Contact Hours/Week** | **24** |

| Semester | I | II | III | IV | V | VI | VII | VIII |
|---|---|---|---|---|---|---|---|---|
| Credits/Semester | 20 | 23 | 22 | 22 | 23 | 24 | 19 | 12 |
| | | | | | | | Total Credits | 165 |

## Elective Tracks

- Sustainable Energy & Smart Grids
- Electric Mobility & Smart Transportation
- Cyber-Physical & Embedded Systems
- VLSI & Semiconductor Design
- AI, Edge & Neuromorphic Computing
- Advanced Communications & Networking
- **Intelligent Robotics & Automation**
- Biomedical & Wearable Electronics / **Health Care Instrumentation**
- Quantum Computing/Electronics

| Professional Electives | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **S.No** | **Couse Code** | **Course Title** | **Course Mode** | **CT** | **L** | **T** | **P** | **J** | **C** |
| **Intelligent Robotics and Automation Track** | | | | | | | | | |
| **1** | **24EIE001** | Basics of Robotics and Mechanisms | **Theory** | PE | **3** | **0** | **0** | **0** | **3** |
| **2** | **24EIE002** | Powertronics | **Theory** | PE | **3** | **0** | **0** | **0** | **3** |
| **3** | **24EIE003** | Fluid Power Systems | **Theory** | PE | **3** | **0** | **0** | **0** | **3** |
| **4** | **24EIE004** | Robotics and Flexible Automation | **Theory** | PE | **3** | **0** | **0** | **0** | **3** |
| **5** | **24EIE005** | DCS and SCADA Systems | **Theory** | PE | **3** | **0** | **0** | **0** | **3** |
| **6** | **24EIE006** | Machine Vision and Image Processing for Robotics | **Theory** | PE | **3** | **0** | **0** | **0** | **3** |
| **7** | **24EIE007** | Mobile Robotics | Theory | PE | **3** | **0** | **0** | **0** | **3** |
| **8** | **24EIE008** | Autonomous Systems and Path Planning | Theory | PE | **3** | **0** | **0** | **0** | **3** |
| **9** | **24EIE009** | Digital Manufacturing | Theory | PE | **3** | **0** | **0** | **0** | **3** |
| **10** | **24EIE010** | Industrial Safety and Hazardous Systems | Theory | PE | **3** | **0** | **0** | **0** | **3** |
| **11** | **24EIE011** | Collaborative Robots (Cobots) | Theory | PE | **3** | **0** | **0** | **0** | **3** |
| **12** | **24EIE012** | Industry 5.0 | Theory | PE | **3** | **0** | **0** | **0** | **3** |
| **13** | **24EIE013** | Smart Farming | Theory | PE | **3** | **0** | **0** | **0** | **3** |

| Professional Electives | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **S.No** | **Couse Code** | **Course Title** | **Course Mode** | **CT** | **L** | **T** | **P** | **J** | **C** |
| **Health Care Instrumentation Track** | | | | | | | | | |
| 1 | 24EIE021 | Bio Sensors and Medical Instrumentation | Theory | PE | 3 | 0 | 0 | 0 | 3 |
| 2 | 24EIE022 | Bio Signal Processing | Theory | PE | 3 | 0 | 0 | 0 | 3 |
| 3 | 24EIE023 | Clinical Support and Laboratory Equipment | Theory | PE | 3 | 0 | 0 | 0 | 3 |
| 4 | 24EIE024 | Medical Device Calibration | Theory | PE | 3 | 0 | 0 | 0 | 3 |
| | 24EIE025 | Bio-MEMS and Lab-on-Chip Systems | Theory | PE | 3 | 0 | 0 | 0 | 3 |
| 5 | 24EIE026 | Smart Biomedical Imaging Analytics | Theory | PE | 3 | 0 | 0 | 0 | 3 |
| 7 | 24EIE027 | AI in Health care | Theory | PE | 3 | 0 | 0 | 0 | 3 |
| 8 | 24EIE028 | Smart Healthcare Systems and Telemedicine | Theory | PE | 3 | 0 | 0 | 0 | 3 |
| 9 | 24EIE029 | Robotics for Surgery and Rehabilitation | Theory | PE | 3 | 0 | 0 | 0 | 3 |
| | 24EIE030 | | | | | | | | |

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# FIRST SEMESTER

| 24HST101 | தமிழர் மரபு / HERITAGE OF TAMILS (Common to all Departments) | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 1 | 0 | 0 | 0 | 1 |
| HS | | SDG | 4, 11, 16 | | | |

| Pre-requisite courses | - | Data Book / Code book (If any) | - |
|---|---|---|---|

## Course Objectives:

The purpose of taking this course is to:

| | |
|---|---|
| 1 | தமிழ் மொழி மற்றும் இலக்கியத்தின் அடிப்படை அம்சங்களை அறிமுகப்படுத்துதல், அதன் தொன்மைக்காலம் முதல் நவீனகாலம் வரையிலான வளர்ச்சியை விளக்கம் செய்யுதல்.<br>Introduce students to the foundational aspects of Tamil language and literature, tracing its evolution from ancient to modern times. |
| 2 | தமிழகத்தின் செழுமையான கலாச்சார பாரம்பரியத்தை அறிமுகப்படுத்துதல், பாறை ஓவியக் கலையிலிருந்து நவீன சிற்ப கலையின்படி அதன் கலை வெளிப்பாடுகளை ஆராய்தல்.<br>Familiarize students with the rich cultural heritage of Tamil Nadu, exploring its artistic expressions from rock art paintings to contemporary sculptures. |
| 3 | தமிழகத்தின் நாட்டுப்புறக் கலைகள் மற்றும் வீரவிளையாட்டுகளை அறிதல்- தினணக்கோட்பாடுகளை ஆராய்தல்- இந்திய தேசிய இயக்கத்தில் தமிழர்களின் பங்கினை அறிதல்.<br>To know the folk arts and heroic ames of Tamilnadu-explore the concept of thinai -to know the role of Tamils in Indian National movement. |

## Course Outcomes

| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
|---|---|---|
| CO1 | தமிழ் மொழி மற்றும் இலக்கியத்தின் அடிப்படை அறிவை மேம்படுத்துதல். மொழி பண்பாட்டில் எவ்வாறு இணைந்துள்ளது என்பதை உணர்தல்.<br>Enhance the fundamental knowledge of Tamil language and literature | U |
| CO2 | பழங்கால பாறை ஓவியங்கள், சிற்பம் என கலைகள் நவீன காலம்வரை எவ்வாறு பயணிக்கிறது என்பதை புரிந்துகொள்ளுதல்.<br>Understand the heritage, rock art paintings to modern art sculpture | U |
| CO3 | நாட்டுப்புறக் கலைகள் தற்காப்புக் கலைகளாகவும், உடல் ஆரோக்கியத்தை மேம்படுத்தும் விதமாகவும் அமைவதை அறிந்து கலைகள் மீதான ஆர்வத்தை அதிகரிக்கச் செய்தல்- தமிழர்களின் அகத்திணை, புறத்திணை கோட்பாட்டினை புரிந்து கொள்ளுதல். இந்திய பண்பாட்டில் தமிழர்களின் பங்களிப்பை அறிதல்.<br>Acquire essential knowledge in the folk and martial arts-understanding the Agam and puram concept- to know the contribution of Tamils in Indian culture. | Ap |

| | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | | |
| Course Outcomes (CO) | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 | PSO-3 |
| 1 | | | | | | | 3 | 2 | 2 | | 2 | | | |
| 2 | | | | | | | 3 | 3 | 2 | | 2 | | | |
| 3 | | | | | | | 3 | 2 | 2 | | 2 | | | |

## Course Content

| | |
|---|---|
| **மொழி மற்றும் இலக்கியம்**<br>இந்திய மொழிக் குடும்பங்கள் - திராவிட மொழிகள் - தமிழ் ஒரு செம்மொழி - தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமய சார்பற்ற தன்மை - சங்க இலக்கியத்தில் பகிர்தல் அறம் - திருக்குறளில் மேலாண்மைக் கருத்துக்கள் - தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தொடக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் - சிற்றிலக்கியங்கள் - தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி - தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.<br><br>**LANGUAGE AND LITERATURE**<br>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. | **3 Hours** |
| **மரபு - பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை - சிற்பக்கலை**<br>நடுகல் முதல் நவீன சிற்பங்கள் வரை - ஐம்பொன் சிலைகள்- பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் - தேர் செய்யும் கலை - சுடுமண் சிற்பங்கள் - நாட்டுப்புற தெய்வங்கள் - குமரிமுனையில் திருவள்ளுவர் சிலை - இசைக் கருவிகள் - மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் - தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.<br>**HERITAGE – ROCK ART PAINTINGS TO MODERN ART SCULPTURES**<br>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. | **3 Hours** |
| **நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்**<br>தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக்கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள். | **3 Hours** |

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| **FOLK AND MARTIAL ARTS**<br>Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Ciabatta, Valari, Tiger dance - Sports and Games of Tami | |
| **தமிழர்களின் திணைக்கோட்பாடுகள்**<br>தமிழகத்தின் தாவரங்களும், விலங்குகளும் - தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக்கோட்பொடுகள் - தமிழர்கள் போற்றிய அறக்கோட்பாடு - சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் - சங்ககால நகரங்களும் துறைமுகங்களும் - சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி - கடல்கடந்த நாடுகளில் தமிழர்களின் வெற்றி.<br>**THINAI CONCEPTS OF TAMIL**<br>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. | **3 Hours** |
| **இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு**<br>இந்திய விடுதலைப் போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் - சுயமரியாதை இயக்கம் - இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு - கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.<br>**CONTRIBUTIONS OF TAMIL TO INDIAN NATIONAL MOMENT AND INDIAN CULTURE**<br>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. | **3 Hours** |

| Theory Hours: 15 | Tutorial Hours: 0 | Practical Hours: 0 | Project Hours: 0 | Total Hours: 15 |
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**Learning Resources**

**Reference books:**


1. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித்தமிழ் - முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி - வைகை நதிக்கரையில் சங்ககால 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 Textbook and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)

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| 11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)<br>12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) |
| **Online Educational Resources:** |
| 1. https://www.youtube.com/watch?v=IKPwEmsmuZc&list=PLMMrJE4pHZmc0iJZIE6lBpFoPK_9Y325e<br>2. https://www.youtube.com/watch?v=j6_ddjn_gLc&list=PLMMrJE4pHZmc0iJZIE6lBpFoPK_9Y325e&index=2<br>3. https://docs.google.com/presentation/d/1pf0jbyuDTNdvlcKMnOfoPjbqha7JqdOc/edit#slide=id.p1<br>4. https://www.youtube.com/watch?v=IKPwEmsmuZc&list=PLMMrJE4pHZmc0iJZIE6lBpFoPK_9Y325e&index=1 |

| **Assessment (Theory course)** |
|---|
| CAT, Activity and Learning Task(s), Mini project, MCQ, End Semester Examination (ESE), Assignments, Quiz, Library Record |

| **Course Curated by** | | | |
|---|---|---|---|
| **Expert from Industry** | **Expert(s) from Higher Education Institutions** | **Internal Expert** | |
| Mr.Vijayan Ramanathan ,<br>Project manager,<br>Toppan Merrill. Technologies,<br>Coimbatore | Dr. Aninditha Sahoo,<br>IIT, Madras<br>Dr.P.R.Sujatha Priyadharshini,<br>Anna University, Chennai<br>Dr. E. Justin Ruben,<br>CIT, Coimbatore | Suriya Prakash<br>Department of Language | |
| **Recommended by BoS on** | 16.08.2024 | | |
| **Academic Council Approval** | No: 27 | **Date** | 24.08.2024 |

| 24MAI113 | LINEAR ALGEBRA AND MULTIVARIATE CALCULUS (Common to EC, EE, EI) | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 0 | 4 |
| BS | | SDG | 7, 9 | | | |

| Pre-requisite courses | - | Data Book / Code book (If any) | - |
|---|---|---|---|

## Course Objectives:

The purpose of taking this course is to:

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|---|---|
| 1 | provide a solid foundation in linear algebra, focusing on eigenvalues, eigenvectors, matrix transformations, and quadratic forms for practical applications. |
| 2 | develop skills in multivariate calculus for solving optimization problems and computing derivatives, integrals, and volumes using double and triple integrals. |
| 3 | teach key concepts in vector calculus, including operations like gradient, divergence, curl, and the application of Green's, Gauss's, and Stokes' theorems. |
| 4 | introduce fundamental principles of complex analysis, covering analytic functions, Cauchy's theorems, and residue calculus for evaluating integrals through contour integration. |
| 5 | equip students with MATLAB proficiency to perform matrix operations, solve optimization problems, compute integrals and verify complex mathematical theorems. |

## Course Outcomes

| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
|---|---|---|
| CO1 | apply the concepts of eigenvalues, eigenvectors, and the Cayley-Hamilton theorem to diagonalize matrices and perform orthogonal transformations of symmetric matrices using matrix operations and eigenvalue computations. | Ap |
| CO2 | apply orthogonal transformations to reduce quadratic forms to their canonical forms and solve related matrix problems, leveraging to compute transformations and quadratic forms. | Ap |
| CO3 | analyze and solve unconstrained and constrained optimization problems using the Lagrange multiplier method and determine the maxima and minima of functions with two or more variables relevant to engineering applications. | An |
| CO4 | apply double and triple integrals in Cartesian coordinates by computing and using them to determine areas and volumes in engineering applications, including changing the order of integration. | Ap |
| CO5 | apply vector calculus operations like gradient, divergence, curl, and directional derivatives to verify Green's theorem, Gauss's divergence theorem, and Stokes' theorem used for computational verification. | Ap |
| CO6 | apply Cauchy-Riemann equations, Cauchy's integral theorem, and Cauchy's integral formula to solve complex analysis problems and evaluate integrals using the residue theorem for performing contour integration. | Ap |

| Course Outcomes (CO) | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | | |
| | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 | PSO-3 |
| 1 | 3 | 2 | | | 2 | | | | | | | | | |
| 2 | | 3 | 2 | | 2 | | | | | | | | | |
| 3 | 2 | | | | 2 | | 1 | | | | | | | |
| 4 | 3 | | | 2 | 2 | | | | | | | | | |
| 5 | | 2 | | | 2 | | | 2 | | | | | | |
| 6 | | | | | 2 | | | | | | | | | |

## Course Content:

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|---|---|
| **MATRICES**<br>Eigenvalues and Eigenvectors of a real matrix – Properties of eigenvalues and eigenvectors – Cayley Hamilton theorem (excluding proof) - Orthogonal matrices – Orthogonal transformation of a symmetric matrix to diagonal form – Reduction of quadratic form to canonical form by orthogonal transformation.<br><br>**Practical Component**<br>Introduction to MATLAB - Matrix Operations - Addition, Multiplication, Transpose, Inverse and eigenvalues and eigenvectors of higher order matrices.<br>Characteristic equation of a Matrix and Cayley-Hamilton Theorem. | **9 Hours**<br><br>**6 Hours** |
| **FUNCTIONS OF SEVERAL VARIABLES**<br>Total derivative – Taylor's series expansion – Maxima and minima of functions of two variables – Constrained maxima and minima: Lagrange's multiplier method with single constraints – Jacobians.<br><br>**Practical Component**<br>Determining Maxima and Minima of a function of one variable.<br>Determining Maxima and Minima of a function of two variables | **9 Hours**<br><br>**6 Hours** |
| **MULTIPLE INTEGRALS**<br>Double integration in Cartesian coordinates – Change of order of integration - Triple integration in Cartesian coordinates – Applications: Area as double integral and Volume as triple integral.<br>**Practical Component**<br>Double Integral and Area as double integral<br>Triple Integral and Volume as triple integral | **9 Hours**<br><br>**6 Hours** |
| **VECTOR CALCULUS**<br>Gradient, divergence and curl – Directional derivative – Irrotational and Solenoidal vector fields - Green's theorem in a plane, Gauss divergence theorem and Stoke's theorem (excluding proofs) – Verification of theorem and simple applications.<br>**Practical Component**<br>Evaluating gradient, divergence and curl.<br>Verifying Green's theorem in the plane | **9 Hours**<br><br>**6 Hours** |

| | |
|---|---|
| **ANALYTIC FUNCTIONS**<br>Functions of a complex variable – Analytic functions – Necessary and sufficient conditions in Cartesian coordinates, Cauchy- Riemann equations (excluding proofs).<br><br>**Practical Component**<br>Check analyticity using Cauchy-Riemann equations | **4 Hours**<br><br>**3 Hours** |
| **COMPLEX INTEGRATION**<br>Cauchy's integral theorem – Cauchy's integral formula –Singularities –Residues – Residue theorem –Application of residue theorem for evaluation of real integrals – Contour Integration (excluding poles on the real axis).<br><br>**Practical Component**<br>Perform contour integration around a circular contour | **5 Hours**<br><br>**3 Hours** |

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|---|---|---|---|---|---|---|---|---|---|
| **Theory Hours:** | **45** | **Tutorial Hours:** | **0** | **Practical Hours:** | **0** | **Project Hours:** | **30** | **Total Hours:** | **75** |

## Learning Resources

### Textbooks

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 45thEdition, 2020.
2. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., New Delhi, 11th Reprint, 2018.
3. Kreyszig E., "Advanced Engineering Mathematics" International students' version, 10th Edition, John Wiley and sons, 2023.

### Reference books

1. Veerarajan T., "Engineering Mathematics (for First Year)", Tata McGraw Hill Pub. Co. Ltd., New Delhi, Revised Edition, 2008.
2. Kandasamy P., Thilagavathy K., and Gunavathy K., "Engineering Mathematics", S. Chand & Co., New Delhi, (Reprint) 2014.
3. Venkataraman M.K., "Engineering Mathematics", The National Publising Co., Chennai, 2003.
4. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.

### Online Resources (Web Links)

1. Linear Algebra by MIT Open Courseware (Free) https://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/
2. Multivariable Calculus by MIT Open Courseware (Free) https://ocw.mit.edu/courses/mathematics/18-02sc-multivariable-calculus-fall-2010/
3. Khan Academy: Multivariable Calculus (Free) https://www.khanacademy.org/math/multivariable-calculus
4. Coursera: Introduction to MATLAB Programming by Vanderbilt University https://www.coursera.org/learn/matlab

## Assessment (Embedded course)

SA, Activity and Learning Task(s), Mini project, MCQ, End Semester Examination (ESE)
Lab Workbook, Experimental Cycle tests, viva-voce

## Course Curated by

| Expert(s) from Industry | Expert(s) from Higher Education Institution | Internal Expert(s) |
|---|---|---|
| Mr. Ramesh V.S.,<br>STEPS Knowledge Services Private Limited, Coimbatore.<br>Mr.Jayakumar Venkatesan,<br>Valles Marineris International Private Limited- Chennai.<br>Mr. Imran Khan,<br>GE Transportation Company, Bangalore. | Dr.T.Govindan, Government College of Engineering, Srirangam, Trichy.<br>Dr.C.Porkodi, PSG College of Technology, Coimbatore.<br>Dr.P.Paramanathan, Amrita Vishwa Vidyapeetham, Coimbatore. | Dr. K.Maheswari<br>Dr. J.Rajasingh<br>Dr. K.Meena,<br>Department of Mathematics |

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| **Recommended by BoS on** | 16.08.2024 | | |
| **Academic Council Approval** | No: 27 | **Date** | 24.08.2024 |

| 24CYI101 | ELECTRONIC MATERIALS CHEMISTRY (Common to EC, EE, EI and MR) | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 0 | 4 |
| BS | | SDG | 7, 9, 12 | | | |

| Pre-requisite courses | - | Data Book / Code book (If any) | - |
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## Course Objectives:

The purpose of taking this course is to:

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|---|---|
| 1 | acquire knowledge of advanced electrochemical energy systems, organic materials, insulating, and high-resistivity materials in electronics to understand their role in modern electronic applications. |
| 2 | develop skills to synthesize, analyze, and characterize various electronic materials such as conducting polymers, nanomaterials, and green electronic materials through theoretical and practical approaches. |
| 3 | gain competency in evaluating the environmental impact of electronic materials and promote sustainable practices, including green chemistry principles, recycling, and e-waste management. |
| 4 | apply advanced concepts of electronic materials to solve real-world engineering problems in the field of energy storage, flexible electronics, and nanoelectronics. |
| 5 | enhance analytical and problem-solving abilities through hands-on laboratory experiments, bridging theoretical concepts with practical applications in the electronic materials domain. |

## Course Outcomes

| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
|---|---|---|
| CO1 | apply electrochemical principles to solve challenges in advanced battery and hybrid energy systems. | Ap |
| CO2 | analyse the properties and synthesis of conducting polymers to compare their applications in flexible electronics and OLEDs. | An |
| CO3 | analyse the applications in electronic components by integrating the properties of insulating and high-resistivity materials. | An |
| CO4 | apply the concepts of nanomaterials to demonstrate their significance in nanoelectronics and electronic sensing technologies. | Ap |
| CO5 | analyse the environmental impact of electronic materials to prioritize the adoption of green chemistry and sustainable electronic practices. | An |
| CO6 | evaluate and recommend innovative eco-friendly electronic materials and recycling strategies to address future environmental challenges. | E |

| Course Outcomes (CO) | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | | |
| | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 | PSO-3 |
| 1 | 3 | 2 | | | | | | | | | | | | |
| 2 | 2 | | 2 | | | | | | | | 2 | | | |
| 3 | 2 | 2 | | 2 | | | | | | | | | | |
| 4 | | | 2 | | 2 | | | | | | | | | |
| 5 | | | | | | 3 | 2 | | | | | | | |
| 6 | | 1 | 1 | | | | 1 | | | | 1 | | | |

## Course Content

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| **ADVANCED ELECTROCHEMICAL ENERGY SYSTEMS**<br>Introduction to electrochemistry for energy systems - Advanced battery technologies (Li-ion batteries, Sodium-ion batteries, Al – air Battery, Zn - air batteries) - Comparison of battery technologies and its challenges.<br>Hybrid energy storage systems:<br>Super-capacitors: Electric double-layer capacitors (EDLCs) - Pseudo capacitors - Hybrid supercapacitors<br>Fuel cells: Principles and recent advancements of Proton exchange membrane fuel cells (PEMFCs) - Solid oxide fuel cells (SOFCs) - Microbial fuel cells - Regenerative fuel cells. | **9 Hours** |
| **Practical Component:**<br>• Compare the Conductivity of different electrolytes in battery systems.<br>• Determination of electrical conductivity in electroplated metal coating on substrate.<br>• Determination of electrode potentials of the cell and construct feasible cell.<br>• Estimation of mixture of acids using strong base by Conductometric titrations. | **12 Hours** |
| **ORGANIC MATERIALS FOR ELECTRONIC APPLICATIONS**<br>Introduction to polymers - Classification - Functionality - Degree of Polymerization.<br>Polymerization: Addition polymerization and its Mechanism (Free Radical, Cationic, and Anionic) - Condensation polymerization – Copolymerization<br>Conducting materials: Small molecule conductors (Pentacenes and their derivatives) - Engineered Pentacenes and Reversible functionalization - Synthesis and doping of conducting polymers (Polyacetylene and Polythiophene) - Applications of conducting materials in devices (Organic light-emitting diodes (OLEDs), Organic photovoltaics, Flexible and printed electronics) | **9 Hours** |
| **Practical Component:**<br>• Determination of molecular weight of polymer using Viscometric method. | **3 Hours** |

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| **INSULATING AND HIGH-RESISTIVITY MATERIALS IN ELECTRONICS**<br>Insulating materials in electronics: Introduction (Importance and Key properties) - Classification (Solid, liquid, and gas insulators) - Properties (Dielectric properties and breakdown) - Preparation, properties, and uses of Solid inorganic (Mica and Porcelain) and organic insulators (Bakelite and Rubber) - Liquid insulators (Epoxy resin and Transformer oil) – Gas Insulator (Sulfur hexafluoride)<br>High Electrical resistivity materials: Factors influencing electrical resistivity - High resistivity materials (Composition, properties, and applications of Manganin and Molybdenum disilicide) - Nanocomposite insulators<br><br>**Practical Component:**<br>• Determination of pH and Conductivity in different Transformer Oils | **9 Hours**<br><br>**3 Hours** |
| **NANOMATERIALS AND NANOELECTRONICS**<br>Introduction to nano chemistry - Distinction between molecules, nanoparticles, and bulk materials - Size-dependent properties of nanomaterials - Quantum confinement effects - Carbon nanotubes and graphene (Preparation by Chemical Vapor Deposition and Laser Ablation, Properties and Applications in electronics) - Nanowires (Preparation by Electrochemical Deposition and Electrospinning, Properties and Applications in electronics) – Nanoparticles, nanoclusters, and nanorods (Preparation by Sol-gel, Solvothermal, Properties and Applications in electronics) - Nanotubes and nanowires in sensing applications.<br><br>**Practical Component:**<br>• Synthesis of Nanoparticle using Solvo-Thermal Method | **9 Hours**<br><br>**3 Hours** |
| **GREEN CHEMISTRY AND SUSTAINABLE ELECTRONICS**<br>Introduction to sustainable electronics (Importance and Environmental challenges in the electronics industry) - Environmental impact (Conductors, semiconductors, and polymers), Toxicity and persistence of electronic materials - Green chemistry principles in electronics manufacturing (12 principles of green chemistry applied to electronics and Eco-friendly materials and processes) - Life cycle assessment of electronic products - Recycling and e-waste management strategies (Recovery, Challenges and innovations in electronics recycling) - Future trends in eco-friendly electronic materials.<br><br>**Practical Component:**<br>• Determination of Copper from electronic waste by Complexometric method.<br>• Estimation of copper ion by spectrophotometry.<br>• Estimation of strength of sulphuric acid in spent Battery Electrolytes by pH metry | **9 Hours**<br><br>**9 Hours** |

| | | | | |
|---|---|---|---|---|
| **Theory Hours: 45** | **Tutorial Hours: 0** | **Practical Hours: 30** | **Project Hours: 0** | **Total Hours: 75** |

## Learning Resources

### References:


1. Singh, G. (2019). Advanced battery technology for energy storage applications (1st ed.). New Age International Publishers.
2. Beguin, F., & Frackowiak, E. (2013). Supercapacitors: Materials, systems, and applications (1st ed.). Wiley-VCH.
3. Kumar, V., & Kumar, A. (2015). Conducting polymers: Synthesis, properties, and applications (1st ed.). Narosa Publishing House.
4. Chandrasekhar, S. (2014). Organic electronics: Concepts and applications (1st ed.). Springer.
5. Sharma, R. K. (2022). Electrochemistry for energy systems (1st ed.). Narosa Publishing House.
6. Hironis, N. P., & Pal, M. (2004). Electrical insulating materials (1st ed.). S. Chand & Company Ltd.
7. Kulkarni, S. K. (2014). Nanotechnology: Principles and practices (3rd ed.). Capital Publishing Company.
8. Ahluwalia, V. K. (2009). Green chemistry: Environmentally benign reactions (1st ed.). Ane Books Pvt. Ltd.
9. Shina, S. G. (2008). Green electronics design and manufacturing (1st ed.). McGraw-Hill.


### Online Resources (Weblinks)

1. https://www.coursera.org/learn/lithium-based-batteries
2. https://www.youtube.com/watch?v=Gbltx4IXLzQ&list=PLbMVogVj5nJT0slH3tuas5BIp1DG8ZpMj&index=2
3. https://www.coursera.org/learn/applied-sustainability-engineering
4. https://www.youtube.com/watch?v=nSAvyQajVzE

## Assessment (Embedded course)

SA, Activity and Learning Task(s) (Concept Map, Think-Pair-Share, Jigsaw), MCQ, End Semester Examination (ESE), Lab Workbook, Model Exam, Viva-Voce.

## Course Curated by

| Expert from Industry | Expert from Higher Education Institution | Internal Expert(s) |
|---|---|---|
| Dr. Muthuraja Perumal<br>General Manager - Research & Development<br>Rohith Industries, APIIC Industrial Park,<br>Andhra Pradesh | Dr. Venkatakrishnan<br>Professor,<br>School of Chemical Sciences<br>Indian Institute of Technology (Mandi)<br>Himachal Pradesh<br>India | Dr K Rathidevi,<br>Dr. K Sampath,<br>Dr S Jyothi,<br>Dr R Ashokkumar,<br>Department of Chemistry |

| | | | |
|---|---|---|---|
| **Recommended by BoS on** | 16.08.2024 | | |
| **Academic Council Approval** | No.27 | **Date** | 24.08.2024 |

| 24MEI103 | Computer Aided – Engineering Graphics (Common to EE, EC, EI, BT) | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 2 | 0 | 2 | 0 | 3 |
| ES | | SDG | 4, 9, 12 | | | |

| Pre-requisite courses | - | Data Book / Code book (If any) | - |
|---|---|---|---|

## Course Objectives:

The purpose of taking this course is to:

| | |
|---|---|
| 1 | understand the fundamental principles of engineering graphics and their significance. |
| 2 | develop proficiency in freehand sketching, usage of drawing instruments, and lettering. |
| 3 | gain competency in using computer graphics technologies for graphical communication, including isometric views and various coordinate systems (absolute, relative, polar) |

## Course Outcomes

| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
|---|---|---|
| CO1 | apply the principles of engineering graphics to create accurate orthographic and isometric projections | Ap |
| CO2 | design free-hand sketches of orthographic views from pictorial representations to improve spatial understanding and communication of engineering concepts | C |
| CO3 | apply CAD software tools to create, edit, and annotate technical drawings and analyse them using ISO and ANSI standards | Ap |
| CO4 | analyse the parametric and non-parametric CAD models, producing detailed two-dimensional documentation, including sectional views and annotations. | An |
| CO5 | apply geometric and topological concepts to design 3D models for additive manufacturing. | Ap |
| CO6 | apply the principles of engineering graphics to create accurate orthographic and isometric projections | Ap |

| | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | | |
| Course Outcomes (CO) | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 | PSO-3 |
| 1 | 2 | 2 | | 2 | | | | | | | 2 | | | |
| 2 | | 1 | 2 | | | | | | | | 1 | | | |
| 3 | 2 | 3 | 2 | 2 | | | | | | | 2 | | | |
| 4 | | 1 | 1 | | | | | | 2 | | 1 | | | |
| 5 | | | | 2 | 2 | | | 1 | | | 1 | | | |
| 6 | | | | 2 | 2 | | | 1 | | | 1 | | | |

| Course Content | |
|---|---|
| **INTRODUCTION TO ENGINEERING DRAWING**<br>Principles of Engineering Graphics and their significance, Freehand sketching, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute. | **6 Hours(T)**<br>**6 Hours(P)** |
| **ORTHOGRAPHIC AND ISOMETRIC PROJECTIONS**<br>Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes; Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions. | **6 Hours(T)**<br>**6 Hours(P)** |
| **OVERVIEW OF COMPUTER GRAPHICS**<br>Listing the computer technologies that impact on graphical communication, Isometric Views of lines, Planes, Simple and compound Solids, Coordinates system - Absolute Coordinates, Relative Coordinates, Polar Coordinates. | **6 Hours(T)**<br>**6 Hours(P)** |
| **CUSTOMIZATION & CAD DRAWING**<br>Setting up modules and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Isometric Projections and Solids. | **6 Hours(T)**<br>**6 Hours(P)** |
| **ANNOTATIONS, LAYERING & OTHER FUNCTIONS**<br>Layers to create drawings, create, edit and use customized layers; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and projecting the true shape of the sectioned surface; Drawing annotation, Computer-aided design (CAD) software modeling of parts and assemblies. Part editing and two-dimensional documentation of models, Shape extractions (Freeform modelling). Planar projection theory includes sketching of perspective, isometric, Multiview, auxiliary, and section views. Spatial visualization exercises – Transformation, Rendering and Lighting. Geometry and topology of engineered components: Introduction to Additive manufacturing (AM); Exporting the 3D model. | **4 Hours(T)**<br>**8 Hours(P)** |

| Theory Hours: 30 | Tutorial Hours: 0 | Practical Hours: 30 | Project Hours: 0 | Total Hours: 60 |
|---|---|---|---|---|

**Learning Resources**

**Textbooks**

1. Dhawan, R. K. *A Textbook of Engineering Drawing*. S. Chand Publishing (2019).
2. Bhatt N.D., Panchal V.M. & Ingle P.R., Engineering Drawing, Charotar Publishing House (2014).
3. Shah, M.B. & Rana B.C. Engineering Drawing and Computer Graphics, Pearson Education (2008).

**Reference books**

1. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
2. Narayana, K.L. & P Kannaiah (2008), Textbook on Engineering Drawing, Scitech Publishers.

**Online Resources (Weblinks)**

1. https://www.youtube.com/watch?v=8UKg928M4C0
2. https://www.youtube.com/watch?v=JvsJf1huMXQ
3. https://www.youtube.com/watch?v=8lHEizPf-wY

**Assessment (Embedded course)**

| |
|---|
| SA, Activity and Learning Task(s), Mini project, MCQ, End Semester Examination (ESE)<br>Lab Workbook, Experimental Cycle tests, viva-voce |

| **Course Curated by** | | | |
|---|---|---|---|
| **Expert(s) from Industry** | **Expert(s) from Higher Education Institution** | | **Internal Expert(s)** |
| Mr. G. Vergin Vino<br>Design Engineer<br>TANCAM, Chennai | Dr. V. Prabhuraja<br>Professor, Department of Mechanical Engineering PSG College of Technology, Coimbatore | | Dr. Samuel Ratna Kumaar<br>Assistant Professor – III<br>Department of Mechanical Engineering |
| **Recommended by BoS on** | 17.08.2024 | | |
| **Academic Council Approval** | No: 27 | **Date** | 24.08.2024 |

| 24MET105 | BASICS ENGINEERING MECHANICS | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 |
| ES | | SDG | 9 | | | |

| Pre-requisite courses | - | Data Book / Code book (If any) | - |
|---|---|---|---|

## Course Objectives:

The purpose of taking this course is to:

| | |
|---|---|
| 1 | apply the principles of statics to analyse mechanical systems in instrumentation: |
| 2 | calculate geometry-dependent properties relevant to electrical and instrumentation systems |
| 3 | understand the role of friction in mechanical and electromechanical systems |
| 4 | analyse kinematic and kinetic behaviour of rigid bodies in instrumentation systems |

## Course Outcomes

| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
|---|---|---|
| CO 1 | analyse the principles of transmissibility and moments to determine equilibrium conditions in rigid bodies. | Ap |
| CO 2 | evaluate the geometry-dependent properties like centre of gravity and moment of inertia to assess their impact on mechanical systems | Ap |
| CO 3 | examine the laws of friction to distinguish between different types of friction in practical scenarios. | An |
| CO 4 | analyse and solve problems related to the kinematics of rigid bodies in plane motion | U |
| CO 5 | apply Newton's laws and principles of kinetics to solve problems involving the motion of rigid bodies. | U |

| Course Outcomes (CO) | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | | |
| | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 | PSO-3 |
| 1 | 3 | | | | | 2 | | | | | | 2 | | |
| 2 | 3 | | | | | 2 | | | | | | 2 | | |
| 3 | 3 | | | | | 2 | | | | | | 2 | | |
| 4 | 3 | | | | | 2 | | | | | | 2 | | |
| 5 | 3 | | | | | 2 | | | | | | 2 | | |

## Course Content

**STATICS OF RIGID BODIES** — **9 Hours**

Equivalent systems of forces acting on a rigid body in 2D space: Principle of transmissibility – Moment of force about a point– Moment of a couple – Equivalent

| | |
|---|---|
| couple –Moment of force about an axis – Resultant and equilibrium of forces – Resolution of a given force into force couple system – Equilibrium of a rigid bodies 2D space – Reactions and supports Analysis of structures. | |
| **GEOMETRY DEPENDENT PROPERTIES**<br>Centre of gravity, Centre of mass and Centroid – Moment of Inertia of simple and complex areas– Radius of gyration – Polar moment of inertia – Product of inertia - Mass moment of Inertia of simple solids. | **9 Hours** |
| **FRICTION**<br>Laws of friction – coefficient of friction – Dry friction – wedge friction – ladder friction – rolling resistance. Applications of friction | **9 Hours** |
| **KINEMATICS OF RIGID BODIES**<br>Kinematics of rigid bodies: Plane motion, translation and rotation:<br>General plane motion: Absolute velocity, relative velocity, absolute acceleration, relative acceleration | **9 Hours** |
| **KINETICS OF RIGID BODIES**<br>Dynamics of rotating systems in instrumentation Equations of motion of a rigid body - angular momentum devices kinetic energy of a rigid body - Vibration analysis: Types of vibrations, natural frequency, and damping | **9 Hours** |

| Theory Hours: 45 | Tutorial Hours: 0 | Practical Hours: 0 | Project Hours: 0 | Total Hours: 45 |
|---|---|---|---|---|

**Learning Resources**

**Textbooks**


1. Ferdinand P. Beer, Jr. Johnston, E. Russell, Mechanics for Engineers: Statics and Dynamics, McGraw-Hill Inc.,US (1987).
2. Hibbeller, R.C., Engineering Mechanics: Statics, and Engineering Mechanics: Dynamics, 15th edition, Prentice Hall, 2022


**Reference books**


1. Beer, Ferdinand P., E. Russell Johnston, David Mazurek, Phillip Cornwell, and Brian Self. *Vector Mechanics for Engineers: Statics and Dynamics*. 2024 ed. New Delhi: Tata McGraw-Hill, 2024. ISBN 9781260710892.
2. .James L. Meriam, L. G. Kraige, J. N. Bolton: Engineering Mechanics Statics , 9th edition, Wiley student edition, 2020.
3. James L. Meriam, L. G. Kraige, J. N. Bolton: Engineering Mechanics: Dynamics, 9th edition, Wiley student edition, 2020.
4. P. Boresi & J. Schmidt, Engineering Mechanics: Statics and Dynamics, 1/e, Cengage learning, 2008.
5. Irving H. Shames, G. Krishna Mohana Rao, Engineering Mechanics - Statics and Dynamics, Fourth Edition – PHI / Pearson Education Asia Pvt. Ltd., 2006.
10. Rajasekaran S and Sankarasubramanian G, “Engineering Mechanics-Statics and Dynamics”,

| |
|---|
| Vikas Publishing House Pvt. Ltd., New Delhi, 2006 |
| **Online Resources (Web Links)** |
| 1. https://www.khanacademy.org/math/differential-calculus<br>2. https://nptel.ac.in/courses/106105171<br>3. https://swayam.gov.in/nd1_noc19_cs42/preview |

| **Assessment (Theory course)** |
|---|
| CAT, Activity and Learning Task(s), Mini project, MCQ, End Semester Examination (ESE) |

| **Course Curated by** | | | |
|---|---|---|---|
| **Expert(s) from Industry** | **Expert(s) from Higher Education Institution** | | **Internal Expert(s)** |
| | | | |
| **Recommended by BoS on** | 17.08.2024 | | |
| **Academic Council Approval** | 27 | **Date** | 24.08.2024 |

| 24ADP001 | BASICS OF ARTIFICIAL INTELLIGENCE (Common to all Departments except CS, IT, AD) | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 0 | 0 | 2 | 0 | 1 |
| ES | | SDG | 8, 9, 16 | | | |

| Pre-requisite courses | - | Data Book / Code book (If any) | - |
|---|---|---|---|

| Course Objectives: | |
|---|---|
| The purpose of taking this course is to: | |
| 1 | introduce students to the fundamentals of Artificial Intelligence (AI) and Generative AI, and its key concepts |
| 2 | enable students to explore and experiment with common generative AI models and tools for generating text, images, audio, video, and code |
| 3 | equip students with the techniques and best practices for crafting effective prompts for AI models |

| Course Outcomes | | |
|---|---|---|
| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
| CO 1 | understand the fundamentals of AI and generative AI, including its potential impact, issues, limitations, and ethical concerns and its practical use cases in real-world scenarios. | U |
| CO 2 | explore common generative AI models and tools for text, code, image, audio, and video generation. | E |
| CO 3 | apply common prompt engineering techniques and approaches for writing effective prompts. | Ap |

| Course Outcomes (CO) | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | | |
| | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 | PSO-3 |
| 1 | 2 | | | | | | 2 | | | | | | | |
| 2 | 2 | | 2 | | | | | | | | | | | |
| 3 | | | | | 2 | | | | | 2 | | | | |

## Course Content

| Introduction to Artificial Intelligence (AI) | 8 Hours |
|---|---|
| **Practical Component**<br>Introduction to Artificial Intelligence (AI) - Generative AI Overview and Use Cases - Impact and Examples of AI - Application Domains for AI - Generative AI Applications. AI | |

| | |
|---|---|
| Concepts, Terminology - Cognitive Computing (Perception, Learning, Reasoning) - Terminology and Related Concepts of AI- Machine Learning Techniques and Training - Deep Learning - Neural Networks - Natural Language Processing, Speech, Computer Vision - Self Driving Cars. AI: Issues, Concerns and Ethical Considerations - AI Ethics, Regulations, Governance, and ESG. The evolution and future of AI - The AI Ladder - The Journey for Adopting AI Successfully - Hotbeds of AI Innovation. | |
| **Generative AI: Introduction and Applications**<br>**Practical Component**<br>Introduction and Capabilities of Generative AI - Applications of Generative AI - Tools for Text Generation - Tools for Image Generation - Tools for Audio and Video Generation - Tools for Code Generation | **6 Hours** |
| **Generative AI: Prompt Engineering Basics**<br>**Practical Component**<br>Introduction to Prompt and Prompt Engineering - Best Practices for Prompt Creation - Common Prompt Engineering Tools - Hands on Lab: Getting to Know Our AI Prompting - Experimenting with Prompts - Naive Prompting and Persona Pattern. Prompt Engineering Techniques and Approaches - Text-to-Text Prompt Techniques - Interview Pattern Approach - Chain-of-Thought Approach - Tree-of-Thought Approach - Future of Human-Crafted Prompts - Text-to-Image Prompt Techniques - Hands-on Lab: Effective Text Prompts for Image Generation. | **7 Hours** |
| **Project and Wrap Up**<br>**Practical Component**<br>Graded Quiz<br>Final Project: Generating Text, Images, and Code. | **9 Hours** |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Theory Hours:** | **0** | **Tutorial Hours:** | **0** | **Practical Hours:** | **30** | **Project Hours:** | **0** | **Total Hours:** | **30** |

## Learning Resources

### Textbooks:

1. George F. Luger "Artificial Intelligence: Structures and Strategies for Complex Problem Solving" (6th Edition), Pearson, 2021.
2. Anna Jordan, Robert S. Menzies, Kristine P. Schwab, "AI-Powered Creativity: Generative AI and the Future of Content Creation" Routledge, 2023.

### References:

1. https://platform.openai.com/docs/overview
2. https://towardsdatascience.com/
3. https://gemini.google.com/

### Online Resource (Weblinks)

1. Introduction to Artificial Intelligence (AI) | Coursera
2. Generative AI: Introduction and Applications | Coursera
3. Generative AI: Prompt Engineering Basics | Coursera

**Assessment (Practical course)**

| | | | |
|---|---|---|---|
| MCQ, Mini project and viva-voce | | | |
| | | | |
| **Course Curated by** | | | |
| **Expert(s) from Industry** | **Expert(s) from Higher Education Institution** | **Internal Expert(s)** | |
| - | - | Dr. S. Sangeetha,<br>Associate Professor<br>Department of AI&DS | |
| **Recommended by BoS on** | 16.08.2024 | | |
| **Academic Council Approval** | No: 27 | **Date** | 24.08.2024 |

| 24HSP111 | HOLISTIC WELLNESS-1 (Common to all Department) | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 0 | 0 | 2 | 0 | 1 |
| HS | | SDG | 2, 3 | | | |

| Pre-requisite courses | - | Data Book / Code book (If any) | - |
|---|---|---|---|

| Course Objectives: | |
|---|---|
| The purpose of taking this course is to: | |
| 1 | introduce first-year students to the foundational concepts of holistic wellness, emphasizing the integration of physical, mental, emotional, and Internal well-being. |
| 2 | create a balanced lifestyle that promotes overall health and happiness through practical activities. |

| Course Outcomes | | |
|---|---|---|
| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
| CO 1 | understand the basic principles of holistic wellness. | U |
| CO 2 | apply strategies for maintaining physical health, including nutrition and exercise | Ap |
| CO 3 | practice mindfulness techniques to enhance mental and emotional well-being. | Ap |
| CO 4 | develop a personal wellness plan incorporating various aspects of holistic health. | C |

| Course Outcomes (CO) | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | | |
| | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 | PSO-3 |
| 1 | | | | | | 2 | | 1 | | | | | | |
| 2 | | | | | | 2 | | | | | | | | |
| 3 | | | | | | 1 | | | | | 3 | | | |
| 4 | | | | | | 2 | | | | | 3 | | | |

## Course Content

| | |
|---|---|
| **INTRODUCTION TO HOLISTIC WELLNESS:**<br>• Overview of holistic wellness: physical, mental, emotional, and internal health.<br>• The importance of balance in overall well-being.<br>• Hands-on activity: Self-assessment of current wellness status. | **4 Hour** |
| **PHYSICAL WELLNESS:**<br>• Importance of physical activity and exercise. | **14 Hours** |

| | |
|---|---|
| • Understanding nutrition and its role in health.<br>• Sleep hygiene and its impact on well-being.<br>• Hands-on activity: Designing a personalized fitness and nutrition plan. | |
| **MENTAL AND EMOTIONAL WELLNESS:**<br>• Stress management techniques.<br>• The role of Yoga, mindfulness and meditation in mental health.<br>• Emotional intelligence and its impact on relationships.<br>• Hands-on activity: Practicing Yoga, mindfulness and emotional regulation exercises. | **6 Hours** |
| **INTERNAL WELLNESS:**<br>• Exploring the concept of Internal wellness.<br>• The role of purpose and meaning in life.<br>• Introduction to meditation and reflective practices.<br>• Hands-on activity: Developing a personal reflection, Yoga and meditation routine. | **4 Hours** |
| **INTEGRATING WELLNESS PRACTICES:**<br>• Combining physical, mental, emotional, and Internal wellness practices into daily life.<br>• Developing a balanced wellness plan.<br>• Hands-on activity: Creating a comprehensive personal wellness plan. | **2 Hours** |

| Theory Hours: | Tutorial Hours: | Practical Hours: | Project Hours: | Total Hours: |
|---|---|---|---|---|
| 0 | 0 | 30 | 0 | 30 |

**Learning Resources**

**Textbooks:**


1. Jayanna, Krishnamurthy., Science & Practice of Integrative Health & Wellbeing Lifestyle., White Falcon Publishing (2020).
2. Rosenberg, Marshall Bertram., Nonviolent Communication: A Language of Life., Puddle Dancer Press, Encinitas, CA (2015).


**References:**


1. B.K.S Iyengar., Yoga: The Path to Holistic Health., Dorling Kindersley Limited, City of Publication (2001)
2. Goleman Daniel., Emotional Intelligence., Bloomsbury India, India, (2021).
3. James Allen., As a Man Thinketh., Maple Press, Noida, (2010)
4. Swami Budhanandha., Will power and its development., Advaita Ashrama Mayavati, Pithoragarh, Himalayas from its Publication Department, Calcutta. (2001)
5. Kalderdon Adizes Ichak., What Matters in Life: Lessons I Learned from Opening My Heart WS Press, Newtown, PA (2023)


**Online Resources (Weblinks)**

1. Learning Suryanamskar
2. Yoga for well-being
3. Nutritional Educational contents
4. Introduction to Psychology
5. Guided Meditation
6. Simplified physical exercises instructions

7. Simplified Physical Exercises
8. Life skills and value education
9. James Allen Library

| Assessment (Practical course) |
|---|
| Participation, Practical activities and assignments, personal wellness plan and reflection. |

| Course Curated by | | | |
|---|---|---|---|
| **Expert(s) from Industry** | **Expert(s) from Higher Education Institution** | **Internal Expert(s)** | |
| | | Dr. Ezhilarasi<br>Principal- KCT | |
| **Recommended by BoS on** | 16.08.2024 | | |
| **Academic Council Approval** | No: 27 | **Date** | 24.08.2024 |

| 24INP101 | DESIGN THINKING<br>(Common to all Department) | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 0 | 0 | 2 | 0 | 1 |
| ES | | SDG | 9 | | | |

| Pre-requisite courses | - | Data Book / Code book (If any) | - |
|---|---|---|---|

| Course Objectives: | |
|---|---|
| The purpose of taking this course is to: | |
| 1 | introduces first-year engineering students to Design Thinking, focusing on practical, user-centered problem-solving techniques |
| 2 | empathize with users, generate ideas, and create models to test and refine their solutions |
| 3 | understand iteration, empathy, and critical reflection to cultivate a creative mindset |

| Course Outcomes | | |
|---|---|---|
| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
| CO 1 | apply problem-solving techniques and the Design Thinking process to engineering problems using simple models | Ap |
| CO 2 | understand user needs through various empathy techniques and develop/refine models iteratively based on user insights. | U |
| CO 3 | reflect critically on their learning journeys and the emotional demands of problem-solving. Collaborate effectively in teams to develop innovative solutions | Ap |

| | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | | |
| Course Outcomes (CO) | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 | PSO-3 |
| 1 | 1 | | 2 | | | 2 | | 2 | | | 1 | | | |
| 2 | 1 | | | | | | | 2 | | | 1 | | | |
| 3 | 1 | | 2 | | | 2 | | 1 | | | 1 | | | |

## Course Content

| | |
|---|---|
| **INTRODUCTION TO PROBLEM SOLVING AND GROUND RULES**<br>Introduction to problem-solving strategies without mentioning Design Thinking-Emphasize problem-solving attitudes, mindsets, and behaviours necessary for iterative problem solving (e.g., openness to failure, patience, empathy)-Set ground rules for the course, including incentives for creative risk-taking and penalties for non-participation or lack of reflection-Overview of the Design Thinking process and its importance. | **6 Hours** |

| | |
|---|---|
| **EMPATHY AND PROBLEM DEFINITION**<br>Techniques for understanding user needs, including observation, interviews, **surveys** and **focus groups-**Importance of secondary research as a complement for the above-mentioned methods-Introduction to empathy cycles: involve students in two empathy cycles before and after problem definition-Finetuning problem definition based on user insights. | **6 Hours** |
| **IDEATION AND CONCEPT MODELLING**<br>Brainstorming ideas and selecting feasible solution-Creating concept modelling to visualize ideas-Include an empathy cycle after students propose solutions, allowing them to revisit and reshape their solutions based on further insights from users. | **6 Hours** |
| **PROTOTYPING AND TESTING WITH MODELS**<br>Building basic prototypes using simple materials (e.g., cardboard, clay)- Introduction to different prototyping methods (e.g., **low-fidelity** vs **high-fidelity models**) for different contexts: product design, space design, policy, and digital/e-commerce solutions-Conduct an empathy cycle after the prototype is developed to gather user feedback and refine the prototype. | **6 Hours** |
| **ITERATION AND FINAL MODELLING PROJECT**<br>Students refine their prototypes based on feedback from the empathy cycle-Finalize prototypes for presentation based on consistent feedback loops. | **6 Hours** |
| **PRESENTATION, REFLECTION, AND LEARNING SUMMARIES**<br>Students present their final projects and reflect on their learning journeys, including how their understanding of problem-solving and empathy evolved during the course-**Learning Summary Activity:** Each student presents their individual journey and learning outcomes from the empathy cycles and iterations-Peer review and group discussions. | **6 Hours** |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Theory Hours:** | **0** | **Tutorial Hours:** | **0** | **Practical Hours:** | **30** | **Project Hours:** | **0** | **Total Hours:** | **30** |

**Learning Resources**

**Textbooks:**

1. Handbook of Design Thinking, Christian Muller – Roterberg, Kindly Direct Publishing
2. The Art of Innovation, Tom Kalley
3. **E Balaguruswamy (2022), Developing Thinking Skills (The way to Success), Khanna Book Publishing Company**

**Online Resources (Weblinks)**

1. Survey and focus group design guides
2. Guidance on Designing, Administering and Analyzing Focus Groups and Interviews
3. Empathy mapping tools
4. How to Make a Concept Model
5. Brainstorming Techniques: 15 Creative Activities
6. 10 Brainstorming Techniques for Developing New Ideas
7. Brainstorming templates
8. 5 Common Low-Fidelity Prototypes and Their Best Practices

9. UX Prototypes: Low Fidelity vs. High Fidelity

10. Low-fidelity vs. High-fidelity Design Prototypes (and when to use which)

Case study 1: Iterative Design and Prototype Testing of the NN/g Homepage

Case study 2: Using iterative design to optimise the user flow of a product

11. Reflective practice toolkit

| **Assessment** |
|---|
| Formative: Assignments, Mini project |

| **Course Curated by** | | | |
|---|---|---|---|
| **Expert(s) from Industry** | **Expert(s) from Higher Education Institutions** | **Internal Expert(s)** | |
| | | Dr. Padhmanand Sudhagar R<br>Department of Bio-Tech<br>Dr. Arul H<br>Department of Physics | |
| **Recommended by BoS on** | 16.08.2024 | | |
| **Academic Council Approval** | No: 27 | **Date** | 24.08.2024 |

# SECOND SEMESTER

| 24HST102 | தமிழரும் தொழில்நுட்பமும்/ TAMILS AND TECHNOLOGY | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 1 | 0 | 0 | 0 | 1 |
| HS | | SDG | 4, 8 | | | |

| Pre-requisite courses | - | Data Book / Code book (If any) | - |
|---|---|---|---|

## Course Objectives:

The purpose of taking this course is to:

| | |
|---|---|
| 1 | தமிழர்களின் நெசவு மற்றும் பானைத் தொழில்நுட்பத்தை அறிமுகப்படுத்துதல், சங்க கால கட்டிட தொழில்நுட்பத்தை விளக்குதல், கோயில்கள் மற்றும் சிற்பக்கலைகளை ஆராய்தல்.<br>introducing weaving and pottery technology of Tamils -Explaining the building technology of the Sangam Period-Explore temples and sculptures. |
| 2 | கப்பல், இரும்பு, நாணயங்கள், மணி உருவாக்கும் தொழிற்சாலைகள், ஆகியவற்றை விளக்கம் செய்தல், தமிழகத்தின் தொல்லியல் சான்றுகளின் பழமையை உணர்த்துதல்.<br>explain Ship, Iron, Coins, Beads Making Factories. Realizing the Antiquity of Archaeological Evidence of Tamil Nadu |
| 3 | வேளாண்மை மற்றும் அறிவியல் தமிழைப் பற்றி அறிதல், இணையத்தில் தமிழின் தேவையை உணர்த்துதல்,தமிழ் மென்பொருள்களை அறிமுகம் செய்தல்.<br>knowledge of Agricultural and Scientific Tamil, Realizing the need for Tamil on the Internet, Introducing Tamil software. |

## Course Outcomes:

| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
|---|---|---|
| CO 1 | தமிழர்களின் நெசவு மற்றும் பானைத் தொழில்நுட்பத்தின் முக்கியத்துவத்தினை அறிந்து கொள்ளுதல். சங்ககால தமிழர் வளர்த்த அழகுக் கலைகளைத் தெரிந்து கொள்ளுதல்.<br>know the importance of weaving and pottery technology of Tamils-To know the Aesthetics arts developed by Sangam Tamils | U |
| CO 2 | கப்பல் கட்டும் கலை, இரும்புத் தொழிற்சாலை, நாணயங்கள் அச்சடித்தல்,மணி உருவாக்கும் தொழிற்சாலைகள், சிலப்பதிகாரத்தில் உள்ள மணிகளின் வகையை அறிதல்.<br>knowledge of ship building, ironworks, coinage, minting, and beads making factories,Knowing the types of beads in Silapathikaram. | U |
| CO 3 | வேளாண்மை மற்றும் நீர்ப்பாசன தொழில்நுட்பத்தை அறிந்து கொள்ளல். அறிவியல் தமிழ் மற்றும் கணினித் தமிழைப் புரிந்து கொள்ளுதல்.<br>know agriculture and irrigation technology. Understanding Scientific Tamil and Computer Tamil. | Ap |

| | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | | |
| Course Outcomes (CO) | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 | PSO-3 |
| 1 | 2 | | 2 | | | | 3 | 2 | 2 | | 2 | | | |
| 2 | 2 | | 2 | | | | 3 | 2 | 2 | | 2 | | | |
| 3 | 2 | | 2 | | | | 3 | 2 | 2 | | 2 | | | |

## Course Content

| | |
|---|---|
| **நெசவு மற்றும் பானைத் தொழில்நுட்பம்:**<br>சங்க காலத்தில் நெசவுத் தொழில் - பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் - பாண்டங்களில் கீறல் குறியீடுகள்.<br>Weaving Industry during Sangam Age - Ceramic technology - Black and Red Ware Potteries (BRW)-Graffiti on Potteries. | **3 Hours** |
| **வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்:**<br>சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் ரூ சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு - சங்க காலத்தில் கட்டுமான 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 அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் - செட்டிநாட்டு வீடுகள் - பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ-சாரோசெனிக் கட்டிடக் கலை.<br>Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period. | **3 Hours** |
| **உற்பத்தித் தொழில் நுட்பம்:**<br>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 - எலும்புத்துண்டுகள் - தொல்லியல் சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.<br>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 evidence - Gem stone types described in Silappathikaram. | **3 Hours** |

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| **வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்:**<br>அணை, ஏரி, குளங்கள், மதகு - சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம்- கால்நடை பராமரிப்பு - கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள்- வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு - மீன்வளம் - முத்து மற்றும் முத்துக்குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசார் சமூகம்.<br>Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu 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. | **3 Hours** |
| **அறிவியல் தமிழ் மற்றும் கணித்தமிழ்:**<br>அறிவியல் தமிழின் வளர்ச்சி - கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம் - தமிழ் இணையக் கல்விக்கழகம் - தமிழ் மின் நூலகம் - இணையத்தில் தமிழ் அகராதிகள்- சொற்குவைத் திட்டம்.<br>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. | **3 Hours** |

| Theory Hours: 15 | Tutorial Hours: 0 | Practical Hours: 0 | Project Hours: 0 | Total Hours: 15 |
|---|---|---|---|---|

**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 சங்ககால 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 Tarnils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Textbook 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 Bookand Educational Services Corporation> Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by: RMRL) - Reference Book.


**Online Resources**

1. https://www.youtube.com/watch?v=Gp1ratX2sOE&list=PLtyn2o7hocf40PtPibRqJTf_dQL3eOtLl
2. https://www.youtube.com/watch?v=jteRvnNiD6w

**Assessment (Theory course)**

SA, Activity and Learning Task(s), Mini project, MCQ, End Semester Examination (ESE)

| Course Curated by | | | |
|---|---|---|---|
| **Expert(s) from Industry** | **Expert(s) from Higher Education Institution** | | **Internal Expert(s)** |
| - | - | | - |
| **Recommended by BoS on** | 16.08.2024 | | |
| **Academic Council Approval** | No: 27 | **Date** | 24.08.2024 |

| 24HST103 | EFFECTIVE COMMUNICATION | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 2 | 0 | 0 | 0 | 2 |
| HS | | SDG | 8 | | | |

| Pre-requisite courses | - | Data Book / Code book (If any) | - |
|---|---|---|---|

## Course Objectives:

The purpose of taking this course is to

| | |
|---|---|
| 1 | enhance students' abilities to communicate ideas effectively, both orally and in writing, by developing skills in organizing thoughts clearly and logically and expressing them through well-structured paragraphs and concise summaries. |
| 2 | enable students to critically evaluate and synthesize information from multiple sources and utilize suitable writing techniques and formats to produce professional-quality content tailored to various contexts. |
| 3 | foster active listening, critical reading, and reflective thinking, empowering students to create engaging, relevant, and informative content by applying effective communication strategies across diverse platforms. |

## Course Outcomes

| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
|---|---|---|
| CO1 | demonstrate proficiency in delivering ideas effectively, both in speaking and writing, with a deeper understanding of the content and the ability to convey complex ideas through well-structured paragraphs and summaries. | Ap |
| CO2 | create and present original content by evaluating information from multiple sources and employing appropriate formats and writing strategies across various professional contexts. | C |
| CO3 | produce engaging and informative content through active listening, reading, reflection, and effective communication skills. | E |

| Course Outcomes (CO) | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | | |
| | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 | PSO-3 |
| 1 | | | | | | | 2 | 2 | 3 | | 3 | | | |
| 2 | | | | | | | 2 | 2 | 3 | | 3 | | | |
| 3 | | | | | | | 2 | 2 | 3 | | 3 | | | |

| Course Content | |
|---|---|
| **TEXT ANALYSIS**<br>Composition of Coherent Paragraphs (Expository, Descriptive, Narrative, Evaluative) - Loud Reading (Reading Extracts will be given were students identify the main idea of paragraphs or sections and debrief) | **6 Hours** |
| **VISUAL & WRITTEN ANALYSIS**<br>Process writing (Drafting effective introduction, process and conclusion using appropriate transition words and phrases) - Describing Visuals (Line graph, Bar Chart, Flow Chart, Pie Chart, Table, Tree diagram) - Note Making & Summarizing | **6 Hours** |
| **PROFESSIONAL CORRESPONDENCE**<br>Crafting Professional Emails - Writing Instruction for Manuals - Reading technical documents (Reading extracts will be given to construct sentences from the new words found in the document) | **6 Hours** |
| **RESEARCH AND DOCUMENTATION**<br>Library Reading (Identify at least three sources and extract information, Summarize the main ideas and key findings from each source, compile them findings into a brief report that includes the main points, sources, and relevance to the topic)- Report Writing (Title Page, Abstract, Introduction, Methodology, Results, Discussion, Conclusion and recommendation) | **6 Hours** |
| **TALK ANALYSIS AND PODCAST SKILLS**<br>Listening to and analyzing TED talks – Preparing Podcast-PRISM (Professional Rhetoric Improvement and Speech Mastery) to share facts, opinions and experiences - Writing Reviews on products. | **6 Hours** |

| Theory Hours: 30 | Tutorial Hours: 0 | Practical Hours: 0 | Project Hours: 0 | Total Hours: 30 |
|---|---|---|---|---|

**Learning Resources**

**References:**


1. Swamy, V. R. Narayana. Strengthen Your Writing. Orient Longman, 2003.
2. Sasikumar, V., and P. V. Dhamija. Spoken English: A Self-Learning Guide to Conversation Practice. Tata McGraw Hill, New Delhi (1993).
3. Maison, Margaret M. Examine Your English. Orient Longman, 1999.
4. Rizwi, Ashraf. Effective Technical Communication. Tata McGraw Hill, 2005.
5. Pickett, Nell Ann, and Ann A. Laster. Technical English: Writing, Reading, and Speaking.
6. Harpercollins College Div, 1993.


**Online Resources (Weblinks)**

1. https://owl.purdue.edu/owl/general_writing/academic_writing/paragraphs_and_paragraphing/index.html
2. https://learnenglish.britishcouncil.org/skills/writing/upper-intermediate b2/describing-trends
3. https://hbr.org/2016/07/how-to-write-email-with-military-precision
4. https://owl.purdue.edu/owl/subject_specific_writing/professional_technical_writing/reports_and_memos/index.html

| Assessment (Theory course) |
|---|
| SA, Activity and Learning Task(s), Mini project, MCQ, End Semester Examination (ESE) |

| Course Curated by | | | |
|---|---|---|---|
| **Expert from Industry** | **Expert(s) from Higher Education Institution** | **Internal Expert(s)** | |
| Mr.Vijayan Ramanathan ,<br>Project manager,<br>Toppan Merrill. Technologies,<br>Coimbatore | Dr. Aninditha Sahoo,<br>IIT, Madras<br>Dr.P.R.Sujatha Priyadharshini,<br>Anna University, Chennai<br>Dr. E. Justin Ruben,<br>CIT, Coimbatore | Dr. Arokia Lawrence Vijay<br>Dr. Sreejana<br>Dr. Tissaa<br>Department of English | |
| **Recommended by BoS on** | 16.08.2024 | | |
| **Academic Council Approval** | No:27 | **Date** | 24.08.2024 |

| 24HST104 | PROFESSIONAL COMMUNICATION (Common to all Departments) | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 2 | 0 | 0 | 0 | 2 |
| HS | | SDG | 8 | | | |

| Pre-requisite courses | - | Data Book / Code book (If any) | - |
|---|---|---|---|

## Course Objectives:

The purpose of taking this course is to

| | |
|---|---|
| 1 | develop students' abilities to craft clear, concise, and well-structured technical content and professional communications |
| 2 | enhance students' communication skills in team settings |
| 3 | equip students with cross-cultural communication skills and effective listening techniques |

## Course Outcomes

| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
|---|---|---|
| CO1 | demonstrate proficiency in crafting clear, concise, and well-structured technical content and professional communications, including emails that meet industry standards. | Ap |
| CO2 | communicate effectively in team settings, showcasing collaboration, conflict resolution, and leadership skills, while employing creative writing techniques to convey complex ideas. | An |
| CO3 | apply principles of cross-cultural communication and effective listening techniques to engage successfully in diverse, globalized professional environments. | Ap |

| | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | | |
| Course Outcomes (CO) | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 | PSO-3 |
| 1 | | | | | | 2 | 1 | 3 | 1 | | 3 | | | |
| 2 | | | | | | 2 | 3 | 3 | 2 | | 3 | | | |
| 3 | | | | | | 1 | 1 | 3 | 1 | | 3 | | | |

## Course Content

| | |
|---|---|
| **MASTERING PROFESSIONAL COMMUNICATION**<br>Industry-specific terminology (Business / Technical Register) - Crafting professional emails - Essential elements of an effective email (subject line, salutation, body, closing) | **6 Hours** |

| | |
|---|---|
| - reading and responding to email communication – Networking Emails - Analyzing and interpreting technical texts (Loud Reading). | |
| **NAVIGATING DIGITAL MEDIA**<br>Introduction to Digital media and online communication tools (instant messaging, video conferencing, social media, blogs, forums) - Listening and analyzing advanced audio materials - Creative & Blog Writing (General & Technical). | **6 Hours** |
| **TECHNICAL WRITING TECHNIQUES**<br>Writing Reflective Essays / Experience Sharing, Process writing, Transcoding graphics (interpreting technical texts), Writing Reviews (Research Articles & Books). | **6 Hours** |
| **BUILDING A PROFESSIONAL DIGITAL PRESENCE**<br>Creating Digital Profile - Overview of different digital platforms (LinkedIn, GitHub, personal websites) - Setting Up a LinkedIn Profile – Crafting a Video Resume – Digital Etiquette and Professionalism - Cross-cultural communication and diversity awareness. | **6 Hours** |
| **SOCIAL RESPONSIBILITY IN PRACTICE**<br>Environmental and social responsibilities - Case studies and real-world applications - Project Work - Writing Project reports. | **6 Hours** |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Theory Hours:** | **30** | **Tutorial Hours:** | **0** | **Practical Hours:** | **0** | **Project Hours:** | **0** | **Total Hours:** | **30** |

**Learning Resources**

**Reference books**


1. Baker, W., & Ishikawa, T. Transcultural Communication Through Global Englishes: An Advanced Textbook for Students. Routledge, 2021.
2. Bodnar, O., Fedak, S., Hinsirovska, I., Denysiuk, N., Perenchuk, O., Plavutska, I., ... & Shchur, N. English for Study and Work: A Coursebook In-class Activities. 2017.
3. Doff, A., Thaine, C., Puchta, H., Stranks, J., & Lewis-Jones, P. Cambridge English Empower Advanced Student's Book. Cambridge University Press, 2016.
4. Hewings, M., Thaine, C., & McCarthy, M. Cambridge Academic English C1 Advanced Student's Book: An Integrated Skills Course for EAP. Cambridge University Press, 2012.
5. Beer, D. F., & McMurrey, D. A. A Guide to Writing as an Engineer. John Wiley & Sons, 2019.


**Online Resources (Web Links)**

1. https://hbr.org/2016/07/how-to-write-email-with-military-precision
2. https://ocw.mit.edu/courses/comparative-media-studies-writing/21w-732-scientific-and-technical-communication-spring-2015/
3. https://www.coursera.org/learn/digital-media
4. https://owl.purdue.edu/owl/subject_specific_writing/professional_technical_writing/reports_and_memos/index.html

**Assessment (Theory course)**

SA, Activity and Learning Task(s), Mini project, MCQ, End Semester Examination (ESE)

| Course Curated by | | | |
|---|---|---|---|
| **Expert from Industry** | **Expert(s) from Higher Education Institution** | | **Internal Expert(s)** |
| Mr.Vijayan Ramanathan ,<br>Project manager,<br>Toppan Merrill. Technologies,<br>Coimbatore | Dr. Aninditha Sahoo,<br>IIT, Madras<br>Dr.P.R.Sujatha Priyadharshini,<br>Anna University, Chennai<br>Dr. E. Justin Ruben,<br>CIT, Coimbatore | | Dr. Arokia Lawrence Vijay<br>Dr. Hema<br>Department of English |
| **Recommended by BoS on** | 16.08.2024 | | |
| **Academic Council Approval** | No: 27 | **Date** | 24.08.2024 |

| 24MAI123 | COMPUTATIONAL DIFFERENTIAL EQUATIONS (Common to EC, EE, EI) | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 0 | 4 |
| BS | | SDG | 7, 9 | | | |

| Pre-requisite courses | - | Data Book / Code book (If any) | - |
|---|---|---|---|

## Course Objectives:

The purpose of taking this course is to:

| | |
|---|---|
| 1 | understand the fundamental concepts and methods for solving linear ordinary differential equations (ODEs) of second and higher order, and apply them to real-world engineering problems such as electric circuits. |
| 2 | develop proficiency in using Laplace Transform techniques to solve ODEs, particularly in scenarios involving constant coefficients, and apply these methods to practical engineering systems. |
| 3 | gain expertise in the application of various numerical methods, including Taylor's series, Euler, Improved Euler, and Runge-Kutta methods, to solve initial value problems for ODEs with a focus on accuracy and efficiency. |
| 4 | master the methods of solving partial differential equations (PDEs), including separation of variables and standard techniques for first-order and higher-order PDEs, and understand their application in modeling physical phenomena. |
| 5 | apply and evaluate finite difference and other numerical techniques for solving complex engineering problems involving PDEs, such as two-dimensional Laplace's and Poisson's equations, as well as one-dimensional heat and wave equations. |

## Course Outcomes

| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
|---|---|---|
| CO 1 | solve linear ordinary differential equations (ODEs) of second and higher order, including applications in electric circuits. | Ap |
| CO 2 | apply Laplace Transform techniques to solve linear ODEs. | Ap |
| CO 3 | apply numerical methods, including Taylor's series, Euler, Improved Euler, and Runge-Kutta methods, to solve initial value problems for ODEs. | Ap |
| CO 4 | analyse and solve partial differential equations (PDEs) using separation of variables and standard methods for first-order PDEs and higher-order linear homogeneous PDEs. | An |
| CO 5 | apply finite difference techniques to solve two-dimensional Laplace's and Poisson's equations and use numerical schemes to solve one-dimensional heat and wave equations. | Ap |
| CO 6 | analyze and solve complex real-world engineering problems using a variety of analytical and numerical methods for ordinary and partial differential equations. | An |

| CO | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | |
|---|---|---|

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | Program Specific Outcomes (PSO) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 | PSO-3 |
| 1 | 3 | 2 | | 2 | | | | | | | | | | |
| 2 | 3 | | | | 2 | | | | | | | | | |
| 3 | | 2 | | | 2 | | | | | | 2 | | | |
| 4 | | 3 | | 2 | | | | | | | | | | |
| 5 | | 2 | | | 3 | | | | | | | | | |
| 6 | 2 | 2 | | | 2 | | | | | | 2 | | | |

## Course Content

| | |
|---|---|
| **ORDINARY DIFFERENTIAL EQUATIONS**<br>Linear equations of second and higher order with constant coefficients – Euler's and Legendre's linear equations – Method of variation of parameters – First order Simultaneous linear equations with constant coefficients – Applications: Electric Circuits. | **9 Hours** |
| **Practical Component:**<br>• Solving Second-Order Linear ODEs with Constant Coefficients<br>• Solving First-Order Simultaneous Linear Equations | **7 Hours** |
| **SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS USING LAPLACE TRANSFORMS:**<br>Laplace Transform – Properties – Inverse Laplace transforms – Properties – Solution of linear ordinary differential equations with constant coefficients. | **9 Hours** |
| **Practical Component:**<br>• Using Laplace Transforms to Solve Linear ODEs | **4 Hours** |
| **NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS**<br>Initial value problems - Single step methods: Taylor's series method – Truncation error – Euler and Improved Euler methods – Fourth order Runge–Kutta method – Multistep method: Milne's predictor - corrector method. | **9 Hours** |
| **Practical Component:**<br>• Numerical Solution Using Taylor's Series Method<br>• Numerical Solution Using Euler and Improved Euler Methods<br>• Numerical Solution Using Fourth Order Runge-Kutta Method | **9 Hours** |
| **PARTIAL DIFFERENTIAL EQUATIONS:**<br>Solution of PDE by variable separable method - solution of standard types of first order partial differential equations (excluding reducible to standard types) - Lagrange's linear equation – Linear homogeneous partial differential equations of second and higher order with constant coefficients. | **9 Hours** |
| **Practical Component:** | **4 Hours** |

| | |
|---|---|
| • Solution of PDE by Variable Separable Method | |
| **NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS:**<br>Finite difference techniques for the solution of two-dimensional Laplace's and Poisson's equations on rectangular domain–Solution of one-dimensional heat equation using Bender Schmidt and Crank Nicholson difference schemes –Solution of one-dimensional wave equation by explicit scheme.<br><br>**Practical Component:**<br>• Numerical Solution of Two-Dimensional Laplace's and Poisson's Equations<br>• Numerical Solution of Heat Equation Using Bender-Schmidt and Crank-Nicholson Methods. | **9 Hours**<br><br>**6 Hours** |

| Theory Hours: 45 | Tutorial Hours: 0 | Practical Hours: 30 | Project Hours: 0 | Total Hours: 75 |
|---|---|---|---|---|

**Learning Resources**

**Textbooks:**


1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2021.
2. Sastry S.S, "Introductory Methods of Numerical Analysis", PHI Learning Pvt. Ltd, 5th Edition, 2015.
3. Thomas, G.B., Weir, M.D., Hass, J., "Thomas' Calculus", Pearson Education, 15th Edition, 2023.


**References:**


1. Kreyzig E., "Advanced Engineering Mathematics", 10th Edition, John Wiley and sons, 2023.
2. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., New Delhi, 11th Reprint, 2018.
3. Zill, D.G., Wright, W.S., "Advanced Engineering Mathematics", Jones & Bartlett Learning, 7th Edition, 2020.
4. O'Neil, P.V., "Advanced Engineering Mathematics", Cengage Learning, 7th Edition, 2017.
5. "Numerical Methods for Engineers" by Steven C. Chapra and Raymond P. Canale,Mc Graw Hill, 8th Edition,2021.


**Online Resources (Weblinks)**

1. MIT OpenCourseWare: Differential Equations
   https://ocw.mit.edu/courses/mathematics/18-03-differential-equations-spring-2010
2. Khan Academy: Differential Equations
   https://www.khanacademy.org/math/differential-equations
3. Paul's Online Math Notes: Differential Equations
   http://tutorial.math.lamar.edu/Classes/DE/DE.aspx
4. Coursera: Introduction to Differential Equations
   https://www.coursera.org/learn/differential-equations
5. Wolfram MathWorld: Differential Equations
   https://mathworld.wolfram.com/topics/DifferentialEquations.html

**Assessment**

| |
|---|
| SA, Activity and Learning Task(s), MCQ, Open Book Assignment, Worksheet assignment, End Semester Examination (ESE), Lab Workbook, Experimental Cycle tests, viva-voce. |

| **Course Curated by** | | | |
|---|---|---|---|
| **Expert from Industry** | **Expert(s) from Higher Education Institution** | **Internal Expert(s)** | |
| Mr.Pradeep.C,<br>Paerless Validation Software for Life Sciences Companies. | Dr. C. Porkodi,<br>PSG College of Technology, Coimbatore.<br>Dr. P. Paramanathan,<br>Amrita Vishwa Vidyapeetham, Coimbatore. | Dr. K. Meena<br>Dr. Vijeta Iyer<br>Dr. R. Krishnamoorthy<br>Department of Mathematics | |
| **Recommended by BoS on** | 16.08.2024 | | |
| **Academic Council Approval** | No: 27 | **Date** | 24.08.2024 |

| 24PHI102 | APPLIED PHYSICS FOR CIRCUIT ENGINEERING (Common to EC, EE, EI an MR) | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 0 | 4 |
| BS | | SDG | 9 | | | |

| Pre-requisite courses | Higher Secondary | Data Book / Code book (If any) | - |
|---|---|---|---|

## Course Objectives:

The purpose of taking this course is to:

| | |
|---|---|
| 1 | discover the fundamental concepts of light-matter interactions, including emission, absorption, and Einstein's theory's presentation of stimulated emission's quantum mechanical foundations. |
| 2 | comprehend the principles of quantum mechanics, including wave-particle duality, the significance of the wave function, and quantum tunnelling. |
| 3 | examine various sources of green energy, including solar, wind, and ocean energy, and assess their efficiency and practical applications. |
| 4 | study the properties of semiconductors, magnetic materials, including carrier concentration, transport phenomena, and applications of the Hall effect in sensors. |

## Course Outcomes

| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
|---|---|---|
| CO 1 | apply the principles of applied optics to demonstrate the operation of laser systems and their applications. | Ap |
| CO 2 | apply quantum mechanical concepts to solve problems related to wave-particle duality and quantum tunnelling. | Ap |
| CO 3 | apply principles of green energy technologies to assess their efficiency and practical applications. | Ap |
| CO 4 | understanding semiconductor physics concepts to analyze carrier transport phenomena and properties of semiconductor devices. | U |
| CO 5 | apply knowledge of magnetic materials to evaluate their properties and uses in modern applications like spintronics. | Ap |
| CO 6 | apply optics, quantum physics, green energy, and semiconductor physics methods to design practical solutions in experimental setups. | Ap |

| Course Outcomes (CO) | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | | |
| | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 | PSO-3 |
| 1 | 3 | 1 | | | | | | | | | | | | |
| 2 | 3 | 1 | | | | | | | | | | | | |
| 3 | 3 | 1 | | | | | | | | | | | | |
| 4 | 3 | 1 | | | | | | | | | 2 | | | |
| 5 | 3 | 1 | | | | | | | | | | | | |
| 6 | 3 | 1 | | | | | | | | | 2 | | | |

## Course Content

**APPLIED OPTICS** — **9 Hours**

Interaction of light and matter - Quantization of electromagnetic radiation – Absorption, Spontaneous emission and Stimulated emission - Einstein's theory of stimulated emission- Population inversion - Sources of excitation - Active medium -Laser beam output- Nd-YAG laser - $CO_2$ laser - Applications – Laser Imaging, Holography and Laser gyroscopes.

**Practical Component** — **6 hours**

1. Semiconductor laser:
   a. Determination of wavelength of laser
   b. Determination acceptance angle and numerical aperture of an optical fibre.
   c. Determination of particle size
2. Spectrometer – Determination of wavelength of mercury source using grating

**QUANTUM PHYSICS** — **9 Hours**

Necessity of quantum mechanical picture - Planck's concept (hypothesis) - Wave-particle duality - de-Broglie waves - Physical significance of wave function - Schrodinger equation (Time independent and time-dependent) - Particle in a box- Eigen values and Eigen function- Superposition Principle - Quantum mechanical tunnelling through a barrier

**Practical Component** — **6 hours**

1. Compound pendulum – Determination of acceleration due to gravity
2. Determination of Planck's constant–electroluminescence method.

**GREEN ENERGY** — **9 Hours**

Introduction to Green energy – Solar energy: Energy conversion by photovoltaic principle – Solar cells – Efficiency measurements – Types (First, Second and Third Generation) - Wind energy: Basic components and principle of wind energy conversion systems – Ocean energy: Wave energy – Wave energy conversion devices. Futuristic Energy: Hydrogen – Methane Hydrates – Carbon capture and storage (CCS).

**Practical Component** — **6 hours**

1. Determination of efficiency of solar cell
2. Melde's string – Determination of frequency of a tuning fork

| | |
|---|---|
| **SEMICONDUCTOR PHYSICS**<br>Semiconductors - Intrinsic and extrinsic semiconductors - Variation of carrier concentration with temperature and impurity concentration - Carrier transport in Semiconductors: Drift, mobility and diffusion – Hall Effect in Semiconductors – Applications of Hall Effect - Magnetic field sensor, current sensor, and position sensor - Ohmic contacts: concept and importance - Schottky diode – construction and working - energy band diagram, I-V characteristics.<br>**Practical Component**<br>1. Determination of band gap of a semiconductor<br>2. Determination of thermal conductivity of a bad conductor – Lee's Disc method<br>3. Non-uniform bending – Determination of Young's modulus | **9 Hours**<br><br>**6 hours** |
| **MAGNETIC MATERIALS**<br>Introduction – Bohr magnetron - types of magnetic material – Hysteresis behaviour – Energy product - Hard and soft magnetic materials - Magnetic Anisotropy- Spintronics and Magnetic Semiconductors- Applications – GMR - MRAM (Magneto resistive Random Access Memory) - Nanomagnetic Materials - Magnetocaloric Materials – Magnetic Materials in Renewable Energy – Magnetic levitation.<br>**Practical Component**<br>1. Determination of magnetic susceptibility of a solid material – B-H curve apparatus | **9 Hours**<br><br>**6 hours** |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Theory Hours:** | **45** | **Tutorial Hours:** | **0** | **Practical Hours:** | **30** | **Project Hours:** | **0** | **Total Hours:** | **75** |

**Learning Resources**

**Textbooks**


1. Avadhanulu, M. N., Kshirsagar, P. G., & Arun Murthy, T. V. S., A Textbook of Engineering Physics, S. Chand Publications, New Delhi (2018).
2. Gaur, R. K., & Gupta, S. L., Engineering Physics, Dhanpat Rai Publishing Co Pvt Ltd, New Delhi (Year not provided).
3. Beiser, A., Mahajan, S., & Choudhury, S. R., Concepts of Modern Physics, McGraw Hill Education, New Delhi (2017).
4. Rajendran, V., Applied Physics, Tata McGraw Hill Publishing, New Delhi (2017).


**Reference books**


1. Lal, Brij, & Subrahmanyam, Properties of Matter, S. Chand & Co Ltd., New Delhi (2014).
2. Prakash, Satya, Quantum Mechanics, Pragati Prakashan Publishers (2015).
3. Thiagarajan, K., & Ghatak, Ajoy, Lasers: Fundamentals and Applications, Springer Science & Business Media (2010)
4. Hill, William Silfvast, Laser Fundamentals, Cambridge University Press, New York (2018).
5. Ultrasonics: Fundamentals, Technology, Applications, 2nd Edition, Marcel Dekker, New York (1988).
6. Sze, S. M., & Ng, K. K., Physics of Semiconductor Devices, Wiley (2020), ISBN: 978-1119090240.
7. Sellmyer, David J., & Skomski, Robert, Permanent Magnetic Materials and Devices,
8. Springer (2017), ISBN: 978-3319315828.


**Online Resources (Weblinks)**

1. National Institute of Standards and Technology (NIST) - Laser Fundamentals
2. Optics.org - Laser Applications

3. IEEE Xplore - Semiconductor Devices
4. Semiconductor Industry Association - Semiconductor Technology
5. Global Wind Energy Council (GWEC) - Wind Energy
6. Ocean Energy Europe
7. Magnetics - Magnetic Materials

| **Assessment (Embedded course)** |
|---|
| SA, Mini project, Qualitative assignments (PrBL/Activity based), MCQ, End Semester Examination (ESE), Lab Workbook, Model exam and viva-voce |

| **Course Curated by** | | | |
|---|---|---|---|
| **Expert(s) from Industry** | **Expert(s) from Higher Education Institution** | **Internal Expert(s)** | |
| | | Dr. R. Balamurugan<br>Dr. K. Sugandhi<br>Department of Physics | |
| **Recommended by BoS on** | 16.08.2024 | | |
| **Academic Council Approval** | No: 27 | **Date** | 24.08.2024 |

| 24CSI101 | LOGICAL THINKING AND PROBLEM SOLVING (Common to all Programmes) | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 0 | 4 |
| ES | | SDG | 8, 9 | | | |

| Pre-requisite courses | - | Data Book / Code book (If any) | - |
|---|---|---|---|

## Course Objectives:

The purpose of taking this course is to:

| | |
|---|---|
| 1 | gain a comprehensive understanding of computing systems, including their classification, processing units, memory structures, storage hierarchies, and the essential functions and types of operating systems |
| 2 | develop strong logical and analytical thinking skills, enabling the systematic analysis and solution of computational problems using reasoning techniques, algorithms, and flowcharts. |
| 3 | acquire a solid foundation in C programming, mastering the use of data types, operators, control structures, and input/output operations to create efficient and effective programs. |
| 4 | apply advanced programming techniques, including the use of arrays, structures, pointers, and functions, to solve complex real-world problems with a focus on modular and efficient coding practices. |

## Course Outcomes

| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
|---|---|---|
| CO1 | understand the basic concepts of hardware, software, Operating systems, and the logic behind the functioning of the Computing systems. | U |
| CO2 | apply logical thinking and reasoning to solve computing problems using tools like algorithms and flowcharts. | Ap |
| CO3 | understand the structured programming paradigms, memory organization and how the language can be used as a tool to solve problems. | U |
| CO4 | develop simple programs using data types, operators, control structures, pointers, and functions as appropriate in real world applications. | Ap |

| Course Outcomes (CO) | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | | |
| | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 | |
| 1 | 2 | | | | | | | | | | | | | |
| 2 | 3 | 2 | 1 | | | | | | | | | 3 | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | | 1 | | | | | | | | | | 2 | | |
| 4 | 3 | 2 | 1 | | | | | | | | | 3 | | |

## Course Content

| | |
|---|---|
| **FUNDAMENTALS OF COMPUTERS AND COMPUTING**<br>Generations of computers, and classification of computers (supercomputers, mainframes, minicomputers, microcomputers). Processing Units (CPU, GPU, TPU), memory (RAM, ROM), storage devices and hierarchy, input / output and peripheral devices. System software, application software. Operating Systems - Functions (process management, memory management, file system management, device management, security), types of operating systems (desktop, mobile, networking, distributed, real-time, embedded). **Number Systems**: Introduction to different number systems (binary, octal, decimal, hexadecimal), conversions between number systems, and binary arithmetic (addition, subtraction, multiplication, division).<br>**Practical Component**<br>Exploring hardware and software components | **6 Hours**<br>**4 Hours** |
| **LOGICAL THINKING, REASONING AND TOOLS**<br>Problem Analysis – Logical Thinking vs Critical Thinking vs Design Thinking - Inference – Inductive Reasoning – Deductive Reasoning – **Logical Thinking Tools: Algorithms**: Definition and importance, characteristics of algorithms (finite, clear and unambiguous, well-defined inputs and outputs, feasible). Algorithm representation Techniques: Pseudocode, stepwise refinement, and top-down design. **Flowcharts**: Symbols used in flowcharts, creating flowcharts, and examples of flowchart-based problem-solving.<br>**Practical Component**<br>Algorithm writing and Flowcharts, | **8 Hours**<br>**4 Hours** |
| **PROGRAMMING PARADIGMS AND INTRODUCTION TO C PROGRAMMING**<br>**Programming Paradigms**: Structured programming - functional programming - object-oriented programming. **Introduction to C Programming**: History of C - features of C - structure of a C program – input / output statements. **Data Types**: Primitive data types (int, char, float, double) - derived data types, typecast. **Operators**: Arithmetic operators - relational operators - logical operators - bitwise operators - assignment operators - operator precedence. **Conditional Statements**: If - if-else - nested if - switch-case. **Looping Statements**: For loop - while loop - do-while loop. Pre-processor Directives and Command line arguments, Storage Classes.<br>**Practical Component**<br>Programs on Operator precedence, Decision Making, Iterations | **11 Hours**<br>**10 Hours** |
| **ARRAYS AND STRUCTURES**<br>**Collections**: Arrays – 2D Arrays – String Manipulation. **Structures and Unions**: Definition - declaration - accessing members - differences between structures and unions - applications.<br>**Practical Component**<br>Programs on Arrays, Structures, Union, | **10 Hours**<br>**6 Hours** |

| | |
|---|---|
| **POINTERS AND FUNCTIONS**<br>**Pointers**: Definition - declaration - pointer arithmetic - pointers and arrays.<br>**Functions**: Definition - declaration - types of functions (user-defined, library functions) - parameter passing (by value, by reference) pointers and functions, recursion.<br>**Practical Component**<br>Pointers and Functions. Additional programs on Files to be discussed. | **10 Hours**<br><br>**6 Hours** |

| Theory Hours: 45 | Tutorial Hours: 0 | Practical Hours: 30 | Project Hours: 0 | Total Hours: 75 |
|---|---|---|---|---|

**Learning Resources**

**Textbooks:**

1. Kanetkar, Yashavant. Let Us C. BPB Publications, New Delhi (2023).
2. Rajaraman, V. Fundamentals of Computers. PHI Learning, New Delhi (2020).
3. Dromey, R.G. How to Solve it by Computer. Prentice Hall International, New York (2008).

**Reference**

1. Cormen, Thomas H., Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein. Introduction to Algorithms. MIT Press, Cambridge (2022).
2. Balagurusamy, E. Programming in ANSI C. McGraw Hill Education, New York (2021).
3. Kernighan, Brian W., and Dennis M. Ritchie. The C Programming Language. Prentice Hall, New York (2017).
4. Patterson, David A., and John L. Hennessy. Computer Organization and Design: The Hardware/Software Interface. Morgan Kaufmann, San Francisco (2017).

**Online Resources (Weblinks)**

1. https://nptel.ac.in/courses/106105214
2. https://www.coursera.org/learn/computer-fundamentals
3. https://www.khanacademy.org/computing/computer-science/algorithms
4. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-006-introduction-to-algorithms-fall-2011/
5. https://www.geeksforgeeks.org/c-programming-language/

**Assessment (Embedded course)**

CAT, Activity and Learning Task(s), Mini project, MCQ, End Semester Examination (ESE)
Lab Workbook, Experimental Cycle tests, viva-voce

**Course Curated by**

| Expert(s) from Industry | Expert(s) from Higher Education Institution | Internal Expert(s) |
|---|---|---|
| - | - | Dr. S. Kavitha, Department of Information Technology |

| | | | |
|---|---|---|---|
| **Recommended by BoS on** | 16.08.2024 | | |
| **Academic Council Approval** | No: 27 | **Date** | 24.08.2024 |

| 24BTT001 | BIOLOGY FOR ENGINEERS | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 1 | 0 | 0 | 0 | 1 |
| BS | | SDG | 3, 9, 12 | | | |

| Pre-requisite courses | - | Data Book / Code book (If any) | - |
|---|---|---|---|

## Course Objectives:

The purpose of taking this course is to:

| | |
|---|---|
| 1 | **understand the fundamental biological concepts** including the origin and evolution of life, biomolecules, genetics, and cellular processes, and their relevance to engineering principles. |
| 2 | **apply biological knowledge to engineering solutions** by integrating biological systems with technology in areas such as biotechnology, biomedical engineering, and materials science. |

## Course Outcomes

| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
|---|---|---|
| CO 1 | conceptualize the relevance of biological principles to various engineering disciplines and describe the origin and evolution of life, emphasizing their implications for modern science and engineering. | Ap |
| CO 2 | identify and explain the structure and function of major biomolecules and biological processes, connecting them to their engineering applications. | An |
| CO 3 | design and understand the functionality of basic biosensors, wearable electronics, lab-on-chip devices, and biomaterials, applying biological knowledge to these engineering solutions. | Ap |

| Course Outcomes (CO) | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | | |
| | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 | PSO-3 |
| 1 | 3 | 3 | | | 2 | | | | | | | | 2 | |
| 2 | 3 | 3 | 2 | 2 | | | | | | | | | | |
| 3 | 2 | 2 | | | 2 | | | | | | | | | |

## Course Content

| | |
|---|---|
| **THE INTERSECTION OF BIOLOGY AND ENGINEERING**<br>Why Should Engineers Know Biology? - Importance of biological knowledge in various engineering fields (biomedical, environmental, materials science). Instances of biological principles in engineering solutions. What is Life? How Did It Originate on Earth and Evolve? - Definitions and characteristics of life, Theories of the origin of life | **3 Hours** |

| | |
|---|---|
| on Earth, Evolutionary processes and their relevance to modern engineering applications. | |
| **MOLECULAR AND CELLULAR FOUNDATIONS**<br>The Fundamental Molecules of Life - Overview of biomolecules: carbohydrates, lipids, proteins, nucleic acids. Structure and function of these molecules in living organisms. DNA Replication - The molecular mechanism of DNA replication. Importance of DNA replication in cell division and inheritance. Cell Replication - Processes of mitosis and meiosis, Techniques for quantifying cell replication (e.g., cell counting, flow cytometry). How Are Proteins Made in the Cell? – Transcription and Translation - The central dogma of molecular biology: from DNA to RNA to protein. | **6 Hours** |
| **BIOTECHNOLOGY AND ENGINEERING APPLICATIONS**<br>Tools for manipulating DNA: PCR, DNA Sequencers (Bridge amplification) - Wearable Electronics and Biosensors (Glucose Biosensor Construction), Introduction to wearable electronics in healthcare, Principles and design of glucose biosensors, Hands-on activity: basic glucose biosensor construction; Lab-on-Chips and Microfluidics - Overview of lab-on-chip technology and its applications in diagnostics, Basics of microfluidic systems and their design considerations. Biomaterials: Metallic and Ceramic Implants - Introduction to biomaterials used in implants (metallic and ceramic), Properties of biomaterials and their interactions with biological tissues. | **6 Hours** |

| **Theory Hours:** | **Tutorial Hours:** | **Practical Hours:** | **Project Hours:** | **Total Hours:** |
|---|---|---|---|---|
| **15** | **0** | **0** | **0** | **15** |

| **Learning Resources** |
|---|
| **Textbooks:** |
| Biology for Engineers; Dr G K Suraishkumar, 2019 (Biology for Engineers (oup.com) |
| **References:** |
| |
| **Online Resources (Weblinks)** |
| https://archive.nptel.ac.in/courses/121/106/121106008/ |

| **Assessment (Theory course)** |
|---|
| Continuous assessments, Activity and Learning Task(s), Mini project, MCQ |

| **Course Curated by** | | | |
|---|---|---|---|
| **Expert(s) from Industry** | **Expert(s) from Higher Education Institution** | **Internal Expert(s)** | |
| Dr. Harishankar<br>BIOCON Biologics, Bangalore | Dr.Selvaraju Narayanasamy<br>IIT Guwahati | Dr. Vinohar Stephen Rapheal<br>Dr. Ram K<br>Department of Biotechnology | |
| **Recommended by BoS on** | 14.08.2024 | | |
| **Academic Council Approval** | No:27 | **Date** | 24.08.2024 |

| 24EII101 | Semiconductor Devices and Applications | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 0 | 4 |
| Professional Core | | SDG | 9,12 | | | |

| Pre-requisite courses | Physics | Data Book / Code book (If any) | |
|---|---|---|---|

**Course Objectives:**

The purpose of taking this course is to:

| | |
|---|---|
| 1 | Understand the role and selection criteria for semiconductor materials in sustainable electronics, with a focus on environmental effect and electronic waste management. |
| 2 | Develop skills to design and analyse practical circuits using diodes, BJTs, and MOSFETs for energy-efficient and sustainable applications. |
| 3 | Apply the knowledge of semiconductor devices to solve real-world problems in analog and digital electronics with a focus on sustainability and high efficiency. |

**Course Outcomes**

| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
|---|---|---|
| CO 1 | analyse the role and impact of semiconductor materials in sustainable electronics and compare traditional and sustainable materials to select appropriate options for modern applications | Ap |
| CO 2 | apply knowledge of diodes to design and analyse practical circuits for various electronic applications. | Ap |
| CO 3 | apply the operation of Bipolar Junction Transistors (BJTs) and Field-Effect Transistors (FETs) in analog and digital circuits. | Ap |
| CO 4 | analyse the performance and characteristics of power semiconductor devices in sustainable and high-efficiency systems | An |
| CO 5 | analyse recent innovations in sustainable semiconductor technologies, including low-energy manufacturing processes and their potential impact on future device applications | An |

| Course Outcomes (CO) | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | |
| | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 |
| 1 | 2 | | | | | | 2 | | | | | | |
| 2 | | 3 | | | | | | | | | | | |
| 3 | | | 2 | | | | | | | | | | |
| 4 | | | | 2 | | | | | | | | | |
| 5 | | | | | 2 | | | | | | | 2 | |

| Course Content | |
|---|---|
| **SEMICONDUCTOR MATERIALS FOR SUSTAINABLE ELECTRONICS**<br>Overview of Sustainable Electronics - Importance of Semiconductor Materials in Sustainability - Traditional vs. Sustainable Semiconductor Materials – Selection Criteria for Sustainable Semiconductor Materials - Case Studies: Current Trends in Sustainable Electronics- Global Electronic Waste Management and ethical sourcing of Materials -case study-Real-world project analysing a product lifecycle from raw material sourcing to disposal.<br>**Practical Component:**<br>• To compare the performance of traditional and sustainable semiconductor devices in a simple circuit<br>• Design a practical circuit using sustainable semiconductor materials, such as a low-power LED driver or a solar-powered circuit<br>• Real-world project analysing a product lifecycle (e.g., smartphone/ Laptop) from raw material sourcing to disposal. | **7 Hours**<br><br>**4 Hours** |
| **DIODES AND APPLICATIONS**<br>Formation of the PN junction – V-I characteristics and analysis - Diode capacitance and switching times- Special diodes-Zener diodes: Characteristics and applications - Schottky diodes: Construction, operation, and applications - Light Emitting Diodes (LEDs) and Photodiodes-Diodes Application Rectifiers: Half-wave, full-wave, and bridge rectifiers - Clipping and clamping circuits - Voltage regulation using Zener diode<br>**Practical Component:**<br>• Design an envelope detector using PN Diode.<br>• Design a Diode Crowbar Circuit using Zener diode.<br>• Design a high-speed switching circuit using Schottky diode.<br>• Design a circuit using LED to display the letter E. | **10 Hours**<br><br>**12 Hours** |
| **INORGANIC SEMICONDUCTOR DEVICE**<br>**BJT Structure and Operation:**NPN and PNP transistors - BJT as a switch - Transistor configurations (CE, CB, CC)-BJT biasing methods: Fixed bias, voltage-divider bias, and emitter bias - Stability factors and thermal runaway.<br>**Field-effect transistor (JFET):**Structure and operation of JFETs - Characteristics and transfer curve analysis - JFET biasing and applications- MOSFET structure: Enhancement and depletion types - MOSFET as a switch<br>Nano-electronics and global innovations in device miniaturization.<br>**Practical Component:**<br>• Design a Relay switch circuit using BJT<br>• Verify NPN transistor datasheet using suitable circuit.<br>• Demonstration of BJT biasing circuits<br>• Verify the N-channel JFET Datasheet using suitable circuit.<br>• Demonstration of JFET biasing methods<br>• Demonstration of MOSFET as a switch | **13 Hours**<br><br>**8 Hours** |
| **POWER SEMICONDUCTOR DEVICES**<br>Overview of Power Semiconductors - Power Diodes – Power Transistors: Power BJT, Power FET, Power MOSFET - Thyristors: SCR, DIAC, TRIAC – Sustainable Power Semiconductor: SiC, GaN devices for renewable energy<br>**Practical Component:**<br>• To evaluate the performance of power diodes in Battery charging circuits | **8 Hours**<br><br>**6 Hours** |

| | |
|---|---|
| •To evaluate the performance of power transistors in UPS.<br>• To evaluate the performance of SCR in the Heat control system. | |
| **INNOVATIONS IN SUSTAINABLE SEMICONDUCTOR MATERIALS**<br>Low-energy Manufacturing Processes - Recycling and Reuse of Semiconductor Materials - Biodegradable and Bio-based Semiconductor Materials - Sustainable Semiconductor Materials in Future Device Applications, Content Enhancements: Add global perspective on circular economy for semiconductor materials and recent innovations in bio-based semiconductors. ,<br>**Practical Component:**<br>• Develop a project utilizing sustainable semiconductor materials to enhance energy efficiency and reduce environmental impact in electronic systems. | **7 Hours** |
| **Theory Hours: 45 Tutorial Hours: - Practical Hours: 30 Project Hours: - Total Hours: 75** | |

| **Learning Resources** |
|---|
| **Textbooks:** |
| 1. Salivahanan, S., and N. Suresh Kumar., *Electronic Devices and Circuits*., McGraw-Hill, New Delhi (2011)<br>2. Zhang, Qianfan., *Sustainable Power Electronics: Efficient Power Conversion and Conservation for Electronics*., Wiley, Chichester (2019 |
| **References:** |
| 1 Streetman, Ben G., and Sanjay Banerjee., Solid State Electronic Devices., 7th edition, Pearson, Upper Saddle River (2015).<br>2 Sze, Simon M., and Kwok K. Ng., Physics of Semiconductor Devices., 3rd edition, Wiley, Hoboken (2007).<br>3 Millman, Jacob, and Arvin Grabel., Microelectronics. 2nd edition, McGraw-Hill, New York (1992).<br>4 Pierret, Robert F., Semiconductor Device Fundamentals. Addison-Wesley, Boston (1996).<br>5 Baliga, B. Jayant., Fundamentals of Power Semiconductor Devices. Springer, Boston (2008).<br>6 Neamen, Donald A., Semiconductor Physics and Devices: Basic Principles., 4th edition, McGraw-Hill, New York (2011).<br>7 Li, Xianjun., Sustainable Electronics Manufacturing. Wiley, Hoboken (2019). |
| **Online Educational Resources:** |
| 1. https://onlinecourses.nptel.ac.in/noc20_bt17<br>2. https://onlinecourses.nptel.ac.in/noc22_mm11<br>3. https://www.mooc-list.com/tags/semiconductor-materials |

| **Assessment (Embedded course)** |
|---|
| SA, Activity and Learning Task(s), MCQ, End Semester Examination (ESE)<br>Lab Workbook, Experimental Cycle tests |

| Course Curated by | | | |
|---|---|---|---|
| **Expert(s) from Industry** | **Expert(s) from Higher Education Institutions** | | **Internal Expert(s)** |
| **Vijayeendra H S**<br>Co-Founder and Director at Avanijal Agri Automation Pvt. Ltd, Bangalore<br><br>**Dr. Parthasarathy Ramaswamy**<br>Senior Principal Engineer at Intel Corporation, Bangalore | **Veena N. Hegde**<br>Professor, Dept. of E & I Engg. at B.M.S. College of Engineering, VTU, Bangalore<br><br>**Dr. M Mythily**<br>Assistant Professor at Dept. of Instrumentation Engg.MIT , Chennai | | **Umesh M V**<br>Associate professor at Dept. of E & I Engg, KCT<br><br>**Dr. Jeya Daisy I**<br>Assistant Professor -II at Dept. of E & I Engg, KCT |
| **Recommended by BoS on** | 10/08/2024 | | |
| **Academic Council Approval** | 27 | **Date** | 10/08/2024 |

| 24INP103 | INNOVATION PRACTICUM – II | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | (Common to All branches) | 0 | 0 | 2 | 0 | 1 |
| ES | | SDG | 9, 11, 12 | | | |

| Pre-requisite courses | - | Data Book / Code book (If any) | - |
|---|---|---|---|

**Course Objectives:**

The purpose of taking this course is to:

| | |
|---|---|
| 1 | equip students with essential tools and techniques for leveraging open-source technologies to develop proof-of-concepts and prototypes |
| 2 | provide hands-on experience and participants will gain a comprehensive understanding of the entire product development process |
| 3 | final prototyping, empowering them to transform their ideas into tangible outcomes |

**Course Outcomes**

| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
|---|---|---|
| CO 1 | analyse the effectiveness of various electronic tools and techniques in product development processes | An |
| CO 2 | develop and implement functional software prototypes using open-source tools | Ap |
| CO3 | design and fabricate 3D models using digital fabrication techniques | Ap |

| Course Outcomes (CO) | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 Engineering Knowledge | 2 Problem Analysis | 3 Design/Development of Solutions | 4 Conduct Investigations of Complex Problems | 5 Engineering Tool Usage | 6 The Engineer and The World | 7 Ethics | 8 Individual and Collaborative Team work | 9 Communication | 10 Project Management and Finance | 11 Life-Long Learning | PSO-1 | PSO-2 | PSO-3 |
| 1 | 3 | 2 | 2 | 2 | 2 | | | | | | | | | |
| 2 | 2 | 2 | 2 | | 2 | | | | | | | | | |
| 3 | 2 | 2 | 3 | 2 | 2 | | | | | | | | | |

**Course Content**

| | |
|---|---|
| **INTRODUCTION TO OPEN-SOURCE TOOLS AND TECHNIQUES**<br>Explore the concept of open-source, its underlying principles and its contrast with proprietary software, Discuss the advantages of using open-source tools, such as lower costs, increased innovation, educational value, and community support, walk through to the commonly used open-source tools for electronics design (KiCad, FreeCAD), software development (Python, Eclipse), and fabrication (Cura, LinuxCNC). | **3 Hours** |
| **ELECTRONICS FUNDAMENTALS AND TOOLS**<br>Introduction to basic electronic components (resistors, capacitors, transistors, etc.), Understanding of electronic circuits and their functions, Hands-on practice with CircuitJS and Falstad, Simulating and analysing electronic circuits, Introduction to | **6 Hours** |

| | |
|---|---|
| Arduino and Raspberry Pi, exploring their capabilities and applications, Designing PCBs using KiCad and EasyEDA, Understanding PCB fabrication processes | |
| **SOFTWARE PROTOTYPING AND TOOLS**<br>Benefits of rapid prototyping in product development, Iterative design and testing, Wireframing tools (Balsamiq, Figma), UI design tools (Sketch, Figma), Programming languages (Python, JavaScript), Testing frameworks (Selenium), No-code platforms (Bubble, Adalo, Wix, AppGyver), Building functional prototypes without extensive coding | **6 Hours** |
| **FABRICATION AND PROTOTYPING**<br>Overview of fabrication techniques (3D printing, laser cutting, CNC machining), Prototyping methods for physical products, using tools like Blender, TinkerCAD, or Fusion 360, Creating 3D models for physical prototypes, Hands-on experience with laser cutting and engraving, Understanding their applications and limitations | **7 Hours** |
| **SIMULATION & DEMONSTRATION**<br>Integrated project demonstration, explaining the design process, technical choices, and outcomes, and a simulation showcase to demonstrate their understanding of various technical tools and prototyping techniques | **8 Hours** |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Theory Hours:** | **0** | **Tutorial Hours:** | **0** | **Practical Hours:** | **30** | **Project Hours:** | **0** | **Total Hours:** | **30** |

**Learning Resources**

**Textbooks:**

1. Damir Godec, Joamin Gonzalez-Gutierrez, Axel Nordin, Eujin Pei, Julia Ureña Alcázar, A guide to additive manufacturing, Springer – 2022. https://doi.org/10.1007/978-3-031-05863-9
2. Introducing SolidWorks, Dassault Systems.

**References:**

1. Insight into Electronics
2. Microcontroller Programming with Arduino and Python
3. Fundamentals of 3D modelling

**Online Resources (Weblinks)**

1. Google Play store apps:
   a. https://play.google.com/store/apps/details?id=com.electronicslab
   b. https://play.google.com/store/apps/details?id=it.android.demi.elettronica
2. https://engservices-ece.sites.olt.ubc.ca/files/2020/01/SolidWorks-3D-Printing-Tutorial-R2.pdf

**Assessment (Practical course)**

Lab Workbook, Experimental Cycle tests, viva-voce

**Course Curated by**

| Expert from Industry | Expert(s) from Higher Education Institution | Internal Expert |
|---|---|---|
| Dr. Mahesh Veezhinathan<br>Director - Innovation Practicum<br>Associate VP - Forge. Innovation | - | Dr. Samuel Ratna Kumar P S<br>Assistant Professor – III<br>Department Mechanical Engineering |

| | | | |
|---|---|---|---|
| **Recommended by BoS on** | 17.08.2024 | | |
| **Academic Council Approval** | No: 27 | **Date** | 24.08.2024 |

| 24HSP112 | HOLISTIC WELLNESS-II<br>(Common to all Department) | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 0 | 0 | 2 | 0 | 1 |
| HS | | SDG | 3, 4 | | | |

| Pre-requisite courses | Holistic Wellness-I | Data Book / Code book (If any) | - |
|---|---|---|---|

| Course Objectives: | |
|---|---|
| The purpose of taking this course is to: | |
| 1 | build on the foundation laid in Holistic Wellness -I and deepening into the practices and principles of holistic wellness. |
| 2 | explore advanced techniques in mental, emotional, and spiritual well-being, with an emphasis on creating sustainable wellness habits. |

| Course Outcomes | | |
|---|---|---|
| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
| CO 1 | apply advanced techniques in mindfulness, meditation, and stress management. | Ap |
| CO 2 | understand the role of community and social connections in wellness. | U |
| CO 3 | develop resilience and adaptability in maintaining wellness. | E |
| CO 4 | refine and sustain a personalized holistic wellness plan. | E |

| Course Outcomes (CO) | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | | |
| | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 | PSO-3 |
| 1 | | | | | | 2 | | 2 | | | | | | |
| 2 | | | | | | 2 | | | | | | | | |
| 3 | | | | | | 2 | | | | | 3 | | | |
| 4 | | | | | | 2 | | | | | 3 | | | |

## Course Content

| | |
|---|---|
| **ADVANCED MINDFULLNESS AND MEDITATION:**<br>• Deepening mindfulness practices for enhanced mental clarity.<br>• Exploring different forms of meditation (e.g., guided, transcendental, movement-based).<br>• Hands-on activity: Daily meditation practice and journaling reflections. | **6 Hours** |
| **EMOTIONAL RESILIENCE AND MENTAL HEALTH:**<br>• Building emotional resilience through positive psychology practices.<br>• Cognitive-behavioural strategies for managing stress and anxiety.<br>• Hands-on activity: Developing and practicing a resilience toolkit. | **6 Hours** |

| | |
|---|---|
| **SOCIAL AND ENVIRONMENTAL WELLNESS:**<br>• The impact of social connections and community on wellness.<br>• Creating a supportive environment for personal growth.<br>• Hands-on activity: Building a community wellness project or group activity. | **6 Hours** |
| **INTERNAL GROWTH AND PURPOSE:**<br>• Exploring the deeper aspects of internal wellness and self-actualization.<br>• Reflective practices for discovering life purpose and meaning.<br>• Hands-on activity: Creating a vision board or personal mission statement. | **6 Hours** |
| **SUSTAINING WELLNESS PRACTICES:**<br>• Strategies for maintaining wellness habits over the long term.<br>• Adapting wellness plans to life changes and challenges.<br>• Hands-on activity: Revising and finalizing a long-term personal wellness plan. | **6 Hours** |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Theory Hours:** | **0** | **Tutorial Hours:** | **0** | **Practical Hours:** | **30** | **Project Hours:** | | **Total Hours:** | **30** |

## Learning Resources

### Textbooks:

1. Hanh, Thich Nhat. The Miracle of Mindfulness: An Introduction to the Practice of Meditation. Beacon Press, Boston (1975).
2. Tolle, Eckhart. The Power of Now: A Guide to Spiritual Enlightenment. New World Library, Novato (1997).
3. Patel, Kamlesh. Heartfulness Way: Heart-Based Meditations for Spiritual Transformation, Kamlesh Patel, 2018.

### References:


1. Goleman Daniel., Emotional Intelligence., Bloomsbury India, India, (2021).
2. James Allen., As a Man Thinketh., Maple Press, Noida, (2010)
3. Swami Budhanandha., Will power and its development., Advaita Ashrama Mayavati, Pithoragarh, Himalayas from its Publication Department, Calcutta. (2001)
4. Rosenberg, Marshall Bertram., Nonviolent Communication: A Language of Life., Puddle Dancer Press, Encinitas, CA (2015).
5. Jayanna, Krishnamurthy., Science & Practice of Integrative Health & Wellbeing Lifestyle., White Falcon Publishing (2020).
6. Lipton, Bruce., The Biology of Belief 10th Anniversary Edition: Unleashing the Power of Consciousness, Matter & Miracles, Hay House, Carlsbad (2015).
7. Kalderdon Adizes Ichak., What Matters in Life: Lessons I Learned from Opening My Heart
8. ., WS Press, Newtown, PA(2023).
9. Murphy, Joseph., The Power of Your Subconscious Mind [Original Edition (Complete)], Prentice-Hall, Englewood Cliffs (1963).
10. Kamlesh D. Patel., Designing Destiny: The Heartfulness Way, Heartfulness Institute, Chennai (2021)


### Online Resources (Weblinks)

- Introduction to Psychology
- Guided Meditation
- Life skills and value education
- James Allen Library

| Assessment (Practical course) |
|---|
| Participation, Practical activities and assignments, personal wellness plan and reflection. |

| Course Curated by | | | |
|---|---|---|---|
| **Expert(s) from Industry** | **Expert(s) from Higher Education Institution** | **Internal Expert(s)** | |
| | | Dr. Ezhilarasi<br>Principal- KCT | |
| **Recommended by BoS on** | 16.08.2024 | | |
| **Academic Council Approval** | No: 27 | **Date** | 24.08.2024 |

# THIRD SEMESTER

| 24HSP005 | 24HSP005-Mastering Conversations | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 0 | 0 | 2 | 0 | 1 |
| HS | | SDG | 4 & 8 | | | |

| Pre-requisite courses - Nil | NIL | Data Book / Codes / Standards ( If any) | Nil |
|---|---|---|---|

| Course Objectives: | The purpose of taking this course is to: (3 to 5) |
|---|---|
| 1 | Demonstrate understanding of different perspectives by analyzing complex personal and professional situations. |
| 2 | Engage in thoughtful dialogue and discussions about complex, real-world issues, utilizing critical thinking to assess different viewpoints. |
| 3 | Apply role-playing as a tool to enhance understanding of workplace dynamics, conflict resolution, and team collaboration. |

| Course Outcomes: | After successful completion of this course, the students shall be able to | Bloom's Taxonomy Level (BTL) |
|---|---|---|
| CO 1 | Empathize with and understand people in both professional and personal contexts, reflecting on situations from multiple perspectives and participating in activities that mirror career-related scenarios | Ap |
| CO 2 | Analyze and converse critically on complex subjects, demonstrating the ability to approach and deal with various social contexts effectively | An |
| CO 3 | Exhibit skills in role-playing and enacting given situations to navigate diverse social interactions and career-related contexts. | C |

| | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | | |
| Course Outcomes (CO) | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 | PSO-3 |
| 1 | | | | | | 3 | | | 3 | 2 | 3 | | | |
| 2 | | | | | | | | | 1 | 2 | | | | |
| 3 | | | | | | | | | 3 | 2 | | | | |

| Course Content | |
|---|---|
| **PRACTICAL COMPONENT / ROLEPLAYS DYNAMICS**<br>Introduction to Role play - Benefits of role plays - Importance of gesture, tone and modulation-Skill development through role play activities - Types of role plays - Conversation Building through communicative functions-Initiating a dialogue- Framing questions- Receiving feedback | **6 Hours** |
| **PRACTICAL COMPONENT /ROLEPLAYS ON SOCIAL SKILL**<br>Social Interactions: - (Ordering food at a restaurant- Making a reservation at a hotel-- Shopping at a store-- Attending a party or social gathering)<br>Travel and Tourism:(Asking for directions- Booking a flight or hotel-- Exploring a new city- Interacting with local people)<br>Community and Volunteering:(Participating in a charity event, Volunteering at a local organization, discussing community issues, Organising a community project) | **6 Hours** |
| **PRACTICAL COMPONENT / ROLEPLAYS ON EDUCATION AND TECHNOLOGY**<br>Education and Personal Growth:(Setting goals-(Short term & Long term)- Creating a study plan- Participating in a workshop- Reflecting on personal growth)<br>Technology and Online Interactions:(Participating in an online meeting- Creating a social media post- Writing an email or text message- Making an online purchase)<br>Technology and Science:(Explaining a scientific concept- Discussing emerging technologies- participating in Hackathons- Presenting a research paper) | **6 Hours** |
| **PRACTICAL COMPONENT / ROLEPLAYS ON STRATEGIC INSIGHTS**<br>Critical Thinking :(Evaluating a news article-solving a moral dilemma-Decision with incomplete information-Assessing a historical event)<br>Problem-Solving:(Resolving a conflict- Negotiating a deal - Making a complaint-Apologizing for a mistake)<br>Business and Entrepreneurship:(Pitching an idea- Negotiating a contract- Conducting a market Research- Presenting a product launch) | **6 Hours** |
| **PRACTICAL COMPONENT / ROLEPLAYS ON CULTURAL EXCHANGE**<br>Cultural Exchange:(Sharing customs and traditions- Discussing cultural differences-Exploring historical events- Participating in a cultural festival)<br>Media and Entertainment:( Event planning- Creating an advertisement-Digital Marketing-Conducting interviews- Creating news broadcast- Writing and Performing a script-Enacting one act plays)<br>Arts and Culture:(Visiting an art gallery - Attending/ organizing a concert or play - Discussing literature- Creating a piece of art) | **6 Hours** |
| **Theory Hours:** **Tutorial Hours:** **Practical Hours:** **30** **Project Hours:** **Total Hours:** **30** | |

| Learning Resources* |
|---|
| **Reference books/ Web Links** |
| 1. 1.Bonwell, C. C., & Eison, J. A. (1991). Active learning: Creating excitement in the classroom. Washington, DC: The George Washington University. |

2. Harbour, E., & Connick, J. (2005). Role playing games and activities rules and tips. Retrieved from https://www.businessballs.com/roleplayinggames.htm
3. Lebaron, J., & Miller, D. (2005). The potential of jigsaw role playing to promote the social construction of knowledge in an online graduate education course. Retrieved from http://paws.wcu.edu/jlebaron/Jigsaw-FnlTCRpdf_050812.pdf
4. Davies, A. (2018). Teaching and learning through role-play: A practical guide. Maidenhead, UK: McGraw-Hill Education.
5. Young, K. C. (2016). The art of role play: Developing realistic scenarios for skill development. Boston, MA: Pearson.
6. 6. Yardley-Matwiejczuk, K. M. (1997). Role play: Theory and practice. London, UK: SAGE Publications Ltd.

**Online Resources**

https://www.niu.edu/citl/resources/guides/instructional-guide
https://positivepsychology.com/role-playing-scripts/

| **Assessment** | |
|---|---|
| Formative | Summative |
| Assignments / Mini project), Quiz, Lab | Quizzes and written assignments, Participation in group activities |

| **Course Curated By** | | |
|---|---|---|
| **Expert(s) from Industry** | **Expert(s) from Higher Education Institutions** | **Internal Expert(s)** |
| Mr.Vijayan Ramanathan , Project manager, Toppan Merrill. Technologies, Coimbatore | Dr. Aninditha Sahoo, IIT, Madras<br>Dr.P.R.Sujatha Priyadharshini, Anna University Chennai<br>Dr. E. Justin Ruben, CIT, Coimbatore | Dr. Arokia Lawrence Vijay<br>Dr. Tissaa Tony |

| | |
|---|---|
| **Approved by: BoS Chairman** |  |
| **BoS Approval date:** | **16-8-2024** |

| 24MAI233 | PROBABILITY AND APPLIED STATISTICS (Common to EE, EI) | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 0 | 4 |
| BS | | SDG | 7, 9 | | | |

| Pre-requisite courses | - | Data Book / Codes / Standards (If any) | Statistical Table |
|---|---|---|---|

## Course Objectives:

The purpose of taking this course is to:

| | |
|---|---|
| 1 | comprehend the basic principles of probability theory, including the axioms that govern probability spaces and the interpretation of probability values in different contexts. |
| 2 | analyze relationships between discrete variables using correlation and understand various distributions for modelling and analyzing random phenomena. |
| 3 | provide students with the knowledge and skills to perform statistical inference through hypothesis testing. |
| 4 | enable effective comparison of multiple treatments and control of variability in experimental data. |
| 5 | introduce the concept of statistical process control and to equip students with the skills to construct and interpret control charts for variables. |

| Course Outcomes: | After successful completion of this course, the students shall be able to | Bloom's Taxonomy Level (BTL) |
|---|---|---|
| CO 1 | apply the concept of probability and random variables. | Ap |
| CO 2 | compute correlation between variables and construct probabilistic models for observed phenomena through distributions | Ap |
| CO 3 | perform hypothesis testing and interpret the results. | An |
| CO 4 | perform analysis of variance by understanding the principles of design of experiments | An |
| CO 5 | sketch control charts and comment on the process control. | An |
| CO 6 | apply the above concepts to solve problems using R Studio. | Ap |

| | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | | |
| Course Outcomes (CO) | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 | PSO-3 |
| 1 | 2 | 3 | | | | | | | 2 | 2 | | | | |
| 2 | 3 | 3 | | | | | | | 2 | 2 | | | | |
| 3 | 3 | 2 | | | | | | | 2 | 2 | | | | |
| 4 | 3 | 3 | | | | | | | 2 | 2 | | | | |
| 5 | 3 | 3 | | | | | | | 2 | 2 | | | | |
| 6 | 3 | | | | | | | | 2 | 2 | | | | |

| Course Content | |
|---|---|
| **PROBABILITY AND RANDOM VARIABLES**<br>Axioms of probability – Conditional probability – Total probability – Bayes' theorem Random variable – Distribution function – properties – Probability mass function Probability density function<br>**PRACTICAL COMPONENT**<br>• Introduction to R programming<br>• Application of descriptive statistics – Mean, Median, Mode and standard deviation | **9 Hours**<br><br>**6 Hours** |
| **CORRELATION AND STANDARD DISTRIBUTIONS**<br>Correlation (Discrete Data): Karl Pearson's Correlation coefficient - Regression lines (Discrete Data) - Binomial, Poisson and Normal distributions<br>**PRACTICAL COMPONENT**<br>• Applications of Correlation and Regression<br>• Application of Normal distribution | **9 Hours**<br><br>**6 Hours** |
| **TESTING OF HYPOTHESIS**<br>Testing of hypothesis for large samples (single mean, difference of means) – Small sample tests based on t and F distributions (single mean, difference of means, paired t-test and variance ratio test) – Chi-square test for independence of attributes and goodness of fit<br>**PRACTICAL COMPONENT**<br>• Application of Student – t test<br>• Application of F test<br>• Application of Chi-square test | **9 Hours**<br><br>**6 Hours** |
| **DESIGN OF EXPERIMENTS**<br>Analysis of Variance (ANOVA) – Completely Randomized Design (CRD) – Randomized BlockDesign (RBD) – Latin Square Design (LSD).<br>**PRACTICAL COMPONENT**<br>• ANOVA – one way classification<br>• ANOVA – two-way classification | **9 Hours**<br><br>**6 Hours** |
| **STATISTICAL QUALITY CONTROL**<br>Concept of process control - Control charts for variables: Mean and Range charts – Control charts forattributes: p, np, c – charts.<br>**PRACTICAL COMPONENT**<br>• Control charts for variables (mean and range chart) | **9 Hours**<br><br>**6 Hours** |

| Theory Hours: | 45 | Tutorial Hours: | 0 | Practical Hours: | 30 | Project Hours: | 0 | Total Hours: | 75 |
|---|---|---|---|---|---|---|---|---|---|

| Learning Resources |
|---|
| **Textbooks** |
| 1. Veerarajan T., Probability, Statistics and Random Processes, Tata McGraw Hill, third edition, 2017.<br>2. Gupta S. P, Statistical Methods, Sultan Chand & Sons Publishers, 2021. |
| **Reference books** |
| 1. Johnson R. A., Miller & Freund's Probability and Statistics for Engineers, ninth Edition, Pearson Education, Delhi, 2017. |

2. Gupta. S.C and Kapoor. V.K, Fundamentals of Mathematical Statistics, Eleventh extensively revised edition, Sultan Chand & Sons, 2020.
3. Montgomery D. C., Design and analysis of experiments, tenth Edition, Wiley, 2019.
4. Gupta S.C, and Kapur V.K Fundamentals of Applied Statistics, Sultan Chand, New Delhi, fourth Edition, 2014.
5. Grant, E. L., & Leavenworth, R. S. Statistical quality control, Seventh edition, McGraw-Hill, 2017.

**Online Resources (Web Links)**

1. Probability and random variables: https://www.coursera.org/learn/foundations-of-probability-and-random-variables
2. Testing of Hypothesis https://archive.nptel.ac.in/courses/103/106/103106120/
3. Design of Experiments: https://www.coursera.org/learn/anova-and-experimental-design
4. Control Charts: https://www.coursera.org/learn/stability-and-capability-in-quality-improvement#modules

| **Assessment** | |
|---|---|
| Formative | Summative |
| Assignments / Group activities (like Group presentation, e-Poster Presentation), Quiz, Lab. | SA- I, SA – II and End Semester Examination (ESE) |

**Course Curated By**

| **Expert(s) from Industry** | **Expert(s) from Higher Education Institutions** | **Internal Expert(s)** |
|---|---|---|
| 1. Dr. R Vasu<br>Business Excellence and Management Systems Consultant Specialisation in Process Excellence, Six Sigma Quality, Health Safety & Environment Systems<br>Vice President (Retired)<br>Brakes India. | 1. Dr. M. Sivakumar<br>Assistant Professor Sr. Grade<br>Vellore Institute of Technology, Vellore<br>2. Dr. Ramesh Babu<br>Assistant Professor (SG)<br>Amrita University<br>Coimbatore, Tamil Nadu. | 1. Dr. A. Ezhilarasi<br>2. Dr. R. Krishna Moorthy<br>3. Ms. S. Princy Flora<br>Department of Mathematics |

| **Recommended by BoS on** | 25.4.2025 | | |
|---|---|---|---|
| **Academic Council Approval** | | **Academic Council Approval** | |

| 24MET205 | THERMODYNAMICS AND FLUID MECHANICS | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 |
| ES | | SDG | 7 , 13 | | | |

| Pre-requisite courses | ---- | Data Book / Code book (If any) | ------- |
|---|---|---|---|

| Course Objectives: | |
|---|---|
| The purpose of taking this course is to: | |
| 1 | To provide fundamental knowledge of thermodynamics and its laws as applied to engineering systems |
| 2 | The power generation concepts in steam power plants |
| 3 | To study the fluid properties, Euler's, Bernoulli's equation Working principles of hydraulic turbines and pumps |

| Course Outcomes | | |
|---|---|---|
| After successful completion of this course, the students shall be able to | | **Revised Bloom's Taxonomy Levels (RBT)** |
| CO 1 | Explain the basic concepts and laws of thermodynamics. | Ap |
| CO 2 | Define and explain the fundamental modes of heat transfer: conduction, convection, and radiation. | Ap, An |
| CO 3 | Explain the principles and operation of thermal systems such as turbines and boilers. | Ap. An |
| CO 4 | Analyze and design basic flow measurement and heat transfer systems used in instrumentation | Ap, An |
| CO 5 | Understand fluid properties and classify different types of fluid machines. | Ap, An |

| Course Outcomes (CO) | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | | |
| | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 | PSO-3 |
| 1 | 3 | 2 | - | - | - | - | - | - | - | - | 2 | 3 | - | - |
| 2 | 3 | 2 | - | - | - | - | - | 2 | 2 | - | - | 2 | - | - |
| 3 | 3 | 3 | - | 2 | 1 | - | - | 3 | 3 | - | - | 2 | - | - |
| 4 | 3 | 2 | - | 2 | - | - | - | 3 | 3 | - | 2 | 2 | - | - |
| 5 | 3 | 3 | 2 | 2 | - | 1 | - | 3 | 3 | - | 2 | 2 | - | - |

| Course Content | |
|---|---|
| **BASIC OF THERMODYNAMICS**<br>Thermodynamic systems – Types, Properties, State - process - Cycle – Equilibrium – Work and heat transfer – First law of thermodynamics for non-flow process (closed system) – First law applied to Flow process (open system) - SFEE (Steady flow energy equation) – Second law of thermodynamics – Heat engines – Refrigerators and heat pumps (Descriptive only). | **10 Hours** |
| **BASIC OF HEAT TRANSFER**<br>Modes of Heat transfer- One dimensional Conduction heat transfer (Steady state) – composite walls, Convection heat transfer – Free and Forced convection- Cooling of electronic components: Thermoelectric cooling – Chip cooling (Descriptive only). | **8 Hours** |
| **STEAM BOILERS AND TURBINES**<br>Formation of steam – properties of steam –working principle – Types of boilers- Mounting and accessories (Descriptive only). Steam power cycle (Rankine), Steam turbines: Impulse and reaction principle (Descriptive only). | **9 Hours** |
| **FLUID PROPERTIES AND FLOW KINEMATICS**<br>Definitions of fluid - Properties of fluids – (Definition only)-Mass density – Specific weight – Specific volume – Specific gravity – Viscosity – Compressibility – Surface tension – Capillarity –Vapor pressure.<br>– Fluid Pressure and Pressure Head – Types of Fluid Flow – Continuity Equation. Euler's equations – Bernoulli's Equation and Applications – Venturi meter and orifice meter. | **9 Hours** |
| **FLUID MACHINES**<br>Definition and classifications- Centrifugal and Reciprocating Pumps: Working principles. Classification of hydraulic turbines, Pelton, Francis, and Kaplan turbines - working principles (Descriptive only) | **9 Hours** |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Theory Hours:** | **45** | **Tutorial Hours:** | **0** | **Practical Hours:** | **0** | **Project Hours:** | **Total Hours:** | **45** | |

**Learning Resources**

**Textbooks:**


3. Yunus A. Cengel, Michael A. Boles, "Thermodynamics: An Engineering Approach**"**, McGraw-Hill.
4. R.K. Bansal, "Fluid Mechanics and Hydraulic Machines", Laxmi Publications (P) Ltd, New Delhi (2006).
5. K.L. Kumar, "Engineering Fluid Mechanics", Eurasia publishing house, New Delhi,(2001).


**References:**


1. D. Patranabis, **"Principles of Industrial Instrumentation"**, Tata McGraw-Hill.
2. P.N. Modi & S.M. Seth, "Hydraulics and fluid mechanics including hydraulic machines",
   a. Standard book house, New Delhi, (2005).
3. V.L. Streeter – "Fluid mechanics", McGraw-Hill, New York, (2002).
4. White, F.M., "Fluid Mechanics", Tata McGraw-Hill, Chennai, (2003).
5. Versteeg, H.K, and Malalasekera, W., "An Introduction to Computational Fluid Dynamics: The Finite Volume Method", Pearsons, United Kingdom, (2007).


**Online Educational Resources:**

1. http://nptel.ac.in/courses/105101082/
2. http://bookboon.com/en/engineering-fluid-mechanics-ebook
3. http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv078
4. http://www.srividyaengg.ac.in/elearn1/coursematerial/Mech/114343. pdf
5. http://www.engineeringtoolbox.com/fluid-mechanics-t_21.html

4. https://www.youtube.com/watch?v=OGIkuJoQzok
5. https://www.youtube.com/watch?v=VZXVdPoy3zs
6. https://www.youtube.com/watch?v=3gxNrc_EEN8
7. https://www.youtube.com/watch?v=BaEHVpKc-1Q

| **Assessment (Embedded course)** |
|---|
| SA, MCQ, Written Assignments , End Semester Examination (ESE) |

| **Course Curated by** | | | |
|---|---|---|---|
| **Expert(s) from Industry** | **Expert(s) from Higher Education Institution** | | **Internal Expert(s)** |
| Mr. Balamurugan M<br>Application Engineer-API Pumps<br>Department : Techno-Commercial Operations<br>M/s. Flowserve India Controls Pvt. Ltd., Coimbatore. | Dr. M Balasubramaniam<br>Assistant Professor<br>Department of Mechanical Engineering<br>Anna University Regional Campus Coimbatore. | | Mr. P.Pradeep<br>Assistant Professor<br>Department of Mechanical Engineering, Kumaraguru College of Technology, Coimbatore. |
| **Recommended by BoS on** | 07/05/2025 | | |
| **Academic Council Approval** | No. | **Date** | XX/YY/2025 |

| 24EII201 | Electronic Circuit Design | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 0 | 4 |
| PC | | SDG | 9 and 3 | | | |

| Pre-requisite courses | 24EII101 | Data Book / Code book (If any) | NIL |
|---|---|---|---|

| Course Objectives: | |
|---|---|
| The purpose of taking this course is to: | |
| 1 | To impart a solid foundation in basic circuit laws, network theorems, and simulation techniques for the analysis and design of electrical and analog networks, including sinusoidal steady-state AC behavior, resonance, and two-port systems. |
| 2 | To enable learners to model, analyze, and design small-signal and power amplifier circuits—including multistage, feedback, and MOSFET-based configurations—for use in analog front-ends, biomedical devices, and low-power wearable electronics. |
| 3 | To provide hands-on experience in the design and simulation of signal conditioning circuits, oscillators, and multivibrators for applications in timing, waveform generation, and frequency stability in embedded and communication systems. |

| Course Outcomes | | |
|---|---|---|
| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
| CO 1 | apply fundamental electrical laws and circuit analysis techniques to model, solve, and simulate linear electrical networks. | Ap |
| CO 2 | analyse AC circuits in the sinusoidal steady state using phasor and impedance concepts, and evaluate resonance behaviour and frequency response. | An |
| CO 3 | interpret and implement classical network theorems to simplify and analyze complex electrical circuits both theoretically and through simulation tools. | An |
| CO 4 | design, analyze, and evaluate the performance of analog amplifier circuits using BJTs and MOSFETs for signal amplification and conditioning. | An |
| CO 5 | integrate multistage, differential, and feedback amplifier configurations in analog front-end systems for biomedical and low-power applications. | An |
| CO 6 | design and simulate stable oscillators and multivibrator circuits for waveform generation and timing applications in embedded and communication systems. | An |

| Course Outcomes (CO) | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | |
| | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 |
| 1 | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 2 | | | 3 | 3 | 1 |
| 2 | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 2 | | | 3 | 3 | 1 |
| 3 | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 2 | | | 3 | 3 | 1 |
| 4 | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 2 | | | 3 | 3 | 1 |
| 5 | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 2 | | | 3 | 3 | 1 |
| 6 | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 2 | | | 3 | 3 | 1 |

## Course Content

| | |
|---|---|
| **FUNDAMENTALS OF CIRCUIT ANALYSIS AND NETWORK**<br>Current and Voltage Laws (KCL, KVL)- Mesh and Nodal Analysis Techniques- Network Theorems: Superposition, Thevenin's, Norton's, Maximum Power Transfer Network Theorems: Superposition, Thevenin's, Norton's, Maximum Power Transfer - Practical Circuit Simulation using LTspice or Multisim<br>**Practical Component:**<br>• Verification of Kirchhoff's Laws using Simulation Tools (LTspice/Multisim)<br>• Implementation and Analysis of Thevenin's and Norton's Theorems<br>• Experimental Validation of the Maximum Power Transfer Theorem | **9 Hours**<br><br>**6 Hours** |
| **AC SIGNAL ANALYSIS AND RESONANT NETWORKS**<br>Sinusoidal Steady State Analysis: Impedance, Phasor Concepts- Resonance in RLC Circuits (Series and Parallel)- Two-port Network Parameters and Interconnections - Application in Sensor Interfaces and Analog Filters for IoT<br>**Practical Component:**<br>• Impedance and Phasor Analysis in RLC Series and Parallel Circuits<br>• Resonance Characteristics in Series and Parallel RLC Circuits<br>• Characterization of Two-Port Network Parameters | **9 Hours**<br><br>**6 Hours** |
| **BJT-BASED ANALOG DESIGN AND SIGNAL PROCESSING**<br>Small Signal Models: r,π Model- Frequency Response: Low, Mid, High Frequency- Miller Effect and Bandwidth Estimation- Multistage Amplifier- Negative Feedback age Amplifiers- Coupling Methods: RC Coupling, Transformer Coupling- Differential Amplifiers: Voltage Series, Voltage Shunt, Current Series, Current Shunt- Power Amplifiers: Class A, B, AB, and Class C Amplifiers- Efficiency and Distortion Analysis - Analog Front-End Design for Biomedical Applications<br>**Practical Component:**<br>• Frequency Response of a Single-Stage BJT Amplifier<br>• Design and Analysis of Differential Amplifier<br>• Performance Analysis of Power Amplifiers (Class A, B, AB) | **9 Hours**<br><br>**6 Hours** |
| **MOSFET AMPLIFIERS AND MODERN ANALOG DESIGN**<br>MOSFET Biasing: Fixed Bias, Voltage Divider Bias- Small Signal Analysis of CS, CG, CD Amplifiers-Frequency Response of MOSFET Amplifiers- Design Examples of | **9Hours** |

| | |
|---|---|
| MOSFET Amplifiers- Multistage Amplifiers: Cascading MOSFET Stages- Differential Amplifier- Case Study: Signal Conditioning for Wearable Health Monitors<br>**Practical Component:**<br>• MOSFET Biasing Techniques – Fixed and Voltage Divider Bias<br>• Frequency Response of Common Source (CS) MOSFET Amplifier<br>• Design and Analysis of Cascaded MOSFET Amplifier for Signal Conditioning | **6 Hours** |
| **OSCILLATORS, MULTIVIBRATORS, AND WAVEFORM GENERATORS**<br>Conditions for Sustained Oscillations (Barkhausen Criterion)- RC Oscillators: Phase Shift Oscillator, Wien Bridge Oscillator- LC Oscillators: Hartley Oscillator, Colpitts Oscillator- Crystal Oscillator (High-frequency Stability)- Multivibrators: Astable and Monostable using BJT circuits- Schmitt Trigger using BJT - Practical Implementation using Proteus/Multisim<br>**Practical Component:**<br>• Design and Simulation of Wien Bridge Oscillator<br>• Design and Simulation of Astable and Monostable Multivibrators<br>• Design and Simulation of Schmitt Trigger Circuits | **9Hours**<br><br>**6 Hours** |

| | | | | |
|---|---|---|---|---|
| **Theory Hours: 45** | **Tutorial Hours:** | **Practical Hours: 30** | **Project Hours:** | **Total Hours: 75** |

**Learning Resources**

**Textbooks:**


1. Boylestad, Robert L., and Nashelsky, Louis,Electronic Devices and Circuit Theory. Pearson Education, Noida (2021).
2. Salivahanan, S., and Suresh Kumar, N. *Electronic Devices and Circuits.* McGraw-Hill Education, New Delhi (2021).
3. Sedra, A. S., and Smith, K. C. *Microelectronic Circuits.* Oxford University Press, New York (2020).


**References:**


1. Millman, Jacob, and Halkias, Christos C. *Integrated Electronics: Analog and Digital Circuits and Systems.* McGraw-Hill Education, New York (2021).
2. Neamen, Donald A. *Microelectronics: Circuit Analysis and Design.* McGraw-Hill Education, New York (2021).
3. Rao, S. S., and Srinivasan, R. *Network Analysis and Synthesis.* Pearson Education, New Delhi (2021).
4. Kumar, A., and Sinha, P. *Electronic Devices and Circuits.* Dhanpat Rai Publishing Company, New Delhi (2020).
5. Muthusubramanian, R., and Salivahanan, S. *Basic Electrical and Electronics Engineering.* McGraw-Hill Education, New Delhi (2021).
6. Sarma, M. S., and Chatterjee, S. *Analog Electronics.* Cengage Learning, New Delhi (2021)
7. Vasudevan, D., and Ranganathan, S. *Electrical and Electronics Engineering.* McGraw-Hill Education, New Delhi (2019).


**Online Educational Resources:**

1. https://www.khanacademy.org/math/differential-calculus
2. https://www.khanacademy.org/science/electrical-engineering
3. https://www.coursera.org/browse/engineering/electrical-engineering
4. https://www.edx.org/learn/electrical-engineering
5. https://www.allaboutcircuits.com
6. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/

| Assessment (Embedded course) |
|---|
| SA, Activity and Learning Task(s)* , Mini project, MCQ, End Semester Examination (ESE) Lab Workbook, Experimental Cycle tests, viva-voce |

| Course Curated by | | |
|---|---|---|
| **Expert(s) from Industry** | **Expert(s) from Higher Education Institution** | **Internal Expert(s)** |
| [Name, Organisation] | [Name, Institution] | 1. Dr. Jeya Daisy I, Assistant Professor-II, EIE<br>2. Dr. Mayurappriyan PS, Professor, EIE |
| **Recommended by BoS on** | 07/05/2025 | |
| **Academic Council Approval** | No.28 | **Date** 26/062025 |

| 24EII202 | SENSORS AND TRANSDUCERS | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 0 | 4 |
| PC | | SDG | 9 and 11 | | | |

| Pre-requisite courses | 24PHI102 | Data Book / Code book (If any) | NIL |
|---|---|---|---|

| Course Objectives: | |
|---|---|
| The purpose of taking this course is to: | |
| 1 | Understand the working principles and characteristics of various types of sensors and transducers. |
| 2 | Analyze the selection criteria and performance evaluation of sensors based on application requirements. |
| 3 | Develop skills to interface sensors with signal conditioning circuits and measurement systems. |
| 4 | Build competency to design and implement sensor-based measurement solutions in real-world applications. |

| Course Outcomes | | |
|---|---|---|
| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
| CO 1 | analyse the static and dynamic behaviour of first-order and zero-order transducers and evaluate the performance of measurement systems with respect to accuracy and uncertainty. | Ap |
| CO 2 | apply the principles of resistive sensor technologies and design simple signal conditioning circuits for temperature, strain, and light measurements. | Ap |
| CO 3 | analyze the working mechanisms of inductive and capacitive transducers and select appropriate sensors based on application-specific requirements. | Ap |
| CO 4 | evaluate the operational effectiveness of thermoelectric, piezoelectric, and photovoltaic sensors and recommend suitable sensors for energy harvesting and dynamic measurement applications. | An |
| CO 5 | examine the architecture of intelligent, MEMS, and fiber-optic sensors and design sensor integration strategies for smart measurement systems. | U |
| CO 6 | integrate the knowledge of conventional, self-generating, and intelligent sensor technologies to design and evaluate complete sensor-based measurement solutions for industrial and scientific applications. | Ap |

| Course Outcomes (CO) | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | | |
| | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 | PSO-3 |
| 1 | 1 | 2 | 3 | 2 | | | | | | | | | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 1 | 2 | 2 | 2 | | | | | | | | | | |
| 3 | 1 | 2 | 3 | 2 | | | | | | | | | | |
| 4 | 1 | 2 | 2 | 3 | | | | | | | | | | |
| 5 | | | 3 | 2 | 2 | 2 | | | | | | | | |
| 6 | 3 | 3 | 3 | 3 | | | | | | | | | | |

## Course Content

| | |
|---|---|
| **INTRODUCTION TO SENSOR BASED MEASUREMENT SYSTEM**<br>Classification of transducers – Selection of transducers. Static characteristics – Dynamic characteristics – Mathematical model of transducer – Zero, first order transducers – Response to impulse, step and ramp inputs. Units and Standards, Classification of errors, Limiting error and probable error – Error analysis – Statistical methods – Odds and uncertainty<br>**Practical Component:**<br>• Calibrate voltmeter / ammeter using Electrical calibration Test Bench<br>• Calibrate RTD/Thermistor using Temperature Calibration Test Bench | **9 Hours**<br><br>**4 Hour** |
| **RESISTIVE SENSORS**<br>Potentiometer, strain gauge, resistance thermometer, Thermistor, Hot-wire anemometer, Magnetoresistors, LDRs, Resistive bendy sensors and Resistive Hygrometers<br>**Practical Component:**<br>• Practical verification of Strain gauge sensor specifications with the signal conditioning circuits.<br>• Practical verification of RTD and Thermistor sensor specifications with the signal conditioning circuits.<br>• Practical verification of LDR specifications with the signal conditioning circuits. | **9 Hours**<br><br>**6 Hours** |
| **REACTANCE VARIATION SENSORS**<br>Inductive transducers: LVDT, Induction potentiometer – Variable reluctance transducers – Synchros – Microsyn Capacitive transducers: Capacitive microphone, Capacitive level sensor, Capacitive pressure sensor, Capacitive humidity sensor, Proximity sensor<br>**Practical Component:**<br>• Practical verification of LVDT Sensors specifications with the signal conditioning circuits.<br>• Practical verification of Capacitive level Sensors specifications with the signal conditioning circuits. | **9 Hours**<br><br>**4 Hours** |
| **SELF-GENERATING SENSORS**<br>Thermocouples, Piezoelectric Sensors, Photovoltaic Sensors, Seismic Sensors, Pyroelectric sensors. Electromagnetic Flow Sensor<br>**Practical Component:**<br>• Practical verification of the Thermocouple Sensors specifications with the signal conditioning circuits.<br>• Practical verification of Piezoelectric Sensors specifications with the signal conditioning circuits.<br>• Practical verification of the Photo Voltaic Sensors specifications with the signal conditioning circuits | **9 Hours**<br><br>**6Hours** |

| | |
|---|---|
| **DIGITAL, INTELLIGENT AND OTHER SENSORS**<br>Sensors Based on MOSFET Transistors, Charge-Coupled and CMOS Image Sensors, Fiber-Optic Sensors, Ultrasonic-Based Sensors, Position Encoders,<br>Hall Effect sensor – Magneto elastic sensor –Introduction to MEMS<br>**PRACTICAL COMPONENT:**<br>• Practical verification of Hall effect Sensors specifications with the signal conditioning circuits.<br>• Practical verification of Tachometer with the signal conditioning circuits.<br>• Project – Design of a measurement system | **9 Hours**<br><br>**10 Hous** |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Theory Hours:** | **45** | **Tutorial Hours:** | | **Practical Hours:** | **30** | **Project Hours:** | | **Total Hours:** | **75** |

**Learning Resources**

**Textbooks:**

1. Fraden, Jacob., Handbook of Modern Sensors: Physics, Designs, and Applications, Springer, New York (2016).
2. John Turner, Martyn Hill., Instrumentation for Engineers and Scientists, Oxford University Press, Oxford (1999).

**References:**

1. Rangan, C. S., Sharma, G. R., Mani, S. V., Instrumentation Devices and Systems, Tata McGraw-Hill Education, New Delhi (1983).
2. Doebelin, Ernest O., Measurement Systems: Application and Design, McGraw-Hill, New York (2011).
3. Patranabis, D., Sensors and Transducers, PHI Learning Pvt. Ltd., New Delhi (2013).

**Online Educational Resources:**

1. https://onlinecourses.nptel.ac.in/noc21_ee32/preview
2. https://onlinecourses.nptel.ac.in/noc23_ee95/preview
3. https://www.coursera.org/learn/sensors-circuit-interface

**Assessment (Embedded course)**

SA, Activity and Learning Task(s) , Mini project, MCQ, End Semester Examination (ESE) Lab Workbook, Experimental Cycle tests, viva-voce, etc.

**Course Curated by**

| Expert(s) from Industry | Expert(s) from Higher Education Institution | Internal Expert(s) |
|---|---|---|
| Mr. S.JEEVANANDHAM<br>Senior Labview Developer<br>Kg Invicta Pvt Ltd, Deputed at BOSCH Pvt. LTD , Coimbatore | [Dr. Swetha R Kumar, Assistant Professor, Sr. Gr. VIT Chennai | Ms.V.Manimekalai, Assistant Professor II EIE |
| **Recommended by BoS on** | 07/05/2025 | |
| **Academic Council Approval** | No.28 | Date 26/062025 |

| 24EII203 | ELECTRICAL MACHINES AND MEASUREMENT SYSTEMS | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 2 | 0 | 2 | 0 | 3 |
| PC | | SDG | | 7,9,12,4 | | |

| Pre-requisite courses | 24PHI102, 24MET105 | Data Book / Code book (If any) | Nil |
|---|---|---|---|

| Course Objectives: | |
|---|---|
| The purpose of taking this course is to: | |
| 1 | Understanding the working principles and characteristics of electrical machines and measurement systems. |
| 2 | Operate, test, and analyze electrical machines and modern sensors/transducers. |
| 3 | Select and integrate appropriate machines and measurement tools in industrial systems. |

| Course Outcomes | | |
|---|---|---|
| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
| CO1 | explain the fundamental principles of electromechanical energy conversion and machine operations | U |
| CO2 | analyze the characteristics and performance of DC and AC machines for industrial applications | An |
| CO3 | apply measurement techniques for voltage, current, power, and energy using standard instruments | Ap |
| CO4 | Integrate and calibrate sensors and transducers for physical parameter measurements | Ap |
| CO5 | Design signal conditioning and DAQ circuits for monitoring systems with noise mitigation | An |
| CO6 | Evaluate sustainable practices in machine operation and instrumentation system design. | E |

| Course Outcomes (CO) | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | |
| | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 |
| 1 | 3 | 2 | 1 | - | - | - | - | - | - | - | - | 2 | - |
| 2 | 3 | 3 | 2 | 2 | - | - | 1 | - | - | - | - | 3 | 1 |
| 3 | 3 | 2 | 1 | 2 | 2 | - | - | - | - | 1 | - | 3 | - |
| 4 | 2 | 2 | 2 | 2 | 3 | - | - | - | - | 1 | - | 3 | 2 |
| 5 | 2 | 3 | 3 | 3 | 3 | - | 1 | - | - | 1 | 1 | 3 | 2 |
| 6 | 2 | 2 | 2 | - | 2 | 2 | 3 | 1 | 1 | 1 | 1 | 2 | 1 |

## COURSE CONTENT

| | |
|---|---|
| **FUNDAMENTALS OF ELECTROMECHANICAL ENERGY CONVERSION**<br>Magnetic circuits: MMF, flux, reluctance, hysteresis, eddy currents - Basic principles of electromechanical energy conversion - Torque equation and energy balance - Construction materials and machine classifications - Applications in robotic actuators and automation systems | **3 Hours** |
| **DC MACHINES**<br>Construction, types and working principle of DC machines - EMF and torque equations, armature reaction and commutation - Types and characteristics of DC generators: separately excited, shunt, series, compound - Types and characteristics of DC motors: shunt, series, compound - Speed control and starting methods - Applications in electric mobility, elevators, and industrial drives - Efficiency and testing methods<br>**PRACTICAL COMPONENT**<br>**Lab 1:** DC Generator Characteristics (No-load and load characteristics, Voltage regulation)<br>**Lab 2:** DC Motor Performance (Speed control, performance curves, efficiency) | **6 Hours**<br><br>**6 Hours** |
| **AC MACHINES**<br>Single-phase and three-phase induction motors: construction, working principle - Rotating magnetic field and slip concept - Torque-speed characteristics and equivalent circuit - Starting methods for single-phase and three-phase induction motors - Synchronous machines: construction, working principles - Synchronous generator: EMF equation, voltage regulation, parallel operation - Synchronous motor: starting methods, power factor control, V-curves - Applications in HVAC, renewable energy, and industrial drives<br>**PRACTICAL COMPONENT**<br>**Lab 3:** Single-Phase Induction Motor (Brake test, efficiency calculation)<br>**Lab 4:** Three-Phase Induction Motor (No-load, blocked rotor test, torque-slip)<br>**Lab 5:** Synchronous Machine Testing (Synchronisation, V-curves, efficiency)<br>**Lab 6:** Motor Protection and Control (VFD testing, protection schemes) | **6 Hours**<br><br>**9 Hours** |
| **MEASUREMENT OF ELECTRICAL QUANTITIES (6 Hours)**<br>Measurement system components and characteristics - Static and dynamic performance parameters - Principles and construction of PMMC, moving iron, electrodynamic instruments - Digital multimeters and their principles - Measurement of voltage, current, power and energy - Current and voltage transformers - Power quality analyzers and energy meters - Error sources, accuracy, precision, and calibration standards<br>**PRACTICAL COMPONENT**<br>**Lab 7:** Basic Electrical Measurements (Analog/digital instrument calibration, error analysis)<br>**Lab 8:** Power Measurement (Single/three-phase wattmeter readings, power factor) | **6 Hours**<br><br>**5 Hours** |
| **TRANSDUCERS AND SIGNAL CONDITIONING (5 Hours)** | **5 Hours** |

| | |
|---|---|
| Classification and characteristics of transducers- Temperature transducers: RTD, thermocouple, thermistor - Pressure, displacement, and flow measurement transducers - Signal conditioning circuits: amplifiers, filters, bridges - Interfacing with microcontrollers and sensor networks - Grounding, shielding and noise reduction techniques<br>**PRACTICAL COMPONENT**<br>**Lab 9:** Temperature Transducers<br>(RTD, thermocouple, thermistor calibration)<br>**Lab 10:** Mechanical Quantity Measurement<br>(Strain gauge, LVDT for pressure/displacement)<br>**Lab 11:** Signal Conditioning and DAQ (Partially)<br>(Amplifiers, filters, sensor interfacing) | **5 Hours** |
| **DATA ACQUISITION AND VIRTUAL INSTRUMENTATION**<br>Data Acquisition Systems (DAQ): ADC/DAC principles - Computer-based measurement systems - Virtual instrumentation concepts and LabVIEW basics - Machine condition monitoring and fault diagnosis - Automated test equipment and industrial applications - IoT applications in measurement systems<br>**PRACTICAL COMPONENT**<br>**Lab 11:** Signal Conditioning and DAQ<br>(DAQ interfacing, LabVIEW, real-time logging)<br>**Lab 12:** Advanced Measurement Techniques<br>(Noise rejection, harmonic analysis, vibration-based fault diagnosis) | **5 Hours**<br><br>**5 Hours** |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Theory Hours:** | **30** | **Tutorial Hours:** | | **Practical Hours:** | **30** | **Project Hours:** | | **Total Hours:** | **60** |

## LEARNING RESOURCES

**TEXTBOOKS:**

### Electrical Machines:

1. A.E. Fitzgerald, Charles Kingsley Jr., Stephen D. Umans - "*Electric Machinery*", 7th Edition,McGraw-Hill, 2013
2. P.S. Bhimbra - "*Electrical Machinery*",7th Edition, Khanna Publishers, 2011
3. I.J. Nagrath and D.P. Kothari - "*Electric Machines*",5th Edition, McGraw-Hill, 2017

### Measurement Systems:

1. Ernest O. Doebelin - "*Measurement Systems: Application and Design*", 5th Edition, McGraw-Hill,2003
2. A.K. Sawhney - "*A Course in Electrical & Electronic Measurements & Instrumentation*", Latest Edition, Dhanpat Rai & Co. , 2019
3. David M. Considine - "*Process/Industrial Instruments and Controls Handbook*", 5th Edition, McGraw-Hill, 1999

**REFERENCES:**

1. Norman Mariott - "*Practical Data Acquisition for Instrumentation and Control Systems*" , 1st Edition, 2003

2. Robert B. Northrop - "*Introduction to Instrumentation and Measurements*" ,3rd Edition, CRC Press, 2014
3. Jon S. Wilson - "*Sensor Technology Handbook*",1st Edition, Newnes (an imprint of Elsevier), 2004

**ONLINE EDUCATIONAL RESOURCES:**

**Electrical Machines**

1. **NPTEL (National Programme on Technology Enhanced Learning)**
   - *Courses:* Electrical Machines I & II by Prof. G. Bhuvaneshwari (IIT Delhi)
   - https://nptel.ac.in
2. **All About Circuits – Electrical Engineering Textbook**
   - *Modules:* Transformers, motors, magnetic circuits
   - https://www.allaboutcircuits.com
3. **Electrical4U**
   - *Content:* Tutorials, diagrams, MCQs on DC/AC machines and transformers
   - https://www.electrical4u.com

**Measurement Systems**

1. **NI (National Instruments) – LabVIEW Learning Resources**
   - *Resources:* LabVIEW fundamentals, DAQ systems, instrumentation tutorials
   - https://www.ni.com/en-us/learn
2. **Coursera – Measurement and Instrumentation Courses**
   - Offered by institutions like Georgia Tech and University of Colorado
   - https://www.coursera.org
3. **EdX – Electrical Engineering Instrumentation Modules**
   - *Courses:* Instrumentation, sensor networks, signal conditioning
   - https://www.edx.org

**Simulation & Virtual Labs**

1. **PSIM and MATLAB Online Resources**
   - Free tutorials and example simulations for motor drives and measurement systems
   - https://powersimtech.com
   - https://www.mathworks.com/learn/tutorials.html
2. **Virtual Labs – MHRD Government of India**
   - *Labs:* Electrical machines, instrumentation, and sensor systems
   - https://vlab.co.in

**Essential Software:**

1. **LabVIEW, Multisim** - Virtual instrumentation and data acquisition
2. **Proteus Design Suite (Labcenter Electronics)**
   - Combines microcontroller simulation with measurement circuit design.
3. **MATLAB/Simulink** - Machine modeling and measurement system design
4. **PSIM/PSPICE/LTspice/Ansys Maxwell** - Circuit simulation for measurement circuits
5. **MS Excel/Python** - Data analysis and statistical calculations

| **Assessment (Embedded course)** |
| --- |
| SA, Activity and Learning Task(s)* , Mini project, MCQ, End Semester Examination (ESE) Lab Workbook, Experimental Cycle tests, viva-voce |

- **Electrical Machines:** 50% (Quizzes, assignments, presentations)
- **Measurement Systems:** 50% (Practical exercises, design problems)

| **Course Curated by** | | | |
|---|---|---|---|
| **Expert(s) from Industry** | **Expert(s) from Higher Education Institution** | | **Internal Expert(s)** |
| Moses Edison P<br>Yageo Pulse<br>Sr. Maintenance Er.<br>Pulse System Electronics (India) Pvt. Ltd., Tiruchi | Dr. Sri Revathi B<br>Professor Gr. 1<br>VIT, Chennai | | 1. Dr. Mayurappriyan M S<br>Professor, EIE KCT<br><br>2. Ranganathan S<br>Assistant Professor - EIE, KCT |
| **Recommended by BoS on** | 07/05/2025 | | |
| **Academic Council Approval** | No.28 | Date | 26/062025 |

| 24INP201 | Innovation Practicum - III | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 0 | 0 | 2 | 0 | 1 |
| ES | | SDG | 4, 9 | | | |

| Pre-requisite courses | - | Data Book / Code book (If any) | - |
|---|---|---|---|

**Course Objectives:**

The purpose of taking this course is to:

| | |
|---|---|
| 1 | Develop a deep understanding of the innovation process and apply customer-centric thinking to innovation |
| 2 | Evaluate the feasibility and viability of innovation ideas. |
| 3 | Optimise innovation projects for efficiency and effectiveness and communicate the ideas effectively. |

**Course Outcomes**

| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
|---|---|---|
| CO1 | Analyse the various stages of innovation and their interdependencies | An |
| CO2 | Create innovative solutions that address specific customer needs | C |
| CO3 | Evaluate the potential impact and risks of different innovation concepts and present them clearly and persuasively. | E |

| Course Outcomes (CO) | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | | |
| | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 | PSO-3 |
| 1 | 3 | 2 | 2 | 2 | 2 | | | | | | | | | |
| 2 | | | 3 | 2 | | | 2 | | 2 | | | | | |
| 3 | | | | | | | | | 2 | 3 | | | | |

## Course Content

| | |
|---|---|
| **IDEA WORTH PROTOTYPING**<br>Discuss potential risks and challenges associated with innovative ideas - Learn to refine and validate the initial concept - Develop a plan outlining key milestones and timelines for advancing from idea to prototype. | **3 Hours** |
| **FRAMING THE CHALLENGE**<br>Define the specific problem or opportunity that the innovation aims to address, understand customer needs and preferences - Identify the gaps in the market and potential obstacles to adoption, assess the potential market size, competition, and feasibility. | **6 Hours** |
| **CRAFTING HIGH-VALUE SOLUTIONS**<br>Generate Minimum Usable Prototype (MUP) concepts that address the identified challenge that provide high value, evaluate the potential of each solution concept based on criteria like feasibility, viability, and desirability. | **6 Hours** |

| | |
|---|---|
| **OPTIMIZATION AND PLANNING**<br>Create Bill of Quantities (BOQ) and Bill of Materials (BOM) to estimate costs and resources - Develop a comprehensive innovation proposal outlining the innovation concept, goals, and benefits - Implement Lean principles to improve efficiency and reduce waste in the innovation process - Reflect on the activities to identify areas for improvement and learning. | **7 Hours** |
| **PROJECT PRESENTATION**<br>Develop and deliver a compelling presentation of your minimum usable prototype (MUP) and innovation solution to effectively communicate its value and impact to a broader audience - Create a visually engaging presentation that clearly outlines the problem, the proposed solution, and the value of your minimum usable prototype - Utilise tools such as slides, infographics, and videos to enhance the visual appeal - Craft a compelling story around your innovation - Highlight the journey from problem identification to solution development, emphasising key insights and milestones. | **8 Hours** |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Theory Hours:** | **0** | **Tutorial Hours:** | **0** | **Practical Hours:** | **30** | **Project Hours:** | **0** | **Total Hours** | **30** |

**Learning Resources**

**References:**

1. Everything you need about value proposition: https://blog.forgeforward.in/everything-you-need-to-know-about-value-proposition-7247493c9 40c
2. Test your Value Proposition: http://businessmodelalchemist.com/2012/09/test-your-value-proposition-supercharge-lean-s tartup-and-custdev-principles.html
3. Valuation Risk versus Validation Risk in Product Innovations: https://blog.forgeforward.in/valuation-risk-versus-validation-risk-in-product-innovations-49f25 3ca8624
4. User Guide for Product Innovation Rubric: https://blog.forgeforward.in/user-guide-for-product-innovation-rubric-857181b253dd
5. Innovation Risk Diagnostic — Product Innovation Rubric: https://blog.forgeforward.in/product-innovation-rubric-adf5ebdfd356
6. Evaluating Product Innovations — proof, potential, & progress:https://blog.forgeforward.in/evaluating-product-innovations-e8178e58b86e

**Online Resourse (Weblinks)**

1. https://formlabs.com/blog/ultimate-guide-to-prototyping-tools-for-hardware-and-product-design/
2. https://docs.kicad-pcb.org/
3. https://www.tinkercad.com/learn/circuits
4. https://docs.github.com/en/free-pro- team@latest/actions/guides

**Assessment (Practical course)**

Lab Workbook, Experimental Cycle tests, viva-voce

| Course Curated by | | | |
|---|---|---|---|
| **Expert(s) from Industry** | **Expert(s) from Higher Education Institution** | | **Internal Expert(s)** |
| Dr. Mahesh Veezhinathan<br>Director - Director Forge. Academy | - | | Dr. Samuel Ratna Kumar P S<br>Assistant Professor – III<br>Department Mechanical Engineering |
| **Recommended by BoS on** | 07/05/2025 | | |
| **Academic Council Approval** | No: 28 | **Date** | 26/06/2025 |

| 24INM201 | Universal Human Values II: Understanding Harmony | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 1 | 0 | 0 | 0 | 1 |
| HS | | SDG | 5,10,16 | | | |

| Pre-requisite courses | UHV-I( Students Induction Program) | Data Book / Code book (If any) | |
|---|---|---|---|

## Course Objectives:

The purpose of taking this course is to:

| | |
|---|---|
| 1 | Introduce the concept and significance of value education in shaping a meaningful and fulfilling life. |
| 2 | Enable students to understand the human being as a co-existence of self and body and the harmony within. |
| 3 | Develop an understanding of harmony in relationships, family, and society. |
| 4 | Help students appreciate the interconnectedness and harmony in nature and existence. |
| 5 | Instil the importance of ethical behaviour in personal, professional, and social contexts. |

## Course Outcomes

| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
|---|---|---|
| CO1 | Understand the foundational concepts of value education and human aspirations. | U |
| CO2 | Analyse the human being as a holistic entity comprising self and body. | An |
| CO3 | Evaluate and cultivate harmonious relationships within the family and society. | E |
| CO4 | Interpret the interconnectedness in nature and recognize harmony in existence. | U |
| CO5 | Apply holistic understanding to professional ethics and sustainable living. | Ap |

| Course Outcomes (CO) | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 Engineering Knowledge | 2 Problem Analysis | 3 Design/Development of Solutions | 4 Conduct Investigations of Complex Problems | 5 Engineering Tool Usage | 6 The Engineer and The World | 7 Ethics | 8 Individual and Collaborative Team work | 9 Communication | 10 Project Management and Finance | 11 Life-Long Learning | PSO-1 | PSO-2 | PSO-3 |
| 1 | | 2 | 2 | 3 | 3 | 3 | 3 | 2 | 2 | | 3 | | | |
| 2 | | 2 | 2 | 3 | 3 | 3 | 3 | 2 | 2 | | 3 | | | |
| 3 | | 2 | 2 | 2 | 2 | 3 | 3 | 2 | 2 | | 3 | | | |
| 4 | | 2 | 2 | 2 | 2 | 3 | 3 | 2 | 2 | | 3 | | | |
| 5 | | 2 | 2 | 3 | 3 | 3 | 3 | 2 | 2 | | 3 | | | |

## Course Content

| | |
|---|---|
| **INTRODUCTION TO VALUE EDUCATION**<br>Value Education- Self-exploration as the Process for Value Education- Basic Human Aspirations and their Fulfilment- Right Understanding, Relationship and Physical | 3 Hours |

| | |
|---|---|
| Facility- Happiness and Prosperity – Current Scenario- Method to Fulfil the Basic Human Aspirations. | |
| **HARMONY IN THE HUMAN BEING**<br>Human Being as Co-existence of the Self and the Body- Distinguishing between the Needs of the Self and the Body- The Body as an Instrument of the Self- Understanding Harmony in the Self- Harmony of the Self with the Body- Programs to Ensure Self-regulation and Health. | 3 Hours |
| **HARMONY IN THE FAMILY AND SOCIETY**<br>Harmony in the Family –The Basic Unit of Human Interaction-'Trust' – The Foundational Value in Relationship-Respect – As the Right Evaluation- Other Values in Human-to-Human Relationship- Understanding Harmony in the Society . Lecture Vision for the Universal Human Order. | 3 Hours |
| **HARMONY IN NATURE (EXISTENCE)**<br>Understanding Harmony in Nature- Interconnectedness, Self-regulation and Mutual Fulfilment among the Four Orders of Nature- Realizing Existence as Co-existence at All Levels- The Holistic Perception of Harmony in Existence. | 3 Hours |
| **IMPLICATIONS OF THE HOLISTIC UNDERSTANDING- A LOOK AT PROFESSIONAL ETHICS**<br>Basis for Universal Human Values-Definitiveness of (Ethical) Human Conduct - professional Ethics in the Light of Right Understanding-A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order-Holistic Technologies, Production Systems-and Management Models-Typical Case Studies Strategies for Transition towards Value-based Life and Profession | 3 Hours |

| **Theory Hours:** 15 | **Tutorial Hours:** | **Practical Hours:** | **Project Hours:** | **Total Hours:** 15 |
|---|---|---|---|---|

**Learning Resources**

**Textbooks:**

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

**References:**


1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi.
4. Small is Beautiful - E. F Schumacher.
5. Economy of Permanence - J C Kumarappa
6. Bharat Mein Angrej Raj – Pandit Sunderlal
7. Rediscovering India - by Dharampal
8. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
9. India Wins Freedom - Maulana Abdul Kalam Azad
10. Vivekananda - Romain Rolland (English)
11. Gandhi - Romain Rolland (English)


**Online Resources (Weblinks)**

https://www.uhv.org.in/uhv-ii

| |
|---|
| **Assessment (Theory course)** |
| Presentatation,MCQ,Assignment,Case Study and E Chart. |

| **Course Curated by** | | | |
|---|---|---|---|
| **Expert(s) from Industry** | **Expert(s) from Higher Education Institution** | **Internal Expert(s)** | |
| | Dr. | 1.Dr.S.Sivakumar, Head/SFS/KCT<br>2.Dr.R.Prakasam,Assistant Professor,Department of Physics/KCT<br>3.Mr.J.Sivaguru,Assistant Professor,Department of Mechatronics/KCT | |
| **Recommended by BoS on** | | | |
| **Academic Council Approval** | | **Date** | |

# FOURTH SEMESTER

| 24HSP006 | MASTERING DISCUSSION AND PRESENTATION SKILLS | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 0 | 0 | 2 | 0 | 1 |
| HS | | SDG | 4&8 | | | |

| Pre-requisite courses | Nil | Data Book / Codes / Standards (If any) | |
|---|---|---|---|

| Course Objectives: | The purpose of taking this course is to: |
|---|---|
| 1 | To equip learners with techniques for organizing and presenting ideas effectively, ensuring logical flow and engaging delivery through appropriate visual and verbal strategies. |
| 2 | To enhance students' ability to evaluate diverse viewpoints and articulate reasoned arguments, fostering meaningful participation in collaborative discussions. |
| 3 | To strengthen students' ability to adapt their speaking style and content to different audiences and contexts, utilizing digital tools for enhanced presentation effectiveness. |

| Course Outcomes: | After successful completion of this course, the students shall be able to | Bloom's Taxonomy Level (BTL) |
|---|---|---|
| CO 1 | Create and deliver structured presentations with a clear introduction, body, and conclusion, utilizing effective visual tools and appropriate pacing to enhance clarity and impact. | C |
| CO 2 | Analyse issues from multiple perspectives, articulate ideas effectively within group discussions | An |
| CO 3 | Deliver confident presentations and speeches in professional and social settings, leveraging digital tools and technologies to enhance quality and effectiveness. | Ap |

| | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | | |
| Course Outcomes (CO) | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 | PSO-3 |
| 1 | | 2 | | | 1 | 2 | | 3 | 3 | | 3 | | | |
| 2 | | 2 | | | 1 | 2 | | 3 | 3 | | 3 | | | |
| 3 | | 2 | | | 1 | 2 | | 3 | 3 | | 3 | | | |

| Course Content | |
|---|---|
| **Introduction to Group** Discussions - Key skills for effective participation - Phases in a GD - Conversational Phrases in GD.<br>**Group Dynamics** - Understanding group roles and dynamics - Conflict resolution and management in groups - Techniques for fostering collaboration.<br>**Presentations** - Introduction to Visual Aids and Technology in Presentations.<br>**Delivery Techniques** - Voice modulation and speech clarity - Body language and gestures – audience analysis.<br>**Handling Q&A Sessions** - Preparing for audience questions - Techniques for handling difficult questions - Mock Presentation with Q&A sessions. | **6 Hours** |
| **Factual Group Discussions**: Focus on sharing and verifying accurate information on a given topic. Participants base their contributions on verifiable data and concrete evidence.<br>**Opinion-based / Argumentative Group Discussion**: Encourages participants to express and defend their point of view on a topic. Evaluate different perspectives and build critical thinking skill. | **6 Hours** |
| **Case Study Group Discussion**: Involves analyzing the complexities, identifying key issues, and developing insights or solutions based on the group's collective knowledge.<br>**Abstract Discussion**: Deals with intangible concepts, ideas, or themes without concrete reference points. Encourages creative thinking and theoretical exploration. | **6 Hours** |
| **Impromptu Presentations**: Participants speak on a given topic with little to no preparation. Helps develop quick thinking and effective communication skills.<br>**Informative Presentation**: Aims to educate the audience on a specific topic by providing clear, factual information. The focus is on clarity, accuracy, and comprehensiveness.<br>**Demonstrative Presentation**: Interactive sessions where participants engage in hands-on activities to learn practical skills. Often includes exercises, demonstrations, and collaborative tasks. | **6 Hours** |
| **Training and Technical Presentation**: Designed to teach specific technical skills or procedures. Includes detailed instructions, demonstrations, and may involve technical jargon.<br>**Academic Presentation**: Involves presenting research findings or theoretical concepts in an academic setting. Emphasizes clarity, evidence-based arguments, and adherence to scholarly standards.<br>**Pitch Presentation:** A concise, persuasive presentation aimed at securing support, investment, or approval. Focuses on the value proposition, potential benefits, and unique selling points.<br>**Persuasive Presentation**: Seeks to convince the audience to adopt a particular viewpoint or take a specific action. Utilizes logical arguments, emotional appeals, and credible evidence.<br>**Multimedia Presentations**: Uses visual and auditory media to convey information and present arguments. Enhances engagement and aids in illustrating complex concepts. | **6 Hours** |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Theory Hours:** | **-** | **Tutorial Hours:** | **-** | **Practical Hours:** | **2** | **Project Hours:** | **-** | **Total Hours:** | **30** |

| Learning Resources* |
|---|
| **Reference books/ Web Links** |
| 1. Powell, M. (2010). Dynamic presentations student's book with audio CDs (2). Cambridge University Press.<br>2. Reynolds, G. (2011). Presentation Zen: Simple ideas on presentation design and delivery. New Riders.<br>3. Galanes, G. J., Adams, K., & Brilhart, J. K. (2020). Effective group discussion: Theory and practice (15th ed.). McGraw-Hill Education.<br>4. Adams, K., & Galanes, G. (2018). Communicating in groups: Applications and skills, a practical guide (18th ed.). McGraw-Hill Education.<br>5. Ivy, D. K., & Backlund, P. (2018). Speak with confidence: A practical guide. Pearson.<br>6. Reynolds, G. (2019). Presentation Zen: Simple ideas on presentation design and delivery. New Riders. |
| **Online Resources** |
| 1. https://www.coursera.org/learn/verbal-communications-and-presentation-skills<br>2. https://www.coursera.org/learn/present-with-purpose<br>3. https://www.coursera.org/learn/teamwork-skills-effective-communication |

| Assessment | |
|---|---|
| Formative | Summative |
| ----- | 1. Participation in group discussions (40%)<br>2. Individual presentations (40%)<br>3. Quizzes and written assignments (20%) |

| Course Curated By | | |
|---|---|---|
| **Expert(s) from Industry** | **Expert(s) from Higher Education Institutions** | **Internal Expert(s)** |
| Mr. Bhuvana Sundar Soorappaiah<br>Program Manager<br>Bosch, Coimbatore | Dr Kishore Selva Babu<br>Head and Associate Professor<br>Department of English and Cultural Studies<br>Christ University<br>Bangalore-560029 | Dr. J Srikala- AP III<br>Dr. C Tissaa Tony - AP III<br>Dr. S G Mohanraj – AP III<br>Dr. S Sreejan – AP III<br>Dr. R Hema – AP II<br>Dr. A S Mythili - AP II |

| | |
|---|---|
| **Approved by: BoS Chairman** | With Signature and date |
| **BoS Approval date:** | **25.04.2025** |

| 24ECI203 | Linear Integrated Circuits<br>(Common to ECE, EEE, E&I) | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 0 | 4 |
| PC | | SDG | 9 | | | |

| Pre-requisite courses | 24EII201, 24ECI102 | Data Book / Code book (If any) | NA |
|---|---|---|---|

| Course Objectives: | |
|---|---|
| The purpose of taking this course is to: | |
| 1 | Introduce operational amplifiers, their structure, configurations, and characteristics. |
| 2 | Enable design and analysis of analog circuits using op-amps and special ICs. |
| 3 | Develop practical skills through hands-on experiments with linear integrated circuits. |

| Course Outcomes | | |
|---|---|---|
| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
| CO 1 | Describe op-amp structure, stages, and characteristics through basic experiments. | U |
| CO 2 | Analyze and implement inverting, non-inverting, and differential amplifiers using op-amps. | An |
| CO 3 | Analyze op-amp circuits such as adders, subtractors, integrators, differentiators, clippers, and clampers. | An |
| CO 4 | Design and evaluate filters and waveform generators using op-amps and IC 555. | C |
| CO 5 | Apply DAC and ADC techniques using R-2R, weighted resistor, flash, SAR, and dual-slope converters. | Ap |
| CO 6 | Evaluate voltage regulator ICs through experiments and analyse the working of PLLs and VCOs in frequency control and modulation. | E |

| Course Outcomes (CO) | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | |
| | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 |
| 1 | 3 | 2 | | | | | | | | | | 3 | |
| 2 | 3 | 3 | 2 | | | | | | | | | 3 | |
| 3 | 3 | 3 | 2 | 2 | | | | | | | | 3 | |
| 4 | 3 | 2 | 3 | 2 | 2 | | | | 1 | | | 3 | 1 |
| 5 | 3 | 2 | 2 | 2 | 2 | | | | | | | 3 | 2 |
| 6 | 3 | 2 | 2 | 2 | 1 | | | | 1 | | | 3 | 1 |

| Course Content | |
|---|---|
| **BASICS OF OPERATIONAL AMPLIFIERS**<br>Basics of Operational Amplifiers – Ideal Operational Amplifier – General operational amplifier stages and internal circuit diagrams of IC 741, DC and AC performance characteristics, Open and closed loop configurations – Voltage follower, Inverting amplifier, Non-inverting amplifier, Differential amplifier.<br>**PRACTICAL COMPONENT**<br>• Inverting and non-inverting amplifiers | **9 Hours**<br><br>**3 Hours** |
| **APPLICATIONS OF OPERATIONAL AMPLIFIERS**<br>Adder and subtractor, Instrumentation amplifiers, V-to-I and I-to-V converters, Differentiators and Integrators, Precision rectifiers, Wave shaping circuits (Clipper and Clampers), Log and Antilog amplifiers, Analog voltage multiplier circuit and its applications, Comparators, Schmitt trigger.<br>**PRACTICAL COMPONENT**<br>• Adder and subtractor<br>• Integrator and differentiator<br>• Clipper and clamper | **9 Hours**<br><br>**9 Hours** |
| **FILTERS AND WAVEFORM GENERATORS**<br>Filters: Comparison between passive and active filters, Active filters: Low-pass, high-pass and band-pass filters – Waveform Generators: Sine, Square, Triangle, Sawtooth wave generators – IC 555 Timer: Monostable operation and its applications, Astable operation and its applications.<br>**PRACTICAL COMPONENT**<br>• Active filters<br>• Waveform generation<br>• Astable and Monostable multivibrators using IC 555 Timer | **9 Hours**<br><br>**9 Hours** |
| **DIGITAL TO ANALOG AND ANALOG TO DIGITAL CONVERTERS**<br>D/A converter: Specifications, Weighted resistor type, R-2R ladder type – Sample and hold circuit – A/D Converter: Specifications, Flash type, Successive Approximation type, Dual Slope type, Sigma-delta converter.<br>**PRACTICAL COMPONENT**<br>• Digital to Analog conversion<br>• Analog to Digital conversion | **9 Hours**<br><br>**6 Hours** |
| **SPECIAL FUNCTION ICs**<br>IC Voltage regulators: Three terminal fixed and adjustable voltage regulators, IC 723 general purpose regulator, Monolithic switching regulator – Frequency to Voltage and Voltage to Frequency converters – PLL: Operation of PLL, Voltage Controlled Oscillator, PLL applications: AM and FM detection, FSK modulation and demodulation and frequency multiplier.<br>**PRACTICAL COMPONENT**<br>• IC Voltage regulator | **9 Hours**<br><br>**3 Hours** |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Theory Hours:** | **45** | **Tutorial Hours:** | **0** | **Practical Hours:** | **30** | **Project Hours:** | **0** | **Total Hours:** | **75** |

| Learning Resources |
|---|
| **Textbooks** |
| 1. D. Roy Choudhry and Shail Jain, Linear Integrated Circuits, New Age International Pvt. Ltd., 6th Edition (2021).<br>2. Ramakant A. Gayakwad and Rekha S., Op-Amps and Linear Integrated Circuits, Pearson Education, 4th Edition (Revised) (2021). |
| **Reference books** |
| 1. Jacob Millman, Christos Halkias and Chetan Parikh, Integrated Electronics, McGraw Hill Education, 2nd Edition (2018).<br>2. Coughlin Robert F. and Driscoll Frederick F., Operational Amplifiers and Linear Integrated Circuits, PHI, 6th Edition (2011).<br>3. S Salivahanan and V. S. Kanchana Bhaskaran, Linear Integrated Circuits and Applications, McGraw Hill Education, 1st Edition (2018). |
| **Online Educational Resources** |
| 1. https://onlinecourses.nptel.ac.in/noc24_ee73/preview<br>2. https://onlinecourses.nptel.ac.in/noc20_ee13/preview<br>3. https://training.ti.com/ti-precision-labs-op-amps<br>4. Falstad Circuit Simulator (Online Practical Tool): https://www.falstad.com/circuit/ |

| Assessment (Embedded course) |
|---|
| SA I and SA II, Activity and Learning Task(s), Mini project, MCQ, End Semester Examination (ESE) Lab Workbook, Experimental Cycle tests, viva-voce, |

| Course Curated By | | | |
|---|---|---|---|
| **Expert(s) from Industry** | **Expert(s) from Higher Education Institutions** | | **Internal Expert(s)** |
| 1. Mr. S. Chella Kumar, Staff CAD Engineer, Infinera India Pvt. Ltd., Bengaluru.<br>2. Ms. Candida John, Sembcorp Energy India Limited | 1. Dr.V.P.Harigovindan, National Institute of Technology-Puducherry<br>2. Dr. Albert Alexander, VIT Vellore | | 1. Dr. P. Thirumoorthi, EEE<br>2. Dr. B. Gopinath, ECE<br>3. M. V. Umesh, E & I |
| **Recommended by BoS on** | **07.05.2025** | | |
| **Academic Council Approval** | No: 28 | **Date** | 26.06.2025 |

| 24EEI203 | DIGITAL SYSTEM DESIGN<br>(Common to ECE, EEE, E&I) | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 0 | 4 |
| PC | | SDG | 9 | | | |

| Pre-requisite courses | 24ECI102, 24EII201 | Data Book / Codes / Standards ( If any) | Nil |
|---|---|---|---|

| Course Objectives**: | The purpose of taking this course is to: |
|---|---|
| 1 | Impart foundational knowledge of number systems, binary codes, Boolean algebra, and logic simplification techniques. |
| 2 | Develop analytical and practical skills in designing and implementing combinational and sequential circuits |
| 3 | Build competency in digital system design using state machine, programmable logic devices like FPGA and verilog HDL programming. |

| Course Outcomes***: | After successful completion of this course, the students shall be able to | Bloom's Taxonomy Level (BTL) |
|---|---|---|
| CO 1 | Apply number systems and Boolean algebra to design basic digital circuits. | Ap |
| CO 2 | Design and analyze the structure and functionality of various combinational circuits. | An |
| CO 3 | Design and construct sequential circuits, including flip-flops, counters, and shift registers. | Ap |
| CO 4 | Analyze synchronous sequential circuits using state diagrams and tables to examine state transitions and circuit behaviour. | An |
| CO 5 | Apply Verilog HDL constructs with various modeling styles to simulate and test digital logic circuits. | Ap |
| CO 6 | Develop, simulate and implement digital systems using logic gates and simulation tools | E |

| | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | |
| Course Outcomes (CO) | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 |
| CO1 | 3 | | 1 | 1 | | | | | | | | 2 | 1 |
| CO2 | 3 | 2 | 1 | 1 | 2 | | | | | | | 2 | 2 |
| CO3 | 3 | 3 | 1 | 2 | 2 | | | | | | | 2 | 2 |
| CO4 | 2 | 2 | 3 | 2 | 2 | 2 | | | | | | 2 | 2 |
| CO5 | 2 | 2 | 3 | 2 | 2 | 3 | | | | | | 2 | 2 |
| CO6 | 3 | 3 | 3 | 3 | 3 | | | 2 | 2 | | | 2 | 2 |

## Course Content

| | |
|---|---|
| **FUNDAMENTALS OF DIGITAL SYSTEMS**<br>Review of number systems, Logic gates, Binary codes and code converters - Boolean algebra and theorems - Sum of Product and Product of Sum simplification - Canonical forms - minterm and maxterm - Simplification of Boolean expressions - Karnaugh map (upto 4 variables).<br>Basic IC Terminologies, Characteristics of Digital Logic families: TTL, ECL and CMOS logic.<br>**PRACTICAL COMPONENT**<br>• Implementation of Boolean Function using Gates.<br>• Implementation of code converters using K-map. | **9 Hours**<br><br>**6 Hours** |
| **DESIGN OF COMBINATIONAL LOGIC CIRCUITS**<br>Design of Combinational Circuits: Adders, Subtractors, Parallel Adder, Carry Look Ahead Adder, Digital Comparator, Parity Generator/Checker, Encoders, Decoders, Multiplexer, De-Multiplexer, Implementation of Boolean function using Multiplexer.<br>**PRACTICAL COMPONENT**<br>• Design and implementation of Adder / Subtractor circuits.<br>• Design of combinational circuit using MUX/DEMUX. | **9 Hours**<br><br>**6 Hours** |
| **SEQUENTIAL LOGIC CIRCUITS**<br>Latches and Flip Flops: SR, JK, T and D , Characteristic Equation, Excitation Table, Types of Triggering, Master Slave Flip Flop - Counters: Synchronous, Asynchronous Counter, Modulo-N Counter, Ring Counter - Shift Registers and its types.<br>**PRACTICAL COMPONENT**<br>• Design and implementation of Synchronous Counter.<br>• Design and implementation of Asynchronous Counter. | **9 Hours**<br><br>**6 Hours** |
| **STATE MACHINE DESIGN AND FPGA**<br>Classification of Sequential Circuits: Moore and Mealy Model, Design of Synchronous Sequential Circuit: State Diagram, State Table, State Reduction, State Assignment, Hazards in sequential circuits - Introduction to PLD and FPGA architectures.<br>**PRACTICAL COMPONENT**<br>• Design and implementation of synchronous sequential circuits | **9 Hours**<br><br>**3 Hours** |
| **VERILOG HDL PROGRAMMING**<br>Overview of Digital Design with Verilog HDL- Basic concepts- Modules and Ports- Gate-Level Modeling- Dataflow Modeling- Behavioral Modeling-Verilog HDL programming examples: gates, multiplexer, encoders, adders, flip flops, counters.<br>**PRACTICAL COMPONENT**<br>• Simulation of Combinational Logic using Verilog HDL<br>• Simulation of Sequential Logic using Verilog HDL<br>• Realization of simple digital module in FPGA | **9 Hours**<br><br>**9 Hours** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Theory Hours:** | **45** | **Tutorial Hours:** | | **Practical Hours:** | **30** | **Project Hours:** | **Total Hours:** **75** |

**Learning Resources***

**Textbooks**

1. M. Morris Mano, “Digital Logic and Computer Design”, Pearson India Education Services Pvt. Ltd., New Delhi, 2018.

2. R. P. Jain, “Modern Digital Electronics”, 4th Edition, Tata McGraw Hill Education Pvt Ltd., 2010.
3. A. Anand Kumar, “Fundamentals of Digital Circuits”, 4th Edition, Prentice Hall India, 2016.
4. Samir Palnitkar, “Verilog HDL A guide to Digital Design and Synthesis” 2nd edition, Pearson, 2003.

**Reference books/ Web Links**

1. M. Morris Mano and Michael D. Ciletti, “Digital Design: With an Introduction to the Verilog HDL, VHDL, and System Verilog”, Pearson India Education Services Pvt. Ltd., New Delhi, 2017.
2. Thomas L. Floyd, “Digital Fundamentals”, 11th Edition, Pearson Education Limited, 2021.
3. Raj Kamal, “Digital Systems: Principles and Design”, 3rd Edition, Pearson Education Limited, 2014.
4. John M. Yarbrough, “Digital Logic: Applications and Design”, West Publishing Company, 2002.
5. David J. Comer, “Digital Logic & State Machine Design”, Oxford University Press, 2012.

**Online Resources**

https://onlinecourses.nptel.ac.in/noc21_ee39/preview
https://www.coursera.org/learn/digital-systems
https://www.allaboutcircuits.com/textbook/digital/chpt-9/combinational-logic-functions
https://youtube.com/playlist?list=PLBlnK6fEyqRiVhbXDGLXDk_OQAeuVcp2O
https://nptel.ac.in/courses/108106086

**Free online tools**

https://www.tinkercad.com/circuits
https://www.falstad.com/circuit/
https://circuitverse.org/simulator/
https://www.dcode.fr/karnaugh-map-solver
https://www.edaplayground.com/
https://hdlbits.01xz.net/wiki/Main_Page
https://www.xilinx.com/products/design-tools/vivado.html

| **Assessment** | |
|---|---|
| Formative | Summative |
| Assignments / Mini project), Quiz, Lab | SA- I, SA – II and End Semester Examination (ESE) |

| **Course Curated By** | | |
|---|---|---|
| **Expert(s) from Industry** | **Expert(s) from Higher Education Institutions** | **Internal Expert(s)** |
| Suganya M,<br>Bosch Global Software Technologies PVT Ltd | Dr. Albert Alexander,<br>Vellore Institute of Technology | Dr.. P.Thirumoorthi , EEE<br>Dr. K.Paramasivam, EEE<br>Dr. B. Gopinath, ECE<br>Dr. I. Jeya Daisy, EIE |
| Recommended by BoS on | 30.04.2025 | |
| Academic Council Approval | No: 28 | 26.06.2025 |

| 24EII204 | SIGNAL PROCESSING TECHNIQUES<br>Common EEE/EIE | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 0 | 4 |
| PC | | SDG | | 9, 12 | | |

| Pre-requisite courses | 24MAI113,24MAI233,24ECI102 | Data Book / Code book (If any) | Nil |
|---|---|---|---|

| Course Objectives: | |
|---|---|
| The purpose of taking this course is to: | |
| 1 | Understand the fundamentals of signals, systems, and transforms used in signal analysis and processing. |
| 2 | Develop practical skills to model, analyse, and simulate signals and systems using modern computational tools. |
| 3 | Build competency to design and evaluate signal processing solutions with a focus on performance and sustainability. |

| Course Outcomes | | |
|---|---|---|
| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
| CO1 | Classify various signals and systems and formulate mathematical representation using differential and difference equations. | U |
| CO2 | Analyze signal behaviour in time and frequency domains using the Fourier series, Fourier transforms and Z-transform. | An |
| CO3 | Apply convolution and transformation techniques to model and simulate the response of continuous-time and discrete-time systems. | Ap |
| CO4 | Apply DFT and FFT algorithms to perform frequency-domain analysis of discrete-time signals. | Ap |
| CO5 | Design digital filters using appropriate techniques for performance and stability improvement. | An |
| CO6 | Demonstrate signal processing methods by analysing their characteristics using analytical and simulation tools | An |

| | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | |
| Course Outcomes (CO) | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 |
| CO1 | 3 | 2 | | | 1 | | | | | | 1 | 3 | 1 |
| CO2 | 3 | 3 | | | 2 | | | | | | 1 | 3 | 2 |
| CO3 | 2 | 3 | 2 | | 1 | | | 2 | | | | 3 | 3 |
| CO4 | 2 | 2 | 2 | 1 | 2 | | | 2 | | | 1 | 2 | 3 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO5 | 3 | 3 | 3 | 1 | 2 | | | 2 | | | 2 | 3 | 3 |
| CO6 | 2 | 2 | 2 | 3 | 3 | | | 3 | | | 3 | 2 | 3 |

| **COURSE CONTENT** | |
|---|---|
| **SIGNAL AND SYSTEMS**<br>Definition of Signals- Classification of Signals -Elementary Signals and Basic Operations –Introduction to Systems- Classification of Systems - Properties of Systems- Impulse Response Characterisation and Convolution **(**CT-LTI and DT-LTI)-System Representation Using Differential and Difference Equations – Applications: Smart home audio control systems.<br>**PRACTICAL COMPONENTS:**<br>• Standard signals, Mathematical operations on signals.<br>• Convolution for CT and DT LTI systems and interpret outputs.<br>• Simulation /modelling of LTI system using difference equations | **9 Hours**<br><br>**6 Hours** |
| **FOURIER ANALYSIS**<br>CT Fourier Series and CT Fourier Transform (CTFT)- Properties of CTFT and Frequency Response - DT Fourier Series and Discrete-Time Fourier Transform (DTFT) - Properties and Applications of DTFT<br>**PRACTICAL COMPONENTS:**<br>• Computation of CTFT and Fourier series synthesis<br>• Fourier Series Representation of Musical Tones<br>• Fault detection and Vibration analysis in Rotating Machines - Simulation | **9 Hours**<br><br>**6 Hours** |
| **Z-TRANSFORM**<br>Discrete-Time Complex Exponentials and Z-Transform - Region of Convergence and Properties - Inverse Z-Transform -Relationship between Z-Transform and Fourier Transform - Application to Solving Difference Equations<br>**PRACTICAL COMPONENTS:**<br>• Z-transform and inverse Z-transform computation<br>• System analysis using Z-transform. | **5 Hours**<br><br>**4 Hours** |
| **DISCRETE FOURIER TRANSFORM**<br>Introduction to DFT and its Properties, and limitations- FFT Algorithms for Efficient Computation - Radix-2 FFT: DIT and DIF Algorithms - Butterfly Diagrams – Applications: FFT in speech recognition systems<br>**PRACTICAL COMPONENTS:**<br>• Power Quality analysis using FFT<br>• FFT in speech recognition systems<br>• ECG Heartbeat Frequency Detection -Simulation | **10 Hours**<br><br>**6 Hours** |
| **DESIGN OF DIGITAL FILTERS**<br>FIR Filter Design: Linear Phase and Windowing (Hamming, Hanning) - IIR Filter Design: Butterworth, Chebyshev - Impulse Invariant and Bilinear Transformation - FIR and IIR Structures: Direct Form I & II, Cascade, Parallel - Finite Precision Effects- Applications: Radar Signal Processing for Object Detection– Introduction to wavelet Transform.<br>**PRACTICAL COMPONENTS:**<br>• FIR filter Design<br>• IIR filter design<br>• Radar Signal Processing for Object Detection -Simulation | **12 Hours**<br><br>**8 Hours** |

| | |
|---|---|
| • Precision effects on filter stability and response | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Theory Hours:** | **45** | **Tutorial Hours:** | **Practical Hours:** | **30** | **Project Hours:** | **Total Hours:** | **75** |

**LEARNING RESOURCES**

**TEXTBOOKS:**

1. Alan V. Oppenheim, Alan S. Willsky, *Signals and Systems*, 2nd Edition, Pearson Education,2015
2. John G. Proakis, Dimitris G. Manolakis, *Digital Signal Processing: Principles, Algorithms, and Applications*, 5th Edition, Pearson Education,2021

**REFERENCES:**

11. Simon Haykin & Barry Van Veen, *Signals and Systems*, Wiley, 2nd Edition, Wiley India, 2007.
12. Sanjit K. Mitra, *Digital Signal Processing: A Computer-Based Approach*, 4th Edition, McGraw-Hill Education, 2013
13. P. Ramesh Babu & R. Anandanatarajan, *Signals and Systems*, Vijay Nicole, 2022
14. P. Ramesh Babu, *Digital Signal Processing*, 7th Edition, Vijay Nicole, 2011

**ONLINE EDUCATIONAL RESOURCES:**

**SIGNALS AND SYSTEMS**

- **NPTEL**: Signals and Systems by Prof. Nagendra Krishnapura (IIT Madras) (https://nptel.ac.in/courses/117106084 )
- **YouTube**: Signals & Systems - EC Academy
- **Interactive Tool**: Desmos Signal Explorer (for plotting signals)

**FOURIER ANALYSIS OF CT AND DT SIGNALS**

- **NPTEL**: Fourier Series and Transforms - IIT Kharagpur (https://nptel.ac.in/courses/117105144 )
- **YouTube**: Fourier Series – MathTheBeautiful
- **Simulation Tool**: PhET Fourier: Making Waves

**Z-TRANSFORM**

- **MIT OCW**: Z-Transform Concepts (Video) (https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-003-signals-and-systems-fall-2011/ )
- **YouTube**: Z-Transform Tutorials by Dr. Saeed Roosta
- **Tool**: Symbolab Z-Transform Calculator

**DFT and FFT**

- **Khan Academy**: Fourier Transform Intuition
- **YouTube**: Understanding FFT - Steve Brunton
- **Online Tool**: FFT Visualizer - Academo.org

**DIGITAL FILTER DESIGN**

- **Coursera**: Digital Signal Processing by EPFL
- **NPTEL**: Digital Signal Processing – Prof. T. K. Basu (IIT KGP) (https://nptel.ac.in/courses/117105130)
- **Online Tool**: T-filter (FIR Design Tool)
- **MATLAB Resource**: Filter Design Using FDAtool (Official MATLAB Guide)

***General Tools and Platforms***

- **MATLAB Online**: https://matlab.mathworks.com
- **Google Colab (Python + SciPy)**: https://colab.research.google.com

- **GNU Octave** (Free MATLAB alternative): https://www.gnu.org/software/octave/
- **Scilab**: https://www.scilab.org/

| **Assessment** | |
|---|---|
| Formative | Summative |
| Assignments / Mini project, Quiz, Lab | SA- I, SA – II and End Semester Examination (ESE) |

| **Course Curated by** | | | |
|---|---|---|---|
| **Expert(s) from Industry** | **Expert(s) from Higher Education Institution** | **Internal Expert(s)** | |
| Vinayaka Hegde<br>Director Software Development, Visteon | Dr Suyampu Lingam A<br>Assistant Professor (Sr. Gr.), Amrita Viswa Vidyapeetham | Umesh M V<br>Associate Professor E& I<br>Dr. Kavitha R<br>Associate Professor EEE<br>Dr. Kandasamy V<br>Associate Professor EEE | |
| Recommended by BoS on | 29.11.2025 | | |
| Academic Council Approval | No 29 | Date | 24.12.2025 |

| 24EII205 | CONTROL PANEL DESIGN & RELAY LOGIC SYSTEMS | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 2 | 0 | 2 | 0 | 3 |
| PC | | SDG | 7, 9, 12 | | | |

| Pre-requisite courses | | Data Book / Code book (If any) | -- |
|---|---|---|---|

| Course Objectives: | |
|---|---|
| This aims the students to: | |
| 1 | Understand the functions, standards, and operating principles of industrial control panel components, wiring methods, motor control circuits, power distribution systems, and fluid power systems. |
| 2 | Develop skills in wiring control panels, implementing relay logic, designing motor starters, selecting LV power distribution components, and integrating pneumatic and hydraulic circuits |
| 3 | Apply multidisciplinary knowledge to design, implement, troubleshoot, and integrate electrical, motor control, and fluid power systems in industrial automation applications. |

| Course Outcomes | | |
|---|---|---|
| After successful completion of this course, the students shall be able to | | **Revised Bloom's Taxonomy Levels (RBT)** |
| CO 1 | Identify the functions of essential control panel and wiring standards, | U |
| CO 2 | Implement relay logic circuits including latching, interlocking, timing, and counting operations. | Ap |
| CO 3 | Construct, analyze and troubleshoot motor control circuits | An |
| CO 4 | Analyze control panel layouts for safety, protection, thermal performance, and compliance with industrial standards. | An |
| CO 5 | Develop pneumatic and electro-pneumatic control circuits integrated with relay logic for basic automation tasks | Ap |
| CO 6 | Assemble a fully functional industrial control panel, demonstrating professional wiring, testing, documentation, and safety practices.. | Ap |

| Course Outcomes (CO) | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | |
| | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 |
| 1 | 3 | 2 | 1 | 1 | 1 | 1 | 2 | – | – | 1 | – | 3 | |
| 2 | 2 | 2 | 3 | 2 | 2 | – | – | – | – | 2 | – | 2 | |
| 3 | 2 | 2 | 3 | 3 | 2 | – | – | – | – | 3 | 1 | 2 | 3 |
| 4 | 2 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | – | 2 | 1 | 3 | |
| 5 | 1 | 1 | 2 | 2 | 2 | – | – | – | 1 | 2 | – | 3 | 3 |
| 6 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 3 | 3 |

| **Course Content** | |
|---|---|
| **MODULE 1: CONTROL PANEL COMPONENTS**<br>Introduction to control panels in automation – Types of Control panels: Power panels, MCC, PCC, Relay Logic panels - Wiring Standards: IEC/IS, cable types, ferruling conventions - Working principle of circuit breakers, relays, contactors, timers, counters, OLR - – LOTO (Lockout–Tagout) fundamentals for safe isolation before maintenance and troubleshooting – Introduction to VFD, power thyristor-based heater control<br>**PRACTICAL COMPONENT:**<br>• **Experiment 1:** Identification, testing, and wiring of industrial control components (relays, contactors, timers, counters, OLR, pushbuttons, tower lamps).<br>• **Experiment 2:** Construction of a basic industrial Start–Stop control circuit with tower lamp status indication.<br>• **Experiment 3:** Heater load control using power-thyristor firing circuit with thermal overload demonstration. | **4 Hours**<br><br>**6 Hours** |
| **MODULE 2: RELAY LOGIC DESIGN & SEQUENTIAL CONTROL SYSTEMS**<br>Relay logic design principles - Latching, interlocking, seal-in circuits - Sequential machine operations (2-step, 3-step sequences) - Timer-based sequencing - Counter-based operations Industrial safety interlocks (door switch, OLR, E-stop) - Electrical diagrams - Mandatory LOTO application before modifying or testing relay logic circuits to prevent accidental energization.<br>**PRACTICAL COMPONENT:**<br>• **Experiment 4:** Relay-based motor Start–Stop control with seal-in logic, OLR protection, and tower lamp alarm indication. | **7 Hours**<br><br>**6 Hours** |

| | |
|---|---|
| • **Experiment 5:** Timer-driven sequential industrial process control (Motor → Heater → Alarm) using relay–timer logic.<br>• **Experiment 6:** Industrial counting system using electromechanical counter and limit switch for part/bottle counting. | |
| **MODULE 3: MOTOR CONTROL CIRCUITS & PROTECTION**<br>DOL starter construction & control - Forward–Reverse motor control (reversing logic) - Star–Delta starter control (timer-based) - Interlocking & protection - VFD overview – wiring external control terminals - Stepper motor basics & driver interface - Motor braking (DC injection / mechanical overview) - Load protection, fuses, OLR, surge suppressors- safe electrical maintenance.<br>**PRACTICAL COMPONENT:**<br>• **Experiment 7:** Construction and testing of a complete DOL starter with MCB–Contactor–OLR–Motor and relay-based control.<br>• **Experiment 8:** Forward–reverse motor control using electrical/mechanical interlocking with tower lamp status indication.<br>• **Experiment 9:** Industrial control of AC motor via VFD external terminals and stepper motor using driver-based relay logic. | **7 Hours**<br><br>**6 Hours** |
| **MODULE 4: CONTROL PANEL DESIGN, SAFETY AND THERMAL MANAGEMENT**<br>GA layout design, component placement and proper cable routing with power–control segregation. Electrical safety covering IP ratings, shock protection and isolation, safe shutdown during panel assembly, maintenance, and testing, safe earthing and grounding practices, arc-flash basics, short-circuit calculation overview, and over-temperature protection methods. Identification of heat sources, techniques for heat dissipation including ventilation, louvers, forced cooling, and heat sinks, basic thermal calculations for derating and airflow, and guidelines for infrared (IR) thermal inspection of control panels.<br>**PRACTICAL COMPONENT**<br>• **Experiment 10**: Design of control panel GA layout and internal wiring routing using Automation Studio with industrial component placement.<br>• **Experiment 11:** Assembly and wiring of a complete industrial control panel (DOL, tower lamp, timer circuit) with proper cable management and safety practices.<br>• **Experiment 12:** Thermal and safety inspection of a control panel with load testing and implementation of ventilation or heat-sink solutions. | **7 Hours**<br><br>**6 Hours** |
| **MODULE 5: ELECTRO-PNEUMATIC & HYDRAULIC SYSTEMS**<br>Pneumatic and hydraulic component basics - Actuators, valves, air preparation units - Electro-pneumatic solenoid valves - Relay-based control of cylinders - Safety in pneumatic systems hydraulic/pneumatic isolation to prevent stored-energy hazards. Application of timer-based sequencing for efficient and reliable industrial motion control systems. reduced leakage, and optimized air usage to minimize compressor energy consumption<br>**PRACTICAL COMPONENT:**<br>• **Experiment 13:** Operation of single-acting and double-acting pneumatic cylinders using pushbutton-controlled circuits. | **5 Hours**<br><br>**6 Hours** |

| | |
|---|---|
| • **Experiment 14:** Electro-pneumatic cylinder extend–retract control using relay logic with solenoid valve interlocking.<br>• **Experiment 15:** Relay- and timer-based sequential electro-pneumatic system for pick-and-place operation | |

| Theory Hours: 30 | Tutorial Hours: 0 | Practical Hours: 30 | Project Hours: 0 | Total Hours: 60 |
|---|---|---|---|---|

**Learning Resources**

**Textbooks:**


3. McMillan, G. K., & Considine, D. M. (2019). Process/Industrial instruments and controls handbook (6th ed.). McGraw-Hill Education.
4. Fink, D. G., & Beaty, H. W. (2007). Standard handbook for electrical engineers (15th ed.). McGraw-Hill Education.
   (Used as an authoritative source for control panel wiring, protection, and motor control.)
5. Schneider Electric. (2022). The essential guide to control panels (Latest ed.). Schneider Electric Publishing.


**References:**


15. Bureau of Indian Standards. (2023). National Electrical Code of India (NEC): IS SP 30 (Latest Revision). BIS Publications.
16. Chapman, S. J. (2012). Electric machinery fundamentals (5th ed.). McGraw-Hill Education. (For motor control theory, starters, and protection systems.)
17. Esposito, A. (2021). Fluid power: Hydraulics and pneumatics (4th ed.). Pearson Education.
18. Coursera. (n.d.). Motor circuits and design. https://www.coursera.org/learn/motors-circuits-design


**Assessment (Embedded course)**

SA, Activity and Learning Tasks, Mini project, MCQ, End Semester Examination (ESE)
Lab Workbook, Experimental Cycle tests, viva-voce

**Course Curated by**

| Expert(s) from Industry | Expert(s) from Higher Education Institution | Internal Expert(s) |
|---|---|---|
| Mr. Babukumar. S, Manager, Automation / Central Engineering, Apollo Tyres, Oragadam | [Name, Institution] | Dr. S. Ranganathan Assistant Professor Department of E&I |

| | | | |
|---|---|---|---|
| **Recommended by BoS on** | 29.11.2025 | | |
| **Academic Council Approval** | No 29 | **Date** | 24.12.2025 |

| 24INM202 | ENVIRONMENTAL SCIENCE AND SUSTAINABILITY (Common to All Branches) | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 1 | 0 | 2 | 0 | 2 |
| HS | | SDG | 6, 13, 15 | | | |

| Pre-requisite courses | - | Data Book / Code book (If any) | - |
|---|---|---|---|

## Course Objectives:

The purpose of taking this course is to:

| | |
|---|---|
| 1 | To introduce the importance, types, and conservation strategies of natural resources, with a focus on sustainable practices in water and food management. |
| 2 | To understand the structure and function of ecosystems and biodiversity, and explore the need for conservation through the study of hotspots and global environmental concerns. |
| 3 | To examine the causes and effects of environmental degradation, including pollution and waste management, and to promote mitigation strategies for sustainable development. |
| 4 | To provide knowledge of the legal and institutional frameworks for environmental protection in India and globally, including critical environmental acts and enforcement challenges. |
| 5 | To explore conventional and alternative energy resources, and to assess methods for energy conservation and carbon footprint reduction through audits and sustainability measures. |

## Course Outcomes

| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
|---|---|---|
| CO1 | apply the concept of natural resource conservation to demonstrate sustainability practices | Ap |
| CO2 | analyse the structure, function, and adaptive capacity of ecosystems to categorize threats and conservation strategies for biodiversity. | An |
| CO3 | analyse various forms of environmental degradation and propose management and preventive solutions. | An |
| CO4 | apply national environmental laws and frameworks in the personal and professional contexts | Ap |
| CO5 | design strategies using renewable energy principles to develop sustainable energy utilization plans through audits and footprint analysis to transfer a healthy environment for future generations. | Ap |

| Course Outcomes (CO) | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | | |
| | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 | PSO-3 |
| 1 | 2 | – | – | – | – | 2 | 3 | – | 1 | – | – | 2 | – | – |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 2 | 2 | – | – | – | 2 | 3 | 1 | – | – | – | 2 | 2 | – |
| 3 | 2 | 3 | – | 2 | – | 3 | 3 | 1 | – | – | – | 2 | 3 | – |
| 4 | – | 2 | – | – | – | 3 | 3 | 3 | 1 | 2 | 2 | – | 2 | – |
| 5 | 2 | 2 | 3 | 2 | 2 | 3 | 3 | – | 1 | 2 | 2 | 2 | 2 | 3 |

## Course Content

| | |
|---|---|
| **NATURAL RESOURCES**<br>**Introduction to Natural resources :** Types, significance, and conservation strategies<br>**Water resources:** Utilization, management practices, and conservation strategies - rainwater harvesting methods.– Water distribution system audit<br>**Food resources:** Challenges of food security in India - impact of modern agriculture, and environmental concerns related to fertilizers and pesticides.<br>**Practical Component:**<br>• Parameter Testing : Water / Effluent / Soil/Fertiliser<br>• Simulation Experiments<br>• Online Course | **3 Hours**<br><br>**10 Hours** |
| **ECOSYSTEM AND BIODIVERSITY**<br>**Ecosystem:** Structure and function of an ecosystem- ecosystem resilience and adaptive capacity<br>**Biodiversity:** Values of biodiversity - Hot Spot of biodiversity (in the Himalayas, the Western Ghats, the Indo-Burma region, and the Gulf of Mannar) - Threats to biodiversity.<br>**Conservation Strategies:** Emerging Issues in Biodiversity Conservation - Citizen science - In-situ and Ex-situ conservation of biodiversity.<br>**Practical Component:**<br>• Documentation of biodiversity in the campus | **3 Hours**<br><br>**6 Hours** |
| **ENVIRONMENTAL DEGRADATION AND MANAGEMENT**<br>**Pollution**: Causes, effects and control measures of Air pollution, Water pollution - Role of an individual in prevention of pollution<br>**Waste management**: Circular Economy vs. Linear Economy - Disposal of solid wastes - Treatment of Liquid wastes<br>**Disaster Management**: Mitigation strategies and Readiness<br>**Practical Component:**<br>• Waste Management and Resource recovery in Campus<br>• Documentation of Environmental Data Resources and Monitoring Tools. | **3 Hours**<br><br>**6 Hours** |

| | |
|---|---|
| **LEGAL FRAMEWORK FOR ENVIRONMENTAL PROTECTION IN INDIA**<br>**Global and National Initiatives**: United Nations Sustainable Development Goals - Coastal Regulation Zone - Environmental impact assessment<br>**Environmental Legislation in India**: Key Legal and Regulatory Terminology in India – Valuation of Ecosystem Services and integration of Acts in the workplace - Plastic Waste Management Rules - E-Waste Management Rules - Environment Protection Act – Air (Prevention and Control of Pollution) Act – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act<br>**Implementation Challenges**: Issues involved in enforcement of environmental legislation<br>**Practical Component:**<br>• Online Course | **3 Hours**<br><br>**2 Hours** |
| **ENERGY MANAGEMENT**<br>**Energy Resources:** Energy Demand and Urban energy Challenges - Necessity of alternate energy methods - Renewable and Non- renewable energy resources - Carbon footprint and carbon credit – Sustainable energy utilization – Case study<br>**Energy Audits** – Purpose, methodology, and common instruments used<br>**Practical Component**:<br>• Documentation of Energy usage through Carbon footprint calculation - Personal as well as Institutional | **3 Hours**<br><br>**6 Hours** |

| Theory Hours: 15 | Tutorial Hours: 0 | Practical Hours: 30 | Project Hours: 0 | Total Hours: 45 |
|---|---|---|---|---|

**Learning Resources**

**References:**


1. Bharucha, E. (2021). Textbook of environmental studies for undergraduate courses (3rd ed.). Orient BlackSwan / Universities Press - Hyderabad, India.
2. Miller, G. T., & Spoolman, S. E. (2014). Environmental science (14th ed.). Cengage India
3. Anubha Kaushik & C.P. Kaushik (2024). Perspectives in Environmental Studies (8th ed.). New Age International Publishers, New Delhi.
4. Masters, G. M., & Ela, W. P. (2013). Introduction to environmental engineering and science (3rd ed.). Pearson Education, New Delhi.
5. Leelakrishnan, P. (2018). Environmental law in India (3rd ed.). LexisNexis Butterworths, New Delhi.
6. Botkin, D. B., & Keller, E. A. (2014). Environmental science: Earth as a living planet (9th ed.). Wiley, Hoboken, NJ.
7. Armstrong, J. (2023). The future of energy: The 2023 guide to the energy transition. Independently published.
8. Easton, T. (Ed.). (2017). Taking sides: Clashing views on environmental issues (17th ed.). McGraw-Hill Education, New York, NY.
9. Ishwaran, N. (2022). Ecosystem services and economic valuation. New Delhi: TERI Press.


**Online Resources (Weblinks)**

https://www.youtube.com/watch?v=j4Z6WmTnhRQ How to Conduct a Water Audit in Institutions

- https://www.youtube.com/watch?v=_OKYio2Yk9U India's Food Security Challenge
- https://www.youtube.com/watch?v=IjNT9Z2OLf4 India's Biodiversity Hotspots
- https://www.youtube.com/watch?v=_c_sJIEJY4M What is Citizen Science?
- https://www.youtube.com/watch?v=1HZR3GyzFZc What is a Circular Economy
- https://www.youtube.com/watch?v=6_tLYyR_3Vo Environmental Law and Acts in India
- https://www.youtube.com/watch?v=kGcrYkHwE80 Introduction to SDGs
- https://www.youtube.com/watch?v=V__eNSHdChA Conducting an Energy Audit
- https://www.youtube.com/watch?v=dUqTt5Qrxn8 - What is Your Carbon Footprint?

| **Assessment (Embedded course)** |
|---|
| SA , Activity and Learning Task(s), MCQ, End Semester Examination (ESE) Lab Workbook, Report Submission |

| **Course Curated by** | | | |
|---|---|---|---|
| **Expert(s) from Industry** | **Expert(s) from Higher Education Institution** | | **Internal Expert(s)** |
| Dr. Muthuraja Perumal<br>General Manager - Research & Development<br>Rohith Industries, APIIC Industrial Park,<br>Andhra Pradesh | Dr. Mathivanan Packiarajan<br>University of Michigan<br>Ann Arbor, MI<br>USA<br><br>Dr. Venkatakrishnan<br>Professor,<br>School of Chemical Sciences<br>Indian Institute of Technology (Mandi)<br>Himachal Pradesh<br>India | | Faculty Of Chemistry<br>Department of Chemistry |
| **Recommended by BoS on** | | | |
| **Academic Council Approval** | No. | **Date** | |

| 24INM102 | Indian Knowledge Systems in Science and Engineering (Common to All branches) | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 1 | 0 | 0 | 0 | 1 |
| HS | | SDG | 5,16 | | | |

| Pre-requisite courses | – | Data Book / Code book (If any) | - |
|---|---|---|---|

**Course Objectives:**

The purpose of taking this course is to:

| | |
|---|---|
| 1 | Explore the Role of Traditional Knowledge in Basic Scientific Concepts |
| 2 | Know the science behind the establishment of traditional architecture |
| 3 | Revive ancient Indian aerospace, metallurgy and navigation technologies |
| 4 | Revitalize ancient textile traditions through sustainable practices, promoting eco- friendly materials |
| 5 | Explore and integrate ancient Indian medical systems like Ayurveda, Siddha & Rasa Shastra |

**Course Outcomes**

| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
|---|---|---|
| CO 1 | understanding Indigenous Knowledge Systems (IKS) in Science and Technology | U |
| CO 2 | apply Traditional Design Principles in Civil Engineering | Ap |
| CO 3 | explore of Ancient Aerospace Technologies for Aeronautical Engineering | E |
| CO 4 | know the sustainable traditional textile practices for ecofriendly atmosphere | R |
| CO 5 | gain knowledge of Ancient Medical Practices for Biotechnologists | U |

| Course Outcomes (CO) | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | | |
| | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 | PSO-3 |
| 1 | 2 | 2 | 2 | 2 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | | | |
| 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 1 | 2 | 1 | 3 | | | |
| 3 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 1 | 2 | 1 | 3 | | | |
| 4 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 1 | 2 | 1 | 3 | | | |
| 5 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 1 | 2 | 1 | 3 | | | |

**Course Content**

| | |
|---|---|
| **IKS IN BASIC SCIENCES**<br>Study of ancient Indian concepts such as atomism (paramāṇu)- the five elements (Panchabhūta)- Exploration of alchemical practices, metallurgy-development of zero, decimal systems, algebra, and trigonometry - works by scholars such as Brahmagupta and Aryabhata- detailing planetary motions and timekeeping systems. | **3 hours** |
| **IKS IN CIVIL ENGINEERING**<br>Evolution from rock-cut caves to grand temples like Madurai Meenakshi and Brihadeeswarar.- Vastu Shastra- The Concept of "Mandala- Courtyard Design- Sacred Geometry- Panchabhuta- Chhatri- dome-shaped canopy- Prana Vayu- Shilpa Shastra- Sthapatya Veda- Kaalchakra- Brahmasthan. | **3 hours** |

| | |
|---|---|
| **IKS IN MECHANICAL ENGINEERING**<br>Exploration of ancient metallurgical techniques-including ore extraction-alloying, furnace design-Vimana (Flying Machines) - Shakti (Energy Source) -Aerospace materials- Vimana Shapes -Ancient Navigation- Vedic Astronomy- Flight Principles in Nature- Matrika Systems-Indian shipbuilding techniques and navigation methods. | **3 hours** |
| **IKS IN TEXTILE TECHNOLOGY**<br>Introduction to Ancient Indian Textiles- Cultural and Historical Context -Traditional Dyeing Techniques-Weaving Techniques and Patterns-Khadi- -Natural Fibers and Materials-Cotton,Silk,Wool and Jute-Sustainable Practices and Eco-Friendly Technologies-Organic Cotton Farming-Recycling and Repurposing. | **3 hours** |
| **IKS IN MEDICINE**<br>Ayurveda- Siddha Medicine- Rasa Shastra- Herbal Medicine- Nadi Pariksha- Chikitsa- Yoga and Pranayama- Surgical Techniques -Charaka Samhita - Sushruta Samhita— Panchagavya usage-Medicinal Plants and Herbal Remedies-Agricultural Practices and Crop Diversity-Sacred and Ritual Plants. | **3 hours** |

| Theory Hours: 15 | Tutorial Hours: 0 | Practical Hours: 0 | Project Hours: 0 | Total Hours: 15 |
|---|---|---|---|---|

**Learning Resources**

**Textbooks:**

1. Indian Knowledge Systems: A Sustainable Approach: The Science of Self-Healing" by Vasant Lad, Excel India Publisher, 2024.
2. Indigenous Knowledge Systems: Towards a Holistic Inclusive Conservation, Satarupa Dutta Majumder, Manohar Publishers & Distributors, 2019.

**References:**

1. Indian Knowledge System: Integrating Heritage with Engineering, Gagan Bansal, Deep Science Publishing, 2025

**Online Resources (Weblinks)**

www.deepscienceresearch.com/dsr/catalog/book/70

**Assessment (Theory course)**

Presentation, MCQ, Assignment, Case Study and E Chart.

**Course Curated by**

| Expert(s) from Industry | Expert(s) from Higher Education Institution | Internal Expert(s) |
|---|---|---|
| | Dr K Sangeetha,<br>Professor and Head-Textile Department,<br>IKS-Nodal officer,<br>Bharathiar University,Coimbatore-46. | Dr.R.Prakasam,<br>AssistantProfessor,<br>Department of Physics.<br>Capt-A.R.Arul,<br>Assistant Professor,<br>Department of Physics |
| **Recommended by BoS on** | 25-04-2025 | |
| **Academic Council Approval** | | **Date** 26-06-2025 |



BoS Chair

BoS Chair

# FIFTH SEMESTER



BoS Chair

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BoS Chair

| 24HSP007 | Building Professional Readiness | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 0 | 0 | 2 | 0 | 1 |
| HS | | SDG | 4&8 | | | |

| Pre-requisite courses | Nil | Data Book / Codes / Standards (If any) | |
|---|---|---|---|

| Course Objectives**: | The purpose of taking this course is to: |
|---|---|
| 1 | To familiarize students with various interview formats and equip them with essential techniques for effectively handling personal, behavioural, stress, and panel interviews. |
| 2 | To develop self-awareness and career readiness by guiding students in analysing job roles, articulating career goals, and confidently presenting their skills and experiences. |
| 3 | To enhance students' adaptability in diverse career pathways by exploring alternative job opportunities, entrepreneurial ventures, and global career options beyond traditional engineering roles. |

| Course Outcomes***: | After successful completion of this course, the students shall be able to | Bloom's Taxonomy Level (BTL) |
|---|---|---|
| CO 1 | **Effectively navigate various interview formats** by applying appropriate techniques for personal, behavioural, stress, and panel interviews, demonstrating confidence and professionalism in different interview scenarios. | Ap |
| CO 2 | **Exhibit career readiness and self-awareness** by analysing job roles, articulating career aspirations, and presenting skills and experiences in alignment with employer expectations. | An |
| CO 3 | **Evaluate and explore diverse career pathways** beyond traditional engineering roles, demonstrating adaptability in pursuing opportunities in entrepreneurship, global careers, public sector roles, and other emerging industries. | E |

| | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | | |
| Course Outcomes (CO) | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 | PSO-3 |
| 1 | | | | | | 2 | 2 | 3 | 3 | | 3 | | | |
| 2 | | | | | | 2 | 2 | 3 | 3 | | 3 | | | |
| 3 | | | | | | 2 | 2 | 3 | 3 | | 3 | | | |

## Course Content

| | |
|---|---|
| **Career Awareness and Goal Setting**<br>• Exploring Varied Career Options Beyond Engineering<br>  • Industry Roles<br>  • Startups and Entrepreneurial Ventures<br>  • Research Opportunities and Higher Education<br>  • Public Sector and Non-Profit Careers<br>• Self-Assessment and Personal Reflection | **6 Hours** |



BoS Chair

| | |
|---|---|
| • Identifying Strengths, Weaknesses, Skills, and Career Aspirations<br>• Setting Short-Term and Long-Term Career Goals | |
| **Fundamentals of Interview Preparation**<br>• Analysing Company Background and Understanding Job Roles<br>• Aligning Career Goals with Job Opportunities<br>• Professional Etiquette and Appearance<br>• Interview Dress Code, Grooming, and First Impression<br>• Resume and Digital Profile Readiness<br>• Types of interviews: personal, behavioural, stress, virtual, and panel | **6 Hours** |
| **Behavioural Interviews – Responding with Purpose**<br>• Introduction to behavioural interviews: What and Why?<br>• Common behavioural interview questions<br>• The STAR technique (Situation – Task – Action – Result)<br>• Identifying and reflecting on past experiences<br>• Mapping soft skills to behavioural questions<br>• Practicing concise storytelling<br>• Active listening and adapting responses | **6 Hours** |
| **Stress Interviews – Performing Under Challenging Situations**<br>• Understanding stress interviews: Purpose and setting<br>• Types of stress tactics (rapid-fire questions, silence, disagreement, interruptions)<br>• Strategies to stay composed and confident<br>• Emotional regulation and response control<br>• Maintaining clarity, tone, and respect under pressure<br>• Practicing assertive and professional body language<br>• Turning pressure moments into strengths | **6 Hours** |
| **Panel Interviews**<br>• What is a panel interview? Structure and expectations<br>• Understanding panel roles (HR, technical, managerial)<br>• Techniques for engaging with a diverse panel<br>• Managing eye contact, addressing questions, and body posture<br>• Preparing multi-perspective answers<br>• Handling follow-up or cross-questions<br>• Strategies for closing the interview with impact | **6 Hours** |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Theory Hours:** | **-** | **Tutorial Hours:** | **-** | **Practical Hours:** | **2** | **Project Hours:** | **-** | **Total Hours:** | **30** |

**Learning Resources***

**Reference books/ Web Links**


1. Amos, J. (2004). Handling Tough Job Interviews: Be Prepared, Perform Well, Get the Job. United Kingdom: How To Books.
2. Clark, A. (2019). Cracking the Behavioral Interview Code!!! How to Answer Behavioral Interview Questions and Answer with a Preparation Guide + 20 Most Popular Behavioral Interview Questions and Answers.. (n.p.): Amazon Digital Services LLC - KDP Print US.
3. Collins, A. (2015). HR Interview Secrets: How to Ace Your Next Human Resources Interview, Dazzle Your Interviewers and LAND the JOB YOU WANT!. United States: Success in HR Publishing.
4. Downes, C. (2008). Cambridge English for Job-hunting Student's Book with Audio CDs (2). Germany: Cambridge University Press.




BoS Chair

5. Hatcher, S. (2015). Group Interview Preparation: Learn How to Use Group Discussion to Your Advantage and Be Comfortable, Confident, and Likeable While Standing Out in a Group Interview. (n.p.): CreateSpace Independent Publishing Platform.
6. McKay, D. R. (2013). The Everything Job Interview Question Book: The Best Answers to the Toughest Interview Questions. United States: Adams Media.
7. Ryan, R. (2016). 60 Seconds and You're Hired!: Revised Edition. United States: Penguin Publishing Group.
8. Winter, S. (2020). Job Interview Preparation and Conversation Skills 2-in-1 Book: Learn How to Crush Your Next Job Interview and Develop A Magnetic Charisma to Enhance Your Communication Skills. United States: Native Publish

**Online Resources**

1. https://www.coursera.org/projects/preparation-for-job-interviews
2. https://www.coursera.org/projects/accomplishment-star-techniques-for-job-interviews
3. https://www.coursera.org/specializations/english-interview-resume

| **Assessment** | |
|---|---|
| Formative | Summative |
| ----- | 1. Participation in Mock interviews (80%)<br>2. Career Readiness Portfolio Submission (20%) |

| **Course Curated By** | | |
|---|---|---|
| **Expert(s) from Industry** | **Expert(s) from Higher Education Institutions** | **Internal Expert(s)** |
| Mr. Bhuvana Sundar Soorappaiah<br>Program Manager<br>Bosch, Coimbatore | Dr Kishore Selva Babu<br>Head and Associate Professor<br>Department of English and Cultural Studies<br>Christ University<br>Bangalore-560029 | Dr. J Srikala- AP III<br>Dr. C Tissaa Tony - AP III<br>Dr. S G Mohanraj – AP III<br>Dr. S Sreejan – AP III<br>Dr. R Hema – AP II<br>Dr. A S Mythili - AP II |

| | |
|---|---|
| **Approved by: BoS Chairman** | With Signature and date |
| **BoS Approval date:** | **25.04.2025** |



BoS Chair

| 24EIT301 | FIELD INSTRUMENTATION | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 0 | 4 |
| PC | | SDG | 9, 12 | | | |

| Pre-requisite courses | Sensors and Transducers | Data Book / Code book (If any) | ISA Standards |
|---|---|---|---|

| Course Objectives: | |
|---|---|
| The purpose of taking this course is to: | |
| 1 | Acquire knowledge on modern industrial field instruments and smart transmitters used in sustainable industries. |
| 2 | Develop skills in installation, calibration, commissioning and troubleshooting of field devices. |
| 3 | Build competency to design safe, reliable and energy-efficient instrumentation systems. |

| Course Outcomes | | |
|---|---|---|
| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
| CO1 | Read and draw P&ID diagrams using ISA-5.1 instrument symbols, identification codes, and loop numbering conventions. | Ap |
| CO2 | Execute calibration and troubleshooting of industrial instruments (pressure, flow, level, temperature) using HART communicators. | Ap |
| CO3 | Configure WirelessHART and smart field transmitters and integrate them into IIoT-enabled process monitoring systems. | Ap |
| CO4 | Analyse and select instruments for process measurements based on process conditions, fluid properties, and safety requirements. | An |
| CO5 | Apply functional safety (IEC 61511) and ISA ethical principles in instrumentation system design and commissioning. | Ap |
| CO6 | Design basic field instrumentation loops integrating smart transmitters, safety interlocks, and IIoT analytics. | Ap |

| Course Outcomes (CO) | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | |
| | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 |
| 1 | 3 | 2 | 1 | - | 2 | 1 | - | 2 | - | 1 | - | 3 | 1 |
| 2 | 3 | 3 | 2 | 3 | 3 | 1 | - | 2 | 2 | 1 | - | 3 | 2 |
| 3 | 3 | 2 | 2 | 2 | 2 | 1 | - | - | - | - | - | 3 | 1 |
| 4 | 2 | 2 | 1 | 1 | 2 | 1 | 2 | - | - | 1 | - | 2 | 2 |
| 5 | 1 | 1 | - | - | 1 | 3 | 3 | 3 | - | - | 2 | 2 | 1 |
| 6 | 3 | 3 | 3 | 2 | 3 | 2 | - | 2 | 2 | 2 | 1 | 3 | 3 |



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| Course Content | |
|---|---|
| **FIELD INSTRUMENTATION FUNDAMENTALS AND P&ID**<br>Industrial measurement systems; smart transmitters; 4-20 mA current loop-Instrument datasheets: functional specifications, environmental ratings, SIL - Lifecycle engineering and sustainable instrumentation practices- P&ID fundamentals (ISA-5.1): instrument identification codes (TIC, FIC, LT, PT, etc.); function designators; process lines; signal types-P&ID drawing exercise: oil & gas separator P&ID; refinery distillation column P&ID-Instrument loop diagram: loop numbering; junction box; field wiring; control room termination-Instrument index / equipment list: tag number, description, spec, location-ISA-18.2 Alarm Management: alarm rationalization; alarm priority (high/medium/low); nuisance alarms; PSSR (Pre-Startup Safety Review)<br>**Lab:**<br>**Draw and interpret a complete P&ID for a heat exchanger loop (TIC with cascade to FIC) per ISA-5.** | **9 Hours**<br><br>**5 Hours** |
| **PRESSURE - FLOW INSTRUMENTATION**<br>Pressure sensing technologies: gauge, absolute, differential; Bourdon tube, diaphragm, capacitive cell-DP transmitter (Rosemount 3051): installation, wet leg/dry leg, purge-ISO 5167 flow measurement: orifice plate, Venturi, flow nozzle-Coriolis flow meter: operating principle, density measurement, energy efficiency-Electromagnetic flow meter: Faraday law; grounding rings; liner selection-Ultrasonic flow meter: transit-time and Doppler types-Smart DP transmitter features: HART configuration (Device ID, tag, range, units); multivariable transmitter (dP + P + T)-Custody transfer metering: API MPMS standards; proving; uncertainty in fiscal measurement-Low-flow metering: Coriolis for pharma/bio applications; micro-Coriolis (Emerson CMF010)<br>**Lab:**<br>• **Dead weight tester calibration of DP transmitter;**<br>• **HART communicator field calibration exercise** | **9 Hours**<br><br>**5 Hours** |
| **LEVEL - TEMPERATURE INSTRUMENTATION**<br>Contact level: displacer, capacitive, resistive types- Non-contact: radar (FMCW and pulse), ultrasonic level measurement -Guided Wave Radar (GWR): principle, single/twin-rod probe, application in interface measurement (oil-water)-Radar level transmitter configuration: VEGAPULS 64; antenna selection; echo curve interpretation-Temperature transmitter- RTD and thermocouple fundamentals; cold-junction compensation: HART-enabled head-mount transmitter (Rosemount 644); sensor drift detection-Multipoint temperature measurement: thermocouple array; averaging; hot-spot detection in reactors- Analytical instrument calibration: two-point pH calibration; conductivity cell constant; temperature compensation<br>**Lab: Radar level transmitter setup and HART configuration; echo curve analysis for agitated vessel** | **9 Hours**<br><br>**5 Hours** |
| **INSTALLATION, COMMISSIONING, MAINTENANCE AND TROUBLESHOOTING** | **9 Hours** |



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| | |
|---|---|
| Industrial instrument installation practices, impulse piping, wiring techniques, grounding and shielding methods, loop checking- calibration- commissioning procedures and documentation practices-Preventive and predictive maintenance concepts- troubleshooting of field instruments and control loop- identification of wiring and transmitter faults, and safety practices during maintenance and commissioning activities.<br><br>**Lab :**<br>**Installation and testing of pressure transmitter with impulse piping arrangement** | **5 Hours** |
| **ANALYTICAL INSTRUMENTS AND SAFETY INSTRUMENTATION**<br>pH, conductivity, density/viscosity, humidity sensors - Smart transmitter architecture: microprocessor, sensor, ADC, HART modem - Gas analyser technologies: paramagnetic O2 analyser; NDIR CO/CO2 analyser; flame ionisation detector (FID) for VOC- Chromatograph overview: process gas chromatograph (PGC); application in refinery off-gas analysis- Safety Instrumented System (SIS) basics: IEC 61511 process safety lifecycle; Safety Instrumented Function (SIF); SIL rating- Safety sensor selection: SIL-rated pressure transmitter (Emerson 3051S SIS); voting logic (1oo2, 2oo3)- Hazardous area instrumentation: ATEX/IECEx zones (Zone 0/1/2 gas; Zone 20/21 dust); intrinsic safety (Ex ia); flameproof (Ex d)- Instrument commissioning checklist: loop check; functional test; as-built documentation; handover to operations | **9 Hours** |
| **Lab: Mini-project**<br>• **Complete instrumentation loop design for a heat exchanger (P&ID → instrument selection → datasheet → loop diagram → HART calibration)** | **10 Hours** |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Theory Hours:** | **45** | **Tutorial Hours:** | **0** | **Practical Hours:** | **30** | **Project Hours:** | **0** | **Total Hours:** | **75** |

**Learning Resources**

**Textbooks:**


6. Lipták, B. G., & Venczel, K. (Eds.). (2022). *Instrument and automation engineers' handbook: Process measurement and analysis* (5th ed., Vols. 1–2). CRC Press
7. Johnson, C. D. (2014). *Process control instrumentation technology* (8th ed.). Pearson Education.
8. *Dunn, W. C. (2013).* Introduction to instrumentation, sensors, and process control *(2nd ed.). Artech House.*


**References:**


1. *Bentley, J. P. (2018).* Principles of measurement systems *(5th ed.). Pearson.*
2. *Bolton, W. (2015).* Instrumentation and control systems *(2nd ed.). Elsevier.*
3. *Morris, A. S., & Langari, R. (2016).* Measurement and instrumentation: Theory and application *(2nd ed.). Academic Press.*
4. *Battikha, N. E. (2010).* The condensed handbook of measurement and control *(3rd ed.). ISA.*


**Online Educational Resources:**

1. Field Comm Group. (2024). *HART and FOUNDATION™ fieldbus technology resources*.
   https://www.fieldcommgroup.org



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2. Instrumentation Tools. (2024). *Industrial instrumentation tutorials and technical articles*. https://instrumentationtools.com
3. International Society of Automation. (2024). *ISA standards, publications, and webinars*. https://www.isa.org

| **Assessment (Theory course)** |
|---|
| SA, Activity and Learning Task(s) , Mini project, MCQ, End Semester Examination (ESE) |

| **Course Curated by** | | | |
|---|---|---|---|
| **Expert(s) from Industry** | **Expert(s) from Higher Education Institution** | **Internal Expert(s)** | |
| [Name, Organization] | [Name, Institution] | Dr.M.Saravanabalaji | |
| **Recommended by BoS on** | 10/06/2026 | | |
| **Academic Council Approval** | No. | **Date** | 19/06/2026 |



BoS Chair

| 24EII302 | EMBEDDED SYSTEMS DESIGN AND DEVELOPMENT | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 2 | 0 | 2 | 2 | 4 |
| PC | | SDG | SDG No's. 9,12 | | | |

| Pre-requisite courses | 24EII201, 24EEI203 | Data Book / Code book (If any) | ARM Cortex-M reference, MISRA C:2012 |
|---|---|---|---|

| Course Objectives: | |
|---|---|
| The purpose of taking this course is to: | |
| 1 | Develop competency in designing and programming modern embedded systems using ARM Cortex-M microcontrollers and embedded development platforms. |
| 2 | Build practical skills in peripheral interfacing, wireless communication, IoT connectivity, and RTOS-based embedded application development. |
| 3 | Introduce safety, reliability, and Edge AI concepts for intelligent embedded-system design on resource-constrained platforms |

| Course Outcomes | | |
|---|---|---|
| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
| CO 1 | Apply modern embedded-system architecture and development platforms for embedded application development. | Ap |
| CO 2 | Develop embedded applications for interfacing and communication using microcontroller peripherals | Ap |
| CO 3 | Analyze wireless communication and IoT-based embedded system applications. | An |
| CO 4 | Apply real-time operating system concepts for multitasking embedded applications. | Ap |
| CO 5 | Analyze safety, reliability, and coding practices in embedded-system design. | An |
| CO 6 | Evaluate Edge AI and TinyML applications on resource-constrained embedded platforms. | E |

| Course Outcomes (CO) | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | |
| | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 |
| 1 | 3 | 2 | 2 | 1 | 3 | - | - | - | 1 | - | - | 3 | |
| 2 | 3 | 2 | 3 | 2 | 3 | - | - | - | 1 | 1 | - | 3 | |
| 3 | 2 | 3 | 2 | 2 | 3 | 1 | 1 | - | 1 | 1 | - | 2 | |
| 4 | 3 | 3 | 2 | 2 | 3 | - | - | - | 1 | - | - | 3 | |
| 5 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | - | - | 2 | |
| 6 | 2 | 3 | 3 | 3 | 3 | 1 | 2 | - | 1 | 1 | 3 | 3 | |



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| Course Content | |
|---|---|
| **MODERN EMBEDDED SYSTEM ARCHITECTURE,ARM CORTEX PLATFORMS**<br>Introduction to Embedded Systems - Embedded Applications in Industry and IoT- Memory Hierarchy in Embedded Systems - CISC vs RISC Architecture - ARM Cortex-M0/M3/M4/M7 Architecture - Interrupt Structures and NVIC- CMSIS Framework - Vendor Ecosystems (STM32/Nordic/NXP)- Modern Embedded Toolchains (STM32CubeIDE/Keil MDK/GCC ARM Toolchain )- Introduction to RISC-V<br>**Practical Component:**<br>• STM32 GPIO Peripheral Programming<br>• GPIO Interrupt Programming<br>• Configuration of STM32 Clock system | **6 Hours**<br>**12 Hours** |
| **PERIPHERAL DRIVERS AND EMBEDDED INTERFACING**<br>GPIO Driver Development - Timer and Counter Programming - PWM Signal Generation - ADC and DAC Interfacing - UART Communication - SPI and I2C Protocols - CAN Bus Architecture - Framing and Error Detection -Interrupt Service Routines - DMA-Based Peripheral Access - Introduction to HAL-based and Register-Level Embedded Programming.<br>**Practical Component:**<br>• Audio Sensor Interfacing using ADC<br>• Design of Sensor Data Logger<br>• UART/SPI/I2C/CAN Sensor Driver Development | **6 Hours**<br>**12 Hours** |
| **IOT CONNECTIVITY AND WIRELESS EMBEDDED SYSTEMS**<br>BLE Fundamentals- Wi-Fi and ESP-IDF Awareness - MQTT Concepts for IIoT - Sensor-to-Cloud Architecture - Embedded Wireless Communication - Industrial IoT Concepts<br>**Practical Component:**<br>• BLE-Based Sensor Data Transmission to Smartphone<br>• ESP32 Wi-Fi Connectivity Demonstration<br>• Python Visualization Tools for Sensor Data using Matplotlib | **6 Hours**<br>**12 Hours** |
| **MODULE 4: RTOS for Embedded Systems**<br>RTOS concepts - Free RTOS - Scheduling - Queues - Semaphores - Mutexes - Priority inversion<br>**Practical Component:**<br>• Task Creation<br>• Multitasking scheduling<br>• simple queue communication<br>• Synchronize tasks using semaphore<br>• Protect shared resource using mutex | **6 Hours**<br>**12 Hours** |
| **SAFETY-CRITICAL EMBEDDED SYSTEMS AND EDGE AI**<br>Watchdog Timers- Power-On Self-Test (POST) - CRC and Data Integrity Techniques - MISRA-C:2012 Coding Standard - IEC 61508 SIL Concepts - Introduction to Edge AI - TensorFlow Lite Micro - Edge Impulse Workflow - Energy-Aware Machine Learning on MCUs<br>**Practical Component:**<br>• Watchdog timer implementation | **6 Hours**<br>**12 Hours** |



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| | |
|---|---|
| • Audio classification<br>• Gesture recognition<br>• Anomaly detection<br>• TinyML mini project | |

| Theory Hours: 30 | Tutorial Hours: | Practical Hours: 60 | Project Hours: | Total Hours: 90 |
|---|---|---|---|---|

**Learning Resources**

**Textbooks:**


1. Barry, Richard., *Mastering the FreeRTOS Real-Time Kernel*., Latest Edition, Real Time Engineers Ltd., United Kingdom (2021)
2. Amos, Brian., *Hands-On RTOS with Microcontrollers: Building Real-Time Embedded Systems using FreeRTOS, STM32 MCUs, and SEGGER Debug Tools*., Packt Publishing, Birmingham (2020)
3. Zhu, Yifeng., *Embedded Systems with ARM Cortex-M Microcontrollers in Assembly Language and C*., 4th Edition, E-Man Press LLC, California (2023)
4. Yiu, Joseph., *The Definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors*., 3rd Edition, Newnes, Oxford (2014)


**References:**


19. Valvano, Jonathan W., *Embedded Systems: Real-Time Interfacing to ARM Cortex-M Microcontrollers*., 3rd Edition, CreateSpace Independent Publishing, Texas (2021)
20. Noergaard, Tammy., *Embedded Systems Architecture: A Comprehensive Guide for Engineers and Programmers*., 2nd Edition, Elsevier, Burlington (2012).
21. White, Elecia., *Making Embedded Systems: Design Patterns for Great Software*., 2nd Edition, O'Reilly Media, Sebastopol (2024)
22. Marwedel, Peter., *Embedded System Design: Embedded Systems Foundations of Cyber-Physical Systems*., 4th Edition, Springer, Dordrecht (2021).
23. Gbati, Israel., *Bare-Metal Embedded C Programming: Develop High-Performance Embedded Systems with C for ARM Microcontrollers*., Packt Publishing, Birmingham (2024).


**Online Educational Resources:**

8. https://onlinecourses.nptel.ac.in/noc25_cs32/preview
9. https://www.st.com/content/st_com/en/support/learning/stm32-education/stm32-moocs.html
10. https://academy.nordicsemi.com/
11. https://www.freertos.org/Documentation/RTOS_book.html
12. https://docs.edgeimpulse.com/
13. https://www.tensorflow.org/lite/microcontrollers
14. https://docs.espressif.com/projects/esp-idf/en/latest/esp32/
15. https://docs.zephyrproject.org/latest/

**Assessment (Embedded course)**

SAT, Activity and Learning Task(s) , Mini project, MCQ, End Semester Examination (ESE)
Lab Workbook, Experimental Cycle tests, viva-voce, etc…



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| Course Curated by | | | |
|---|---|---|---|
| **Expert(s) from Industry** | **Expert(s) from Higher Education Institution** | | **Internal Expert(s)** |
| [Name, Organization] | [Name, Institution] | | Dr.I.JEYA DAISY<br>Electronics and Instrumentation Engineering |
| **Recommended by BoS on** | XX/YY/2026 | | |
| **Academic Council Approval** | No. | **Date** | XX/YY/2024 |



BoS Chair

| 24EII303 | CONTROL ENGINEERING | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 0 | 4 |
| PC | | SDG | 7, 9, 12 | | | |

| Pre-requisite courses | 24EII201, 24EII204 | Data Book / Code book (If any) | -- |
|---|---|---|---|

| Course Objectives: | |
|---|---|
| The purpose of taking this course is to: | |
| 1 | Acquire the fundamental principles of classical and modern control systems, including mathematical modelling of physical systems, block diagram and signal-flow graph representations, time- and frequency-domain analysis, stability concepts, and state-space methods. |
| 2 | Develop the ability to model, analyse, simplify, evaluate, and design control systems using classical and modern control techniques, supported by MATLAB-based simulation and performance assessment. |
| 3 | Demonstrate competency in designing and validating stable, efficient, and reliable control systems for real-world engineering applications by integrating modelling, analysis, controller design, and simulation tools. |

| Course Outcomes | | |
|---|---|---|
| After successful completion of this course, the students shall be able to | | RBT |
| CO 1 | Determine the overall transfer function of interconnected systems using block-diagram reduction and signal-flow-graph (Mason's gain formula) techniques. | Ap |
| CO 2 | Analyse the transient and steady-state response of first- and second-order systems and interpret time-domain specifications and error constants. | An |
| CO 3 | Assess the absolute and relative stability of linear systems using the Routh–Hurwitz criterion and the root-locus technique. | An |
| CO 4 | Analyse system stability and performance in the frequency domain using Bode and Nyquist methods and design lead, lag and lead-lag compensators. | An |
| CO 5 | Develop state-space models of linear systems and evaluate controllability, observability and state-feedback / observer-based design. | Ap |
| CO 6 | Determine the overall transfer function of interconnected systems using block-diagram reduction and signal-flow-graph (Mason's gain formula) techniques. | Ap |



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| Course Outcomes (CO) | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | |
| | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 |
| **1** | 3 | 2 | | | 2 | 1 | | | | | | 3 | |
| **2** | 3 | 3 | | 2 | 2 | | | | | | | 3 | |
| **3** | 3 | 3 | | 2 | 3 | 2 | | | | | | 3 | |
| **4** | 3 | 3 | 3 | 3 | 3 | 2 | | | | | 1 | 3 | 1 |
| **5** | 3 | 3 | 3 | 2 | 3 | | | | | | 2 | 3 | 2 |
| **6** | 3 | 3 | 2 | 3 | 3 | 2 | 1 | 2 | 1 | 1 | 2 | 3 | 2 |



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| Course Content | |
|---|---|
| **MATHEMATICAL MODELLING OF DYNAMIC SYSTEMS**<br>• Open loop and closed loop systems;<br>• Modelling of mechanical, electrical, thermal, electromechancial systems; transfer functions<br>**Practical Component:**<br>• MATLAB simulation: Modelling of Electric Vehicle Cruise Control System.<br>• Derivation and validation of transfer function for a spring-mass-damper system. | **7 Hours**<br><br>**6 Hours** |
| **BLOCK DIAGRAM ALGEBRA AND SIGNAL FLOW GRAPHS**<br>• Block diagram reduction; signal flow graph (SFG); Mason's gain formula<br>• Multi-loop systems; aircraft pitch control model<br>**Practical Component:**<br>• MATLAB simulation: Block diagram reduction and SFG analysis for an Aircraft Pitch Control System. | **6 Hours**<br><br>**3 Hours** |
| **TIME DOMAIN ANALYSIS OF CONTROL SYSTEMS**<br>• Standard test signals; first and second order system response; time domain specifications<br>• Steady-state errors and error constants; generalised error constants<br>• Disturbance rejection analysis: feed-forward vs feedback; sensitivity and complementary sensitivity functions<br>**Practical Component:**<br>• MATLAB simulation: step(), impulse(), lsim() commands; stepinfo() for time response & time domain specifications | **6 Hours**<br><br>**3 Hours** |
| **STABILITY ANALYSIS**<br>Concept of stability – Routh-Hurwitz stability criterion – Root locus technique – Rules for construction of root locus – Effect of addition of poles and zeros – Introduction to Maglev Train control.<br>**Practical Component:**<br>• MATLAB simulation: Root locus plot for Magnetic Levitation System.<br>• Stability check of temperature regulation in a chemical reactor using Routh Array. | **8 Hours**<br><br>**6 Hours** |
| **FREQUENCY DOMAIN ANALYSIS**<br>Bode plot construction and stability analysis – Polar plot and Nyquist stability criterion – Frequency response specifications and analysis.<br>**Practical Component:**<br>• MATLAB simulation: Stability Analysis using Bode Plot for Smart Grid Frequency Response.<br>• Nyquist Stability Verification for Industrial Flow Control System. | **8 Hours**<br><br>**6 Hours** |
| **COMPENSATOR DESIGN**<br>Lead, Lag, Lead-Lag compensator design using Bode Plot.<br>**Practical Component:**<br>• Design and Implementation of Control Systems for Engineering Applications | **3 Hours**<br><br>**3 Hours** |
| **STATE SPACE ANALYSIS AND DESIGN**<br>State space formulation-state model of linear system-state diagram-state space representation using physical variable-, phase variable, canonical variable-Solution of state equations using Laplace Transform-Concepts of controllability and observability - State Space Design ; Introduction to state feedback and observer based feedback design.<br>**Practical Component:**<br>• State-Space Design and Analysis in Electronic Systems | **7 Hours**<br><br>**3 Hours** |



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| Theory Hours: 45 | Tutorial Hours: 0 | Practical Hours: 30 | Project Hours: 0 | Total Hours: 75 |
|---|---|---|---|---|

**Learning Resources**

**Textbooks:**


1. N. S. Nise, *Control Systems Engineering*, 8th ed. New Delhi, India: Wiley India Pvt. Ltd., 2020.
2. K. Ogata, *Modern Control Engineering*, 5th ed. New Delhi, India: Pearson Education, 2010.
3. B. C. Kuo, *Automatic Control Systems*, 10th ed. New Delhi, India: McGraw Hill Education, 2017.


**References:**


1. M. Gopal, *Control Systems: Principles and Design*, 5th ed. New Delhi, India: McGraw Hill Education, 2023.
2. R. C. Dorf and R. H. Bishop, *Modern Control Systems*, 13th ed. New Delhi, India: Pearson Education, 2020.
3. K. J. Åström and R. M. Murray, *Feedback Systems: An Introduction for Scientists and Engineers*. Princeton, NJ, USA: Princeton University Press, 2021.


**Online Educational Resources:**

1. Massachusetts Institute of Technology, "Feedback Systems," MIT OpenCourseWare. [Online]. Available: https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-302-feedback-systems-fall-2007/
2. NPTEL, "Control Systems," IIT Kharagpur. [Online]. https://nptel.ac.in/courses/108/106/108106098/
3. MathWorks, "Control System Toolbox Documentation." [Online]. https://www.mathworks.com/help/control/
4. Electrical4U – Control Systems Concepts *(Quick conceptual explanations for revision)* https://www.electrical4u.com/control-system/

**Interactive & Visual Learning Platforms**

- YouTube – Brian Douglas (Control Systems Series) ***(Best conceptual explanations for control theory)*** https://www.youtube.com/c/BrianBDouglas
- YouTube – Neso Academy (Control Systems) ***(Structured lecture-style videos)*** https://www.youtube.com/c/NesoAcademy
- Khan Academy (Math Foundations for Control) ***(Strengthens prerequisite math concepts)*** https://www.khanacademy.org/math

**Assessment (Embedded course)**

SA, Activity and Learning Tasks, Mini project, MCQ, End Semester Examination (ESE)

Lab Workbook, Experimental Cycle Tests, Viva-voce



BoS Chair

| Course Curated by | | | |
|---|---|---|---|
| **Expert(s) from Industry** | **Expert(s) from Higher Education Institution** | | **Internal Expert(s)** |
| Mr. R. Suresh<br>Senior Technical Lead– Research on Electric Vehicle,<br>Bosch Global Software Technologies Private Limited | Prof. S. Rajendran<br>Associate Teaching Professor<br>Electrical Engineering<br>IIT-Gandhinagar | | Dr. P.S. Mayurappriyan<br>Professor<br>Department of E&I |
| **Recommended by BoS on** | /YY/2026 | | |
| **Academic Council Approval** | No. | **Date** | XX/YY/2026 |



BoS Chair

| 24EII304 | Data Structures & Algorithms for Intelligent Systems | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 2 | 0 | 2 | 0 | 3 |
| PC | | SDG | 9,4,12 | | | |

| Pre-requisite courses | 24CSI103 | Data Book / Code book (If any) | • Standard **Time and Space Complexity Tables (Big-O, Ω, Θ)**<br>• Sorting and searching complexity comparison charts |
|---|---|---|---|

| **Course Objectives:** | |
|---|---|
| The purpose of taking this course is to: | |
| 1 | understand data structures, algorithms, and OOP concepts for computational and instrumentation systems. |
| 2 | develop analytical and programming capabilities for structured and real-time data problems. |
| 3 | design efficient, scalable, and resource-aware engineering solutions. |

| **Course Outcomes** | | |
|---|---|---|
| After successful completion of this course, the students shall be able to | | **Revised Bloom's Taxonomy Levels (RBT)** |
| CO 1 | explain DS, algorithms, and OOP principles | U |
| CO 2 | apply DS for structured and streaming data | Ap |
| CO 3 | analyze algorithm efficiency and scalability | An |
| CO 4 | design modular OOP-based systems | Ap |
| CO 5 | analyze and compare data structures and algorithms for suitability in different problem contexts | An |
| Co6 | analyze problem requirements and select appropriate data structures and algorithms for efficient implementation | |

| Course Outcomes (CO) | **Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)** | | | | | | | | | | | **Program Specific Outcomes (PSO)** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **PSO1** | **PSO2** |
| | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 |
| 1 | 3 | 2 | | | 2 | 2 | | | | | 2 | 2 | 1 |
| 2 | 3 | 3 | 2 | | 3 | 2 | | 2 | 2 | | 2 | | 2 |
| 3 | 3 | 3 | | 2 | 2 | 3 | | | | | 2 | 3 | 2 |
| 4 | 3 | 2 | 3 | | 3 | 2 | | 2 | 2 | | 2 | 2 | 3 |
| 5 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | | | | 3 | 3 | 2 |
| 6 | 3 | 3 | 2 | 2 | 3 | 3 | | 2 | | | 3 | 3 | 3 |



BoS Chair

| Course Content | |
|---|---|
| **COMPUTATIONAL THINKING & DATA HANDLING**<br>Algorithm fundamentals, ADT, asymptotic analysis (Big-O, Ω, Θ) - Growth of functions and scalability - Real-time data characteristics in engineering Data: Sensor data , Time series Data, Streaming data, Time stamp, sampling rate handling, missing data concepts and handling; outlier identification concepts; Algorithm selection for embedded and industrial systems<br>Data types and structures: Python list / dict / set vs C++ array / struct / STL<br><br>**Embedded Practice & Application**<br>• Compare iterative vs recursive approaches<br>• Analyze complexity (best/average/worst case)<br>• Simulate streaming datasets<br>**Exploratory Exercises:** Compare brute-force vs optimized methods<br>**Mini Application Task:** Sensor anomaly detection and trend analysis. | **06 Hours**<br><br>**06 Hours** |
| **LINEAR DATA STRUCTURES**<br>**Arrays:** prefix sums, sliding window, ring buffer for sensor streams; **Linked Lists**: SLL, DLL, Dynamic memory Concepts, circular - Memory optimization strategies , Circular buffers for sensor acquisition; Data logging systems; Time-series windowing techniques; Rolling average computation<br><br>**Embedded Practice & Application**<br>• Implement dynamic and static data handling<br>• Solving subarray and traversal problems<br>**Exploratory Exercises:** Trade-offs in memory vs performance<br>**Mini Application Task;** Continuous data logging system | **06 Hours**<br><br>**06 Hours** |
| **STACKS & QUEUES**<br>Stack, queue, circular queue - Deque and priority queue (intro) -Applications in scheduling and buffering: Event Scheduling-Alarm management -Real-time buffering-Task prioritization<br><br>Language note: Python deque (collections) ↔ C++ std::deque / std::queue / std:stack<br><br>**Embedded Practice & Application**<br>• Expression evaluation<br>• Sliding window problems<br>• Scheduling simulation<br>**Exploratory Exercises:** Model real-time buffering systems<br>**Mini Application Task:** Task scheduling & buffering system/PLC event queue simulation | **06 Hours**<br><br>**06 Hours** |
| **OBJECT-ORIENTED PROGRAMMING**<br>Classes, encapsulation - Inheritance, polymorphism, abstraction - Graph representation, BFS, DFS, Shortest path concepts, Modular system design- Industrial network topology modeling- WirelessHART networks -Industrial Ethernet topology- Sensor network routing<br><br>Language note: Python networkx (optional) or dict-based graph ↔ C++ adjacency list with STL vectors<br><br>**Embedded Practice & Application**<br>• OOP-based sensor system modeling.<br>• BFS and DFS implementation. | **06 Hours**<br><br>**06 Hours** |

| | |
|---|---|
| • Shortest-path analysis in industrial network<br>• **Exploratory Exercises:** Compare modular vs monolithic systems<br>**Mini Application Task:** Multi-component system simulation / Industrial communication network analysis. | |
| **SEARCHING, SORTING & OPTIMIZATION**<br>Searching: linear, binary - Sorting: merge, quick, selection - Greedy algorithms (intro), Sliding window algorithms, Change-point detection concepts, Anomaly detection fundamentals, Streaming analytics concepts, Resource-aware algorithms<br><br>Language note: Python pandas resample / rolling ↔ C++ manual sliding window on raw arrays<br><br>**Embedded Practice & Application**<br>• Solve searching and sorting problems<br>• Performance benchmarking<br>• Sliding-window processing of sensor streams.<br>• Time-series trend analysis.<br>**Exploratory Exercises:** Algorithm trade-offs under constraints<br>**Mini Application Task:** Data analysis and anomaly detection system/ Sensor anomaly detection and trend analysis. | **06 Hours**<br><br>**06 Hours** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Theory Hours:** | **30** | **Tutorial Hours:** | **Practical Hours:** | **30** | **Project Hours:** | **Total Hours:** | **60** |

**Learning Resources**

**Textbooks:**


1. Cormen, Thomas H., Leiserson, Charles E., Rivest, Ronald L., and Stein, Clifford., *Introduction to Algorithms.*, **4th ed.**, MIT Press, Cambridge, MA (2022).
2. Balagurusamy, E., *Object Oriented Programming with C++.*, **8th ed.**, McGraw Hill Education, New Delhi (2020).


**References:**


1. Weiss, Mark Allen., *Data Structures and Algorithm Analysis in C++.*, **4th ed.**, Pearson Education, Boston (2014). *(Latest widely used academic edition)*
2. Goodrich, Michael T., Tamassia, Roberto., and Goldwasser, Michael H., *Data Structures and Algorithms in Python.*, **2nd ed.**, Wiley, Hoboken (2023).
3. Stroustrup, Bjarne., *Programming: Principles and Practice Using C++.*, **3rd ed.**, Addison-Wesley, Boston (2021).
4. Stroustrup, Bjarne., "Classes and Objects.", *The C++ Programming Language.*, **4th ed.**, Addison-Wesley, Boston (2013): pp. 45–120.
5. Mittal, Sparsh., "A Survey of Techniques for Improving Energy Efficiency in Embedded Computing Systems.", Technical Report, Iowa State University, USA (2014).
6. Gubbi, Jayavardhana., Buyya, Rajkumar., Marusic, Slaven., and Palaniswami, Marimuthu., "Internet of Things (IoT): A Vision, Architectural Elements, and Future Directions.", *Future Generation Computer Systems*, Vol. 29 No. 7 (2013): pp. 1645–1660. DOI: 10.1016/j.future.2013.01.010,
7. Dean, Jeffrey., and Ghemawat, Sanjay., "MapReduce: Simplified Data Processing on Large Clusters.", Proceedings of the 6th Symposium on Operating Systems Design and Implementation (OSDI)., San Francisco, USA (2004): pp. 137–150. DOI: 10.1145/1327452.1327492


**Online Educational Resources:**

1. **NPTEL – Data Structures and Algorithms**
   Provides comprehensive lecture series covering data structures, algorithm analysis, and problem-solving techniques.



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https://nptel.ac.in/courses/106105085

2. **SWAYAM – Programming and Algorithm Courses**
   Offers curriculum-aligned courses on programming, data structures, and embedded systems
   https://swayam.gov.in
3. **GeeksforGeeks – Data Structures & Algorithms**
   Structured tutorials, explanations, and examples for all core topics including arrays, linked lists, stacks, queues, and sorting algorithms.
   https://www.geeksforgeeks.org
4. **Programiz – Programming & OOP Concepts**
   Beginner-friendly explanations for programming and object-oriented concepts.
   https://www.programiz.com
5. **LeetCode – Algorithmic Problem Solving**
   Collection of structured problems covering arrays, linked lists, stacks, queues, searching, and sorting.
   https://leetcode.com
6. **HackerRank – Coding Practice & Skill Development** Practice problems and structured tracks for data structures and algorithms.
   https://www.hackerrank.com
7. **VisuAlgo – Interactive Algorithm Visualization**
   Visual representation of data structures and algorithms such as sorting, searching, graphs, stacks, and queues.
   https://visualgo.net
8. **Python Tutor – Code Execution Visualization**
   Step-by-step visualization of code execution for better understanding of logic and memory usage
   https://pythontutor.com
9. **Abdul Bari – Data Structures & Algorithms**
   Concept-focused explanations of algorithms and complexity analysis.
   https://www.youtube.com/c/AbdulBari
10. **FreeCodeCamp – Full DSA Courses**
    Long-form tutorials covering complete data structures and programming concepts.
    https://www.youtube.com/c/Freecodecamp

| **Assessment (Embedded course)** |
|---|
| SA, Activity and Learning Task(s) , Mini project, MCQ, End Semester Examination (ESE)<br>Lab Workbook, Experimental Cycle tests, viva-voce, etc… |

| **Course Curated by** | | | |
|---|---|---|---|
| **Expert(s) from Industry** | **Expert(s) from Higher Education Institution** | **Internal Expert(s)** | |
| [Name, Organization] | [Name, Institution] | | |
| **Recommended by BoS on** | XX/YY/2026 | | |
| **Academic Council Approval** | No. | **Date** | XX/YY/2026 |



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| 24EIJ204 | INTERNSHIP-2/MINI PROJECT-2 | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 0 | 0 | 0 | 4 | 2 |
| PRJ | | SDG | 4,8,9,11,17 | | | |

| Pre-requisite courses | - | Data Book / Code book (If any) | |
|---|---|---|---|

| Course Objectives: | |
|---|---|
| The purpose of taking this course is to: | |
| 1 | enable students to undertake industry, research or innovation-oriented mini projects addressing practical engineering problems. |
| 2 | develop competencies in problem identification, design, implementation and validation of engineering solutions. |
| 3 | foster innovation, entrepreneurship, sustainability and Industry 4.0 readiness. |
| 4 | strengthen project management, teamwork and technical communication skills. |
| 5 | prepare students for major projects, internships and professional careers. |

| Course Outcomes | | |
|---|---|---|
| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
| CO 1 | analyze engineering problems and define project objectives, constraints and success criteria. | An |
| CO 2 | design and plan appropriate technical solutions using engineering tools and methodologies. | C |
| CO 3 | develop and implement a functional prototype, model, software application or process solution. | Ap |
| CO 4 | evaluate project outcomes through testing, validation and performance analysis. | Ev |
| CO 5 | communicate project outcomes through professional reports, demonstrations and presentations. | C |

| Course Outcomes (CO) | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | |
| | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 |
| 1 | 2 | 3 | 2 | 2 | 2 | | | 2 | 2 | 2 | 2 | 3 | 2 |
| 2 | 2 | 3 | 3 | 2 | 2 | | | 2 | 2 | 3 | 2 | 3 | 2 |
| 3 | 2 | 3 | 3 | 2 | 3 | | | 2 | 2 | 2 | | 3 | 2 |
| 4 | 2 | 3 | 2 | 3 | 2 | | | 2 | | 2 | 2 | 2 | 2 |
| 5 | | | | | | 2 | 2 | 2 | 3 | 3 | 3 | | 2 |



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| Course Content | |
|---|---|
| **PROJECT INITIATION & PROBLEM FORMULATION**<br>• Problem identification.<br>• Need analysis.<br>• Literature survey.<br>• Benchmarking existing solutions.<br>• Objective formulation.<br>**Practical Component**<br>• Proposal preparation.<br>• Review-I. | **6 J Hours** |
| **DESIGN & PROJECT PLANNING**<br>• System architecture.<br>• Hardware/software selection.<br>• Design methodology.<br>• Risk assessment.<br>• Project scheduling.<br>**Practical Component**<br>• Design document.<br>• Block diagrams.<br>• Project plan. | **10 J Hours** |
| **IMPLEMENTATION & PROTOTYPING**<br>• Hardware development.<br>• Software development.<br>• Integration.<br>• Simulation and modelling.<br>• Prototype realization.<br>**Practical Component**<br>• Prototype/model development.<br>• Weekly reviews. | **24 J Hours** |
| **TESTING, VALIDATION & OPTIMIZATION**.<br>• Functional testing.<br>• Performance evaluation.<br>• Data analysis.<br>• Reliability considerations.<br>• Sustainability assessment.<br>**Practical Component**<br>• Testing reports.<br>• Review-II. | **12 J Hours** |
| **DOCUMENTATION & DISSEMINATION**<br>• Technical report writing.<br>• Poster preparation.<br>• Demonstration.<br>• Technical paper preparation.<br>• Project showcase.<br>**Practical Component**<br>• Final report.<br>• Presentation and viva. | **8 Hours** |

| Theory Hours: | Tutorial Hours: | Practical Hours: | Project Hours: 60 | Total Hours: 60 |
|---|---|---|---|---|



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**Learning Resources**

**References:**


1. Ulrich, Karl T. and Eppinger, Steven D., *Product Design and Development*, 7th ed., McGraw-Hill Education, New York (2023).
2. Pahl, Gerhard., Beitz, Wolfgang., Feldhusen, Jörg and Grote, Karl-Heinrich., *Engineering Design: A Systematic Approach*, 4th ed., Springer, London (2023).
3. Kerzner, Harold., *Project Management: A Systems Approach to Planning, Scheduling and Controlling*, 13th ed., Wiley, Hoboken (2022).
4. PMI., *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*, 7th ed., Project Management Institute, Pennsylvania (2021).
5. Baxter, Mike., *Product Design: A Practical Guide to Systematic Methods of New Product Development*, CRC Press, Boca Raton (2018).
6. Cross, Nigel., *Design Thinking: Understanding How Designers Think and Work*, 2nd ed., Bloomsbury Publishing, London (2021).
7. Rajkamal., *Internet of Things: Architecture and Design Principles*, McGraw-Hill Education, New Delhi (2023).
8. Groover, Mikell P., *Automation, Production Systems and Computer-Integrated Manufacturing*, 5th ed., Pearson Education, New York (2023).


**Online Educational Resources:**

**Project Management**

- Project Management Institute (PMI)
  https://www.pmi.org
- PMI Learning Resources
  https://www.pmi.org/learning

**Engineering Design and Innovation**

- MIT OpenCourseWare – Engineering Design
  https://ocw.mit.edu
- Stanford d.school – Design Thinking Resources
  https://dschool.stanford.edu/resources

**Industry 4.0 and Industrial IoT**

- Industrial Internet Consortium
  Website: https://www.iiconsortium.org
- Siemens Digital Industries
  Website: https://www.siemens.com/global/en/products/automation.html

**Instrumentation and Automation**

- Instrumentation Tools
  https://instrumentationtools.com
- RealPars Industrial Automation Learning
  https://www.realpars.com

**MOOCs and Certification Platforms**

- NPTEL
  https://nptel.ac.in
- SWAYAM
  https://swayam.gov.in
- Coursera
  https://www.coursera.org

| **Assessment (Internship/Project course)** | |
|---|---|
| Project Proposal & Review-I/Mid Review | 10% |
| Design Review | 10% |



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| | |
|---|---|
| Implementation & Progress Reviews | 20% |
| Demonstration & Validation | 15% |
| Final Report | 15% |
| Poster/Paper Presentation | 15% |
| Log Book | 15% |

| **Course Curated by** | | | |
|---|---|---|---|
| **Expert(s) from Industry** | **Expert(s) from Higher Education Institution** | **Internal Expert(s)** | |
| [Name, Organization] | [Name, Institution] | 1. **Dr. Dinesh Kumar V** Associate Professor & Head, E&I, KCT<br>2. **Umesh M V** Associate Professor, E&I, KCT | |
| **Recommended by BoS on** | XX/YY/2026 | | |
| **Academic Council Approval** | No. | **Date** | XX/YY/2026 |



BoS Chair

# SIXTH SEMETSER



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| 24EII306 | Industrial Automation | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 0 | 4 |
| PC | | SDG | 4, 8, 9, 12 | | | |

| Pre-requisite courses | 24CSI103,24EII202, 24MAI203/233, 24EII201 | Data Book / Code book (If any) | • IEC 61131-3 Standard<br>• ISO 50001:2018<br>• ISA-95 / ISA-88 Standards<br>• OPC-UA Specifications |
|---|---|---|---|

| Course Objectives: | |
|---|---|
| The purpose of taking this course is to: | |
| 1 | To develop expertise in advanced PLC programming and industrial control system design based on IEC standards. |
| 2 | To understand and implement industrial communication networks and supervisory systems (HMI, SCADA, DCS), including real-time concepts such as latency and determinism. |
| 3 | To analyze and apply industrial drives, motion control, and smart manufacturing concepts, including IIoT and system integration. |

| Course Outcomes | | |
|---|---|---|
| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
| CO 1 | Explain the principles of advanced PLC programming and industrial automation systems based on IEC standards. | U |
| CO 2 | Develop and implement PLC programs using LD, FBD, ST, and SFC for industrial control applications. | Ap |
| CO 3 | Design and configure industrial communication networks, including protocols and real-time concepts such as latency and determinism. | Ap |
| CO 4 | Analyze and interpret HMI, SCADA, and DCS architectures for effective monitoring and supervisory control. | An |
| CO 5 | Implement and evaluate industrial drives and motion control systems for precise machine operation. | Ap |
| CO 6 | Examine and integrate smart manufacturing concepts (IIoT, data acquisition, system integration) in industrial automation systems. | An |

| Course Outcomes (CO) | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | PSO1 | PSO2 |
| | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 |
| 1 | 3 | 2 | – | – | 2 | – | – | – | – | – | 1 | 2 | 3 |
| 2 | 3 | 2 | 3 | – | 3 | – | – | – | – | – | 1 | 2 | 3 |
| 3 | 2 | 3 | 2 | – | 3 | – | – | – | – | – | 1 | 2 | 3 |



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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 2 | 3 | 2 | 2 | 2 | – | – | – | – | – | 1 | 2 | 3 |
| 5 | 3 | 2 | 3 | – | 3 | – | – | – | – | – | 1 | 2 | 3 |
| 6 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | – | – | – | 2 | 3 | 3 |

## Course Content

| | |
|---|---|
| **ADVANCED PLC SYSTEMS & CONTROL LOGIC**<br>PLC Architecture and IEC 61131-3 programming standards – Advanced programming languages – Ladder Digram (LD), Function Block Diagram (FBD), Structured Text (ST) – Memory mapping and addressing – Sequential Function Charts (SFC) – Fault diagnostics and debugging – Safety PLC concepts<br>**Practical Component:**<br>• Design and Implementation of Advanced PLC Control Logic Using Timers and Counters (Siemens S7-1200/1500)<br>• Design and Implementation of PLC-Based Sequential Control for Conveyor System with Forward and Reverse Operation<br>• Development of Interlocking and Safety Control Logic for Motor Protection Using PLC | **9 Hours**<br><br>**6 Hours** |
| **INDUSTRIAL COMMUNICATION & NETWORKING**<br>Industrial communication architecture – Real-time communication concepts (**latency, determinism and jitter**) – Communication protocols: Modbus RTU/TCP, Profibus/Profinet, EtherNet/IP – PLC-to-PLC communication – OPC-UA basics – Fieldbus vs Industrial Ethernet – Network design and troubleshooting – Cybersecurity in industrial networks<br>**Practical Component:**<br>• Implementation of PLC-to-PLC Communication Using PROFINET (Siemens S7-1200 and S7-1500)<br>• Design and Implementation of Modbus RTU Communication with Delta VFD Using RS485<br>• Configuration and Implementation of Ethernet/TCP Communication Between PLC and SCADA System<br>• Integration of Siemens PLC with LabVIEW Using OPC Server for Industrial Data Communication. | **9 Hours**<br><br>**6 Hours** |
| **HMI, SCADA & DISTRIBUTED CONTROL SYSTEM**<br>HMI Screen development principles, PLC and HMI interfacing methods, SCADA Architecture and design, Tag database and data acquisition, alarm management and trends – Distribution control System (DCS) architecture- PLC Vs SCADA Vs DCS<br>**Practical Component:**<br>• Design and Implementation of HMI Interface with Siemens PLC Using TIA Portal<br>• Development of SCADA System with Alarm and Trend Configuration for Level Process Plant<br>• Design and Implementation of SCADA-Based Supervisory Control for a Pressure Process Plant | **9Hours**<br><br>**6 Hours** |
| **INDUSTRIAL DRIVES & MOTION CONTROL**<br>Electrical Drives overview – Variable Frequency Drives (VFD), Scalar and Vector control – Servo drive fundamentals – closed loop motion control – position and speed control system – integration of drives with PLC. | **9 Hours**<br><br>**6 Hours** |



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| | |
|---|---|
| **Practical Component:**<br>• Design and Implementation of Speed Control for AC Induction Motor Using Delta VFD (Local and PLC-Based Control)<br>• Development of PLC-Based Motor Control System for Forward/Reverse Operation and Speed Variation Using VFD<br>• Implementation of Stepper Motor Control Using PLC-Based Pulse Control Technique<br>• Design and Implementation of Servo Motor Position Control Using PLC | |
| **SMART MANUFACTURING & INDUSTRIA INTEGRATION**<br>Industrial Internet of Things (IIoT) – Data Acquisition and cloud integration – Edge computing in automation – Digital Manufacturing Concepts – Predictive maintenance basics – Energy monitoring and optimization.<br>**Practical Component:**<br>• Design and Implementation of PLC-Based Sequential Control for Pneumatic Systems<br>• Development of IIoT-Based Monitoring System Using Ethernet Communication and SCADA for Data Acquisition | **9 Hours**<br><br>**6 Hours** |

| **Theory Hours:** | **45** | **Tutorial Hours:** | **0** | **Practical Hours:** | **30** | **Project Hours:** | **Total Hours:** | **75** |
|---|---|---|---|---|---|---|---|---|

**Learning Resources**

**Textbooks:**


1. Bolton, W. (2021). *Programmable logic controllers* (7th ed.). Newnes.
2. Groover, M. P. (2020). *Automation, production systems, and computer-integrated manufacturing* (4th ed.). Pearson Education.


**References:**


24. Petruzella, F. D. (2022). *Programmable logic controllers* (5th ed.). McGraw-Hill Education.
25. Webb, J. W., & Reis, R. A. (2019). *Programmable logic controllers: Principles and applications* (6th ed.). Pearson.
26. Boucher, T. O. (2018). *Computer automation in manufacturing: An introduction*. Springer.
27. Thomesse, J.-P. (2005). *Fieldbus technology in industrial automation*. IEEE Press.
28. Berger, H. (2018). *Automating with SIMATIC S7-1500 and TIA Portal*. Publicis Publishing.
29. Parr, E. A. (2011). Programmable controllers: An engineer's guide (3rd ed.). Newnes.
30. Nise, N. S. (2019). Control systems engineering (8th ed.). Wiley.
31. Schwab, K. (2016). The fourth industrial revolution. World Economic Forum.
32. International Organization for Standardization. (2018). ISO 50001:2018 energy management systems — Requirements with guidance for use. https://www.iso.org
33. International Electrotechnical Commission. (2013). IEC 61131-3: Programming languages for programmable controllers. https://www.iec.ch


**Online Educational Resources:**


5. National Programme on Technology Enhanced Learning (NPTEL). (2023). *Industrial automation and control*. https://nptel.ac.in
6. Siemens AG. (2024). *Siemens automation training and PLC learning portal*. https://www.siemens.com/automation
7. Rockwell Automation. (2024). *Automation university training resources*. https://www.rockwellautomation.com




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8. Factory I/O. (2024). *Industrial automation simulation software*. https://factoryio.com
9. MathWorks. (2024). *PLC and industrial automation solutions using MATLAB & Simulink*. https://www.mathworks.com

| **Assessment (Embedded course)** |
|---|
| SA, Activity and Learning Task(s) , Mini project, MCQ, End Semester Examination (ESE) Lab Workbook, Experimental Cycle tests, viva-voce, etc… |

| **Course Curated by** | | | |
|---|---|---|---|
| **Expert(s) from Industry** | **Expert(s) from Higher Education Institution** | | **Internal Expert(s)** |
| [Name, Organization] | [Name, Institution] | | Ranganathan S |
| **Recommended by BoS on** | XX/YY/2026 | | |
| **Academic Council Approval** | No. | **Date** | XX/YY/2026 |



BoS Chair

| 24EEI308<br>PC | VLSI DESIGN | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 2 | 0 | 2 | 0 | 3 |
| | | SDG | 9, 12,13 | | | |

| Pre-requisite courses | 24ECI102(24EII101, 24EII201),24EEI203 | Data Book / Code book (If any) | - |
|---|---|---|---|

| Course Objectives: | |
|---|---|
| The purpose of taking this course is to: | |
| 1 | Understand CMOS technology and fabrication processes |
| 2 | Analyze digital circuits at transistor level |
| 3 | Design combinational and sequential circuits using VLSI principles |
| 4 | Implement digital systems using HDL tools |
| 5 | Develop optimized VLSI designs for real-world applications |

| Course Outcomes | | |
|---|---|---|
| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
| CO1 | Explain VLSI design flow and CMOS fabrication process | U |
| CO2 | Analyze CMOS logic circuits and timing characteristics | An |
| CO3 | Design combinational and sequential circuits using VLSI principles | C |
| CO4 | Implement digital systems using HDL (Verilog/VHDEL) tools | Ap |
| CO5 | Evaluate VLSI design performance in terms of area, power and delay | E |
| CO6 | analyze and validate VLSI system performance using simulation, layout verification, and FPGA implementation. | An |

| Course Outcomes (CO) | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | | |
| | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 | PSO-3 |
| 1 | 3 | 2 | - | - | - | - | - | - | - | - | - | | - | |
| 2 | 3 | 3 | 2 | 2 | 2 | - | - | - | - | - | - | - | - | |
| 3 | 3 | 2 | 3 | - | 2 | - | - | - | - | - | - | - | - | |
| 4 | 3 | 2 | 2 | 2 | 3 | 1 | - | - | 2 | - | - | - | - | |
| 5 | 3 | 3 | 3 | 3 | 2 | 1 | - | - | - | - | 3 | - | - | |
| 6 | 3 | 3 | 2 | 3 | 3 | 1 | - | - | - | - | 2 | - | - | |



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| Content | |
|---|---|
| **CMOS TECHNOLOGY AND LOGIC DESIGN**<br>Introduction to VLSI design, Moore's law, VLSI design flow, IC fabrication process (oxidation, diffusion, lithography), CMOS technology, MOS transistor operation, CMOS inverter characteristics, noise margins, power dissipation, stick diagrams, layout design rules<br>**Practical Component:**<br>• Introduction to EDA tools (Cadence / Tanner / LTSPICE/ Microwind)<br>• CMOS inverter design and simulation<br>• Layout design of inverter and NAND/NOR gates<br>• Verification of layout using DRC and LVS | **10 Hrs**<br><br>**3 Hrs** |
| **COMBINATIONAL AND SEQUENTIAL CIRCUITS DESIGN**<br>Static CMOS, pseudo-NMOS logic, pass transistor logic, transmission gate logic, dynamic CMOS logic, clocked CMOS logic, combinational circuits: basic gates, adder, multiplier, sequential circuits: Static and dynamic flip-flops, registers, timing issues: setup, hold, clock skew.<br>**Practical Component:**<br>• Design and simulation of combinational circuits<br>• Implementation of adder circuits<br>• Design of flip-flops using CMOS<br>• Timing analysis of sequential circuits | **10 Hrs**<br><br>**10 Hrs** |
| **HDL-BASED DESIGN AND VLSI SYSTEM IMPLEMENTATION**<br>Hardware Description Languages (Verilog/VHDL), behavioral and structural modeling, RTL design, synthesis, FPGA-based design, testing and verification, introduction to ASIC design, performance metrics: area, power, delay optimization<br>**Practical Component:**<br>• Introduction to Verilog/VHDL programming<br>• Design of combinational circuits using HDL<br>• Sequential circuit implementation using HDL<br>• FPGA implementation (simulation and synthesis)<br>• Mini Project: VLSI system design (ALU / counter / controller) | **10 Hrs**<br><br>**10 Hrs** |

| Theory Hours:30 | Tutorial Hours: | Practical Hours:30 | Project Hours: | Total Hours: 60 |
|---|---|---|---|---|

| Learning Resources |
|---|
| **Textbooks:** |
| 1. Weste, Neil H.E., Harris, David., *CMOS VLSI Design: A Circuits and Systems Perspective*., 4th ed., Pearson Education, Boston (2011).<br>2. Pucknell, Douglas A., Eshraghian, Kamran., *Basic VLSI Design*., 3rd ed., Prentice Hall, New Delhi (2007). |
| **References:** |



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**Core Advanced References**


1. Rabaey, Jan M., Chandrakasan, Anantha., Nikolic, Borivoje., *Digital Integrated Circuits: A Design Perspective*., 2nd ed., Pearson Education, New Jersey (2003).
2. Kang, Sung-Mo., Leblebici, Yusuf., *CMOS Digital Integrated Circuits: Analysis and Design*., 4th ed., McGraw-Hill Education, New York (2021).


**Modern / Industry-Oriented References**


3. Baker, R. Jacob., *CMOS: Circuit Design, Layout, and Simulation*., 4th ed., Wiley-IEEE Press, Hoboken (2019).
4. Weste, Neil H.E., Harris, David., *CMOS VLSI Design*., 4th ed., Pearson, Boston (2011). *(for design-centric depth)*
5. Weste, Neil., "CMOS Inverter Design.", *Principles of CMOS VLSI Design*., Addison-Wesley, Boston (1993): pp. 45–78.


**IEEE / Research-Oriented Sources**


5. "IEEE Transactions on VLSI Systems.", IEEE, (Latest issues).
6. Chandrakasan, Anantha., Brodersen, Robert., *Low Power Digital CMOS Design*., Springer, New York (1995). *(Classic reference)*
7. Pedram, Massoud., "Power Minimization in IC Design.", *Proceedings of IEEE Design Automation Conference*., pp. 533–538., San Francisco, CA, June 1996., DOI: 10.1109/DAC.1996.545941
8. Smith, John., "VLSI Design Optimization Techniques.", Technical Report No. TR-2010-45., MIT, Cambridge, MA (2010).


***Optional***


9. Pedram, Massoud., Power Aware Design Methodologies., Springer (2020).
10. Kahng, Andrew B., et al., VLSI Physical Design: From Graph Partitioning to Timing Closure., Springer (2011).
11. Brown, David., "Low Power VLSI Design Techniques.", PhD Thesis., Stanford University, California (2015).


**Online Educational Resources:**

1. NPTEL: *Comprehensive Learning of CMOS VLSI Design and Fabrication Principles* https://nptel.ac.in/courses/117106092
2. NPTEL: *Advanced VLSI Design: CMOS Circuits, Timing Analysis, and Physical Design Concepts* https://onlinecourses.nptel.ac.in/noc25_ee106/preview
3. *Advanced Concepts in Microelectronics, VLSI Design, and Integrated Circuits*
4. https://ocw.mit.edu
5. Research Papers and Emerging Trends in VLSI Design, RTL Optimization, and Low-Power Circuits
   https://ieeexplore.ieee.org
6. *Structured Online Courses on Digital Electronics, HDL, and VLSI System Design* https://swayam.gov.in
7. Industry-Oriented Learning on VLSI Physical Design, Timing Analysis, and ASIC Design Flow https://www.vlsiuniverse.com
8. *Practical Tutorials on Verilog HDL, ASIC Design Flow, and Digital System Implementation* https://asic-world.com

| **Assessment (Embedded course)** |
|---|
| SA, Activity and Learning Task(s)* , Mini project, MCQ, End Semester Examination (ESE) Lab Workbook, Experimental Cycle tests, viva-voce, etc… |

*



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| Course Curated by | | | |
|---|---|---|---|
| **Expert(s) from Industry** | **Expert(s) from Higher Education Institution** | | **Internal Expert(s)** |
| [Name, Organization] | [Name, Institution] | | Dr. K.Paramasivam<br>Dr.V.Kandasamy |
| **Recommended by BoS on** | | | |
| **Academic Council Approval** | | **Date** | |



BoS Chair

| 24EII307 | PROCESS DYNAMICS AND CONTROL | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 0 | 4 |
| PC | | SDG | 9,12,7 | | | |

| Pre-requisite courses | 24MAI123,24EII202,24EII303 | Data Book / Code book (If any) | |
|---|---|---|---|

| Course Objectives: | |
|---|---|
| The purpose of taking this course is to: | |
| 1 | To impart knowledge in the design of process control systems and PID controller tuning for processes. |
| 2 | To familiarize the students with characteristics, selection and sizing of control valves. |
| 3 | To elaborate different types of control schemes such as cascade control, feed forward control and Model Based control schemes |

| Course Outcomes | | |
|---|---|---|
| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
| CO 1 | Explain the components of process control systems, interpret P&ID diagrams, and develop mathematical models (transfer functions) for simple and interacting processes such as STR/CSTR. | Ap |
| CO 2 | Apply different control strategies (ON-OFF, P, PI, PID) and evaluate their performance in servo and regulatory control applications. | Ap |
| CO 3 | Analyse controller performance using standard error criteria (IAE, ISE, ITAE) and apply appropriate tuning methods for PID controllers. | An |
| CO 4 | Analyse the characteristics and selection of final control elements such as control valves and actuators for safe and efficient industrial operation. | An |
| CO 5 | Apply advanced control strategies (cascade, ratio, feedforward, split range) and analyse their effectiveness in multivariable industrial processes. | An |
| CO 6 | Conduct experiments on real-time and simulated process control systems to identify dynamic parameters, tune controllers, analyse performance indices and document technical findings aligned with professional engineering practice. | An |

| Course Outcomes (CO) | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | |
| | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 |
| 1 | 3 | 2 | 2 | 1 | 2 | 1 | - | - | - | - | - | - | - |
| 2 | 3 | 2 | 2 | 2 | 2 | 1 | - | - | - | - | - | - | - |
| 3 | 3 | 3 | 2 | 2 | 2 | 1 | - | - | - | - | - | - | 1 |



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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 3 | 2 | 2 | 2 | 2 | 2 | - | - | - | - | - | 1 | 2 |
| 5 | 3 | 3 | 3 | 2 | 2 | 2 | - | - | - | - | - | 2 | 2 |
| 6 | 3 | 3 | 2 | 3 | 3 | 2 | 1 | - | 2 | 2 | 1 | 2 | 3 |

## Course Content

| | |
|---|---|
| **INTRODUCTION & PROCESS MODELLING**<br>Hardware Elements of Process Control Systems – Piping and Instrumentation Diagram -Instrument Terms and Symbols - Degrees of Freedom – Self-regulating processes – Modelling – Input Output Models and Transfer Functions – Examples – Stirred Tank Reactor (STR) - Continuous Stirred Tank Reactor (CSTR) - Interacting and Noninteracting processes. Importance in safe Industrial Operation<br><br>**Practical Component:**<br>• Step response of level/flow/Pressure/Temperature trainer,<br>• determination of process gain & time constant,<br>• simulation of first-order systems & Interacting and Noninteracting processes | **9 Hours**<br><br>**6 Hours** |
| **FEEDBACK CONTROL ACTIONS**<br>Servo & Regulatory Control – ON-OFF Control in Thermal Systems – Continuous Controller Modes: Proportional, Integral, Derivative. Composite Controller Modes: P-I, P-D, P-I-D Control actions, Integral wind-up.<br><br>**Practical Component:**<br>• Design & Implementation of ON/OFF and Proportional, P+I, P+I+D control using trainer<br>• Comparison of transient response of different processes. | **9 Hours**<br><br>**6 Hours** |
| **CONTROLLER TUNING**<br>Evaluation criteria - IAE, ISE, ITAE - PID Controller Tuning - Process Reaction Curve Method, Continuous Oscillation Method, Damped Oscillation Method.<br><br>**Practical Component:**<br>Simulation-based controller Tuning using different tuning methods. | **9 Hours**<br><br>**6 Hours** |
| **FINAL CONTROL ELEMENT**<br>Pneumatic and Electrical Actuators, Valve Positioners. Control Valve Types, Construction Details, Various Plug Characteristics. Valve Sizing - Selection of control valves. Inherent and Installed Valve Characteristics. Fail-safe operation, Cavitation and Flashing in Control Valves.<br><br>**Practical Component:**<br>• Real time analysis of different Control Valve Characteristics. | **9 Hours**<br><br>**6 Hours** |
| **ADVANCED PROCESS CONTROL STRATEGIES**<br>Cascade control, Ratio Control, Feed Forward Control, Split Range Control. Introduction to Multivariable Process Control & Model Predictive Control. Case Studies: Distillation Column, Boiler Drum Level. Applications in low-carbon industrial automation and emission reduction<br><br>**Practical Component:**<br>Performance study & analysis of Cascade Control, Ratio Control & Split Range Control. | **9 Hours**<br><br>**6 Hours** |
| | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Theory Hours:** | **45** | **Tutorial Hours:** | **0** | **Practical Hours:** | **30** | **Project Hours:** | **0** | **Total Hours:** | **75** |



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| Learning Resources |
|---|
| **Textbooks:** |
| 1. G. Stephanopoulos, Chemical Process Control-An Introduction to Theory and Practice. Prentice Hall of India, New Delhi, 3rd Edition,2008.<br>2. D.R. Coughanowr, Steven E LeBlanc, Process Systems Analysis and Control, McGraw Hill, Singapore, 3rd Edition,2009.<br>3. B.W. Bequette, Process Control Modelling, Design and Simulation. Prentice Hall of India, New Delhi,2004.<br>4. D.E. Seborg, T.E. Edgar, D.A. Mellichamp. Process Dynamics and Control, Wiley India Pvt. Ltd., Fourth Edition.2016.<br>5. William C. Dunn, Introduction to Instr umentation, Sensors, and Process Control, Artech House Publishers, 2005. |
| **References:** |
| 1. C.A. Smith and A.B Corripio., Principles and Practice of Automatic Process Control, John Wiley and Sons, New York, 3rd Edition2005.<br>2. Paul W. Murril, Fundamentals of Process Control Theory, ISA press, New York, 3rd Edition, 2000.<br>3. Bela G. Liptak, Instrument Engineers' Handbook, Volume II: Process Control and Optimization, CRC Press, 4th Edition,2005.<br>4. Wolfgang Altmann, Practical Process Control for Engineers and Technicians, Elsevier/Newnes publishing, 2009<br>5. Donald P. Eckman, Automatic Process Control, Wiley India Pvt Ltd , 2009. |
| **Online Educational Resources:** |
| 1. NPTEL: *Chemical Process Control* – IIT Bombay https://nptel.ac.in/courses/103101142<br>2. NPTEL: *Advanced Process Dynamics* – IIT Kharagpur https://nptel.ac.in/courses/103105216<br>3. NPTEL Video Lectures: Process Control & Instrumentation https://www.youtube.com/playlist?list=PLF404D44A280B5C77<br>4. YouTube Lecture Series: Process Dynamics & Control https://www.youtube.com/@processdynamicsandcontrol3819 |

| Assessment (Embedded course) |
|---|
| SA, Activity and Learning Task(s)* , Mini project, MCQ, End Semester Examination (ESE) Lab Workbook, Experimental Cycle tests, viva-voce, etc… |

| Course Curated by | | | |
|---|---|---|---|
| **Expert(s) from Industry** | **Expert(s) from Higher Education Institution** | **Internal Expert(s)** | |
| [Name, Organization] | [Name, Institution] | Mr. V. ATHAPPAN – AP-II/E&I | |
| **Recommended by BoS on** | | | |
| **Academic Council Approval** | | **Date** | |



BoS Chair

| 24EIT310 | Industrial Communication and Networking | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 |
| PC | | SDG | 9, 7,12 | | | |

| Pre-requisite courses | 24EII101,24ECI203, 24EII204,24EII302 | Data Book / Code book (If any) | Standard Industrial Protocol Datasheets |
|---|---|---|---|

| Course Objectives: | |
|---|---|
| The purpose of taking this course is to: | |
| 1 | Acquire knowledge of industrial communication systems to understand reliable and energy-efficient industrial operations. |
| 2 | Develop skills to analyse and evaluate industrial communication protocols and networks for efficient data exchange. |
| 3 | Build competency to design and implement secure, scalable, and sustainable industrial networking solutions aligned with global standards. |

| Course Outcomes | | |
|---|---|---|
| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
| CO 1 | Explain industrial communication fundamentals, signal characteristics, and standards for reliable and efficient data transmission | U |
| CO 2 | Analyse modulation, transmission techniques, and error control mechanisms for industrial communication performance | An |
| CO 3 | Apply industrial protocols such as Modbus, HART, CAN, and fieldbus systems in automation environments | Ap |
| CO 4 | Examine industrial networking architectures including Industrial Ethernet and wireless systems for smart factories | An |
| CO 5 | Evaluate IIoT-based industrial communication solutions for performance, scalability, and resource efficiency | An |

| Course Outcomes (CO) | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | PSO1 | PSO2 |
| | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 |
| 1 | 3 | 2 | – | – | 2 | – | 1 | – | – | 1 | – | 2 | 1 |
| 2 | 3 | 3 | 2 | 3 | 2 | – | 1 | – | 1 | 1 | 1 | 2 | 1 |
| 3 | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | 1 | 3 | 3 |
| 4 | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 |
| 5 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 1 | 2 | 2 | 2 | 1 | 2 |



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| Course Content | |
|---|---|
| **FUNDAMENTALS OF INDUSTRIAL COMMUNICATION**<br>Communication as the backbone of automated and resource-efficient industrial systems; elements of industrial communication including sensors, transmitters, controllers and SCADA with emphasis on reliable and low-loss signal transmission; characteristics of industrial signals and methods to minimise attenuation and power consumption in long-distance communication; electrical noise sources and grounding/shielding practices that enhance system life and reduce maintenance overhead; performance metrics such as latency, throughput and availability in the context of efficient industrial infrastructure; overview of IEC/IEEE standards enabling globally interoperable and sustainable communication system. | **09 Hours** |
| **MODULATION & DATA TRANSMISSION TECHNIQUES**<br>Analog and digital modulation techniques analysed with respect to bandwidth utilization and energy efficiency; baseband and broadband transmission methods for high-speed industrial data transfer; multiplexing techniques (TDM, FDM) reducing cabling complexity and material usage in large-scale plants; error detection and correction mechanisms improving reliability while minimizing retransmission energy; signal integrity considerations ensuring stable and efficient communication in harsh industrial environments. | **09 Hours** |
| **INDUSTRIAL COMMUNICATION PROTOCOLS**<br>Serial communication standards (RS-232, RS-422, RS-485) for distributed control; Modbus RTU/TCP for efficient industrial data acquisition and monitoring; HART communication enabling smart instrumentation, diagnostics and predictive maintenance; CAN bus and DeviceNet supporting deterministic and efficient manufacturing systems; protocol comparison based on scalability, interoperability, reliability and lifecycle efficiency for optimal industrial deployment. | **09 Hours** |
| **INDUSTRIAL NETWORKING & FIELDBUS TECHNOLOGIES**<br>Fieldbus systems enabling decentralized control and reduction in wiring complexity; PROFIBUS and FOUNDATION Fieldbus for integrated automation; Industrial Ethernet technologies (PROFINET, EtherNet/IP) supporting high-speed smart manufacturing; industrial network topology design incorporating redundancy, fault tolerance and lifecycle cost considerations; network diagnostics and monitoring improving system resilience and minimizing downtime in industrial operations. | **09 Hours** |
| **EMERGING TRENDS IN INDUSTRIAL NETWORKING**<br>Wireless industrial communication technologies such as WirelessHART, Zigbee and LoRa enabling low-power distributed sensing; Industrial Internet of Things (IIoT) architectures for real-time monitoring and intelligent resource management; cloud and edge computing for efficient data processing and reduced latency; cybersecurity frameworks ensuring safe and reliable industrial communication; role of digital networking in smart factories, green manufacturing and globally connected Industry 4.0 ecosystems. | **09Hours** |

| Theory Hours: 45 | Tutorial Hours: 00 | Practical Hours:00 | Project Hours:00 | Total Hours: 45 |
|---|---|---|---|---|



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**Learning Resources**

**Textbooks:**

1. Zurawski, Richard., *Industrial Communication Technology Handbook (2nd ed.)*, CRC Press, Boca Raton (2015).
2. Marshall, Perry S., & Rinaldi, John S., *Industrial Ethernet (3rd ed.)*, ISA, Research Triangle Park (2016).
3. Gilchrist, Alasdair., *Industry 4.0: The Industrial Internet of Things*, Apress, New York (2016).

**References:**

1. Forouzan, Behrouz A., *Data Communications and Networking (5th ed.)*, McGraw-Hill Education, New York (2017).
2. Mahnke, Wolfgang., Leitner, Stefan-Helmut., & Damm, Matthias., *OPC Unified Architecture*, Springer, Berlin (2009).
3. Knapp, Eric D., & Langill, Joel T., *Industrial Network Security (2nd ed.)*, Syngress, Boston (2015).
4. Björses, Stig., *Control and Automation with Industrial Ethernet*, Studica Press, Ontario (2019).

**Key Websites and Online Educational Resources:**

1. International Electrotechnical Commission., *IEC Standards*, https://www.iec.ch
2. Institute of Electrical and Electronics Engineers., *IEEE 802 Standards*, https://www.ieee802.org
3. OPC Foundation., *OPC Unified Architecture*, https://www.opcfoundation.org
4. PROFIBUS & PROFINET International., *Industrial Communication Technologies*, https://www.profibus.com
5. International Society of Automation., *Automation Standards and Practices*, https://www.isa.org
6. FieldComm Group., *HART and Fieldbus Technologies*, https://www.fieldcommgroup.org
7. ODVA., *EtherNet/IP and DeviceNet*, https://www.odva.org

**Tools for Visual Learning & Simulation**

1. Wireshark Foundation., *Wireshark Network Protocol Analyzer*, https://www.wireshark.org
2. MathWorks., *MATLAB Online*, https://matlab.mathworks.com
3. CODESYS., *CODESYS Development System (Free Runtime Version).*, CODESYS Group. https://www.codesys.com
4. Node-RED., *Node-RED Visual Programming Tool.*, OpenJS Foundation. https://nodered.org
5. GNS3., *GNS3 Network Simulator.*, Open-Source Community. https://www.gns3.com
6. OpenPLC., *OpenPLC Automation Platform.*, OpenPLC Project. https://www.openplcproject.com
7. Grafana., *Grafana Visualization Platform.*, Grafana Labs. https://grafana.com
8. ThingSpeak., *ThingSpeak IoT Analytics Platform.*, MathWorks. https://thingspeak.com



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9. Falco., *Falco Runtime Security.*, Cloud Native Computing Foundation. https://falco.org
10. Zeek., *Zeek Network Security Monitor.*, Zeek Project. https://zeek.org

| **Assessment (Theory course)** |
|---|
| SAI (Concept + Problem), SA II(Protocol + Design), Assignment(SDG+Industry case) Activity and Learning Task(s)* End Semester Examination (ESE) |

| **Course Curated by** | | | |
|---|---|---|---|
| **Expert(s) from Industry** | **Expert(s) from Higher Education Institution** | **Internal Expert(s)** | |
| [Name, Organization] | [Name, Institution] | Umesh M V<br>Associate Professor, EIE , KCT | |
| **Recommended by BoS on** | XX/YY/2026 | | |
| **Academic Council Approval** | No. | **Date** | XX/YY/2026 |



BoS Chair

BoS Chair

# SEVENTH SEMESTER



BoS Chair

BoS Chair

| 24EII401 | ADVANCED CONTROL SYSTEMS | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 2 | 0 | 2 | 0 | 3 |
| PC | | SDG No's. | | 4, 9 | | |

| Pre-requisite courses | 24EII303 | Data Book / Code book (If any) | eg. Design Data book |
|---|---|---|---|

| Course Objectives: | The purpose of taking this course is to: |
|---|---|
| 1 | Acquire knowledge of state space modelling, state feedback and observer design, non-linear system behaviour, Lyapunov and frequency-domain stability criteria, and optimal and robust control formulations. (Knowledge to be Acquired) |
| 2 | Gain hands-on skills to analyse, design, simulate, and validate state feedback, observer-based, non-linear, optimal (LQR/Kalman), and robust (H2/H∞) controllers using MATLAB/Simulink, LabVIEW, and open-source tools (Python Control/Scilab). (Skills to be Gained) |

| Course Outcomes | After successful completion of this course, the students shall be able to | Revised Bloom's Taxonomy Levels (RBT) |
|---|---|---|
| CO 1 | Apply state space techniques to model continuous and discrete systems, compute state transition matrices, and assess controllability and observability. | Ap |
| CO 2 | Design state feedback controllers and full/reduced-order observers using pole placement for given closed-loop specifications. | C |
| CO 3 | Analyse non-linear system behaviour using phase plane and describing function methods, including limit cycles and stability of oscillations. | An |
| CO 4 | Perform stability analysis of non-linear systems using Lyapunov's direct method, Popov and circle criteria. | An |
| CO 5 | Design optimal controllers and estimators (LQR, LQ tracking, Kalman filter) and evaluate robust H2/H∞ control solutions. | E |
| CO 6 | Demonstrate simulation-based analysis and design of linear, non-linear, optimal, and robust control systems using MATLAB/Python tools, and relate them to emerging AI-assisted control practice. | Ap |

| Course Outcomes (CO) | Program Outcomes (PO) (Strong-3, Medium-2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | |
| | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 |
| 1 | 2 | 3 | 2 | 2 | – | – | – | – | – | – | 1 | 2 | – |
| 2 | 2 | 3 | 3 | 2 | 1 | – | – | – | – | – | 1 | 3 | 1 |



BoS Chair

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 2 | 3 | 2 | 2 | – | – | – | – | – | – | 1 | 2 | – |
| 4 | 2 | 3 | 2 | 2 | – | – | – | – | – | – | 1 | 2 | – |
| 5 | 2 | 3 | 3 | 2 | 3 | – | – | – | – | – | 1 | 3 | 2 |
| 6 | 1 | 2 | 3 | 3 | 3 | – | – | 2 | 2 | – | 2 | 2 | 3 |

| Course Content | Hours |
|---|---|
| **STATE SPACE ANALYSIS**<br>• State space representation of continuous and discrete systems; solution of time-invariant autonomous and forced systems.<br>• State transition matrix – properties and computation; relationship between state equations and transfer functions.<br>• Controllability and observability criteria; canonical forms.<br>**Practical Component (Simulation Tools: MATLAB / Simulink / LabVIEW / Python Control / Scilab):**<br>• State model development for a second-order system cascaded with an active lead circuit – step and impulse response (MATLAB / Python Control).<br>• Eigenvalue determination, state-model-to-transfer-function conversion; transformation to controllable canonical and diagonal forms. | **5 Hours**<br>(Theory)<br>**5 Hours**<br>(Practical) |
| **STATE FEEDBACK CONTROLLER AND OBSERVER DESIGN**<br>• Controller design by state feedback based on pole placement; design of state feedback control systems.<br>• Full-order and reduced-order observer design; output feedback controllers.<br>• Separation principle; introduction to digital implementation of state feedback laws.<br>**Practical Component (Simulation Tools: MATLAB / Simulink / LabVIEW / Python Control / Scilab):**<br>• Controllability and observability tests for given systems.<br>• Design and simulation of a state feedback controller and a full-state observer for specified closed-loop poles. | **5 Hours**<br>(Theory)<br>**5 Hours**<br>(Practical) |
| **PHASE PLANE ANALYSIS**<br>• Concept of phase portraits; singular points; limit cycles.<br>• Construction of phase portraits – isocline and delta methods.<br>• Phase plane analysis of linear and non-linear systems.<br>**Practical Component (Simulation Tools: MATLAB / Simulink / LabVIEW / Python Control / Scilab):**<br>• Plotting phase portraits of systems having stable/unstable nodes and focus; vortex and saddle points.<br>• Demonstration of limit cycles for Van der Pol's equation and the effect of common non-linearities. | **5 Hours**<br>(Theory)<br>**5 Hours**<br>(Practical) |
| **DESCRIBING FUNCTION ANALYSIS**<br>• Basic concepts; derivation of describing functions for common non-linearities (saturation, dead zone, relay, backlash).<br>• Describing function analysis of non-linear systems.<br>• Conditions for stability; stability of oscillations – prediction of limit cycle amplitude and frequency.<br>**Practical Component (Simulation Tools: MATLAB / Simulink / LabVIEW / Python Control / Scilab):**<br>• Stability analysis of a relay/saturation-type non-linear feedback system using the describing function method with simulation validation. | **5 Hours**<br>(Theory)<br>**5 Hours**<br>(Practical) |



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| | |
|---|---|
| **STABILITY ANALYSIS OF NON-LINEAR SYSTEMS**<br>• Lyapunov's stability concept and direct method; Lure's transformation.<br>• Aizerman's and Kalman's conjectures; Popov's criterion; circle criterion.<br>• Introduction to feedback linearization of non-linear systems.<br>**Practical Component (Simulation Tools: MATLAB / Simulink / LabVIEW / Python Control / Scilab):**<br>• Lyapunov stability analysis of given non-linear systems with simulation verification.<br>• Design of an exact feedback linearizing controller for a non-linear system. | **5 Hours**<br>(Theory)<br>**5 Hours**<br>(Practical) |
| **OPTIMAL, ROBUST AND EMERGING CONTROL**<br>• Optimal control: performance measures, Linear Quadratic Regulator, LQ tracking, optimal estimation – Kalman filter.<br>• Robust control: norms of vectors, matrices and systems; H2 and H∞ optimal control and estimation.<br>• Emerging directions (bridging beyond-2030 skills): model predictive control concepts, data-driven/AI-assisted control and reinforcement learning overview for autonomous and cyber-physical systems (WEF Future of Jobs 2025 skill priorities).<br>**Practical Component (Simulation Tools: MATLAB / Simulink / LabVIEW / Python Control / Scilab):**<br>• Design of an optimal control system (LQR/Kalman filter) for a benchmark plant (e.g., inverted pendulum) with simulation.<br>• Design of a robust control system; comparative study with LQR under plant uncertainty (MATLAB Robust Control Toolbox / Python). | **5 Hours**<br>(Theory)<br>**5 Hours**<br>(Practical) |

| Theory Hours: 30 | Tutorial Hours: 0 | Practical Hours: 30 | Project Hours: 0 | Total Hours: 60 |
|---|---|---|---|---|

**Learning Resources**

**Textbooks:**

1. K. Ogata, Modern Control Engineering, 5th ed. Upper Saddle River, NJ, USA: Pearson Education, 2010.
2. J.-J. E. Slotine and W. Li, Applied Nonlinear Control. Englewood Cliffs, NJ, USA: Prentice-Hall, 1991.

**References:**

1. R. C. Dorf and R. H. Bishop, Modern Control Systems, 14th ed. Hoboken, NJ, USA: Pearson Education, 2022.
2. G. F. Franklin, J. D. Powell, and A. Emami-Naeini, Feedback Control of Dynamic Systems, 8th ed. New York, NY, USA: Pearson Education, 2019.
3. H. K. Khalil, Nonlinear Systems, 3rd ed. Upper Saddle River, NJ, USA: Prentice Hall, 2002.
4. M. Gopal, Modern Control System Theory, 3rd ed. New Delhi, India: New Age International, 2014.
5. D. E. Kirk, Optimal Control Theory: An Introduction. Mineola, NY, USA: Dover Publications, 2004.
6. World Economic Forum, "The Future of Jobs Report 2025," Insight Report, World Economic Forum, Geneva, Switzerland, Jan. 2025. [Online]. Available: https://www.weforum.org/publications/the-future-of-jobs-report-2025/

**Online Educational Resources:**

1. https://nptel.ac.in/courses/107106081 (NPTEL – Linear Dynamical Systems / state space methods)
2. https://nptel.ac.in/courses/108103008 (NPTEL – Nonlinear Control System)
3. https://python-control.readthedocs.io (Python Control Systems Library – open-source alternative to MATLAB)
4. https://in.mathworks.com/learn (MathWorks self-paced courses – Control System Design with MATLAB and Simulink)

**Assessment (Embedded course)**

SAT, Activity and Learning Task(s)*, Mini project, MCQ, End Semester Examination (ESE)



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| |
|---|
| Lab Workbook, Experimental Cycle tests, viva-voce, model practical examination. |

| **Course Curated by** | | | |
|---|---|---|---|
| **Expert(s) from Industry** | **Expert(s) from Higher Education Institution**<br>[Name, Institution] | | **Internal Expert(s)** |
| [Name, Organization] | | | [Name, Department] |
| **Recommended by BoS on** | XX/YY/2025 | | |
| **Academic Council Approval** | No. | **Date** | XX/YY/2025 |



BoS Chair

| 24HSE0XX | PROJECT MANAGEMENT AND FINANCE | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 |
| HS | | SDG No's. | | 8, 9, 12 | | |

| Pre-requisite courses | Nil | Data Book / Code book (If any) | eg. Design Data book |
|---|---|---|---|

| Course Objectives: | The purpose of taking this course is to: |
|---|---|
| 1 | Acquire knowledge of project management concepts, life cycles, planning and scheduling techniques, cost estimation, sources of finance, and financial statement fundamentals relevant to engineering projects. (Knowledge to be Acquired) |
| 2 | Gain skills to prepare work breakdown structures, CPM/PERT schedules, budgets, and investment appraisals (NPV, IRR, payback), and to analyse financial statements using software tools such as MS Project/ProjectLibre and spreadsheets. (Skills to be Gained) |
| 3 | Develop competency to manage engineering projects with agile, risk, contract, ESG, and AI-enabled practices, exercising leadership, communication and ethical judgement, aligned with WEF Future of Jobs 2025 skill demands beyond 2030. (Competency to be Developed) |

| Course Outcomes | After successful completion of this course, the students shall be able to | Revised Bloom's Taxonomy Levels (RBT) |
|---|---|---|
| CO 1 | Explain project management concepts, project life cycles, organizational structures, and project selection and feasibility frameworks. | U |
| CO 2 | Apply work breakdown structures, CPM/PERT network analysis, and resource scheduling techniques to engineering projects using software tools. | Ap |
| CO 3 | Evaluate project investment decisions using cost estimation, budgeting, and capital budgeting techniques such as NPV, IRR, and payback period. | E |
| CO 4 | Analyse financial statements of engineering enterprises using ratio, break-even, and cash flow analysis. | An |
| CO 5 | Examine risk, quality, contract, agile, ESG, and AI-enabled project management practices in line with beyond-2030 skill requirements. | An |



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| Course Outcomes (CO) | Program Outcomes (PO) (Strong-3, Medium-2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | |
| | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 |
| 1 | 1 | – | – | – | – | 1 | 1 | 2 | 1 | 3 | 2 | – | 1 |
| 2 | 1 | 2 | – | – | 2 | – | – | 2 | 1 | 3 | 1 | – | 2 |
| 3 | 1 | 2 | – | – | 1 | 1 | – | – | 1 | 3 | 1 | – | 1 |
| 4 | 1 | 2 | – | – | 1 | – | 1 | – | 1 | 3 | 1 | – | 1 |
| 5 | 1 | 1 | – | – | 2 | 2 | 2 | 2 | 2 | 3 | 3 | – | 2 |

| Course Content | Hours |
|---|---|
| **PROJECT MANAGEMENT FUNDAMENTALS**<br>• Projects and project management – characteristics, project life cycle, stakeholders; project management knowledge areas (PMBOK overview) and process groups.<br>• Organizational structures – functional, matrix, projectized; role and skills of the project manager.<br>• Project identification, screening, and selection; feasibility studies – market, technical, financial; Detailed Project Report (DPR). | **7 Hours** |
| **PROJECT PLANNING AND SCHEDULING**<br>• Scope management and Work Breakdown Structure (WBS); responsibility assignment; Gantt charts and milestone charts.<br>• Network analysis: CPM and PERT – critical path, floats, probability of project completion; time-cost trade-off and crashing.<br>• Resource allocation, levelling and smoothing; scheduling with software tools (MS Project / open-source ProjectLibre); earned value management basics. | **8 Hours** |
| **COST ESTIMATION AND PROJECT FINANCE**<br>• Elements of project cost; cost estimation methods and budgeting; project cash flow projections.<br>• Sources of project finance – equity, debt, term loans, venture capital, government schemes (Startup India, MSME support); cost of capital.<br>• Capital budgeting: payback period, accounting rate of return, Net Present Value (NPV), Internal Rate of Return (IRR), profitability index; time value of money. | **8 Hours** |
| **FINANCIAL STATEMENTS AND ANALYSIS**<br>• Introduction to financial accounting; balance sheet, profit and loss statement, cash flow statement – structure and interpretation.<br>• Ratio analysis – liquidity, solvency, profitability, and activity ratios; Du Pont analysis overview.<br>• Break-even analysis and cost-volume-profit relationships; depreciation methods; basics of taxation (GST, corporate tax) for engineering enterprises; working capital management. | **8 Hours** |
| **RISK, QUALITY AND CONTRACT MANAGEMENT**<br>• Project risk management – identification, qualitative and quantitative assessment, mitigation and contingency planning.<br>• Project quality management – quality planning, assurance and control; cost of quality. | **7 Hours** |



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| | |
|---|---|
| • Contracts and procurement – types of contracts, tendering and bidding process, e-procurement (GeM overview); professional ethics in project execution. | |
| **AGILE, LEADERSHIP AND SKILLS BEYOND 2030**<br>• Agile project management – Scrum roles, sprints, Kanban; hybrid approaches for engineering and instrumentation projects.<br>• Leadership, motivation, negotiation, and team management; communication and conflict resolution (WEF Future of Jobs 2025 skill priorities – leadership and social influence, analytical thinking).<br>• AI and analytics in project management – forecasting, scheduling assistants, dashboards; ESG and sustainable project finance; green project appraisal; entrepreneurship and startup funding landscape in India; lifelong learning and professional certifications (PMP, PRINCE2). | **7 Hours** |

| Theory Hours: 45 | Tutorial Hours: 0 | Practical Hours: 0 | Project Hours: 0 | Total Hours: 45 |
|---|---|---|---|---|

**Learning Resources**

**Textbooks:**

1. H. Kerzner, Project Management: A Systems Approach to Planning, Scheduling, and Controlling, 13th ed. Hoboken, NJ, USA: John Wiley & Sons, 2022.

2. P. Chandra, Projects: Planning, Analysis, Selection, Financing, Implementation, and Review, 9th ed. Chennai, India: McGraw Hill Education, 2019.

**References:**

1. Project Management Institute, A Guide to the Project Management Body of Knowledge (PMBOK Guide), 7th ed. Newtown Square, PA, USA: Project Management Institute, 2021.

2. E. W. Larson and C. F. Gray, Project Management: The Managerial Process, 8th ed. New York, NY, USA: McGraw-Hill Education, 2021.

3. M. Y. Khan and P. K. Jain, Financial Management: Text, Problems and Cases, 8th ed. Chennai, India: McGraw Hill Education, 2018.

4. R. A. Brealey, S. C. Myers, F. Allen, and A. Edmans, Principles of Corporate Finance, 14th ed. New York, NY, USA: McGraw Hill, 2023.

5. World Economic Forum, "The Future of Jobs Report 2025," Insight Report, World Economic Forum, Geneva, Switzerland, Jan. 2025. [Online]. Available: https://www.weforum.org/publications/the-future-of-jobs-report-2025/

**Online Educational Resources:**

1. https://nptel.ac.in/courses/110104073 (NPTEL – Project Management, IIT Kanpur)
2. https://nptel.ac.in/courses/110101131 (NPTEL – Financial Accounting)
3. https://www.projectlibre.com (ProjectLibre – open-source project management software)
4. https://www.pmi.org (Project Management Institute – standards and certifications)

**Assessment (Theory course)**

SAT, Activity and Learning Task(s)*, Mini project, MCQ, End Semester Examination (ESE)



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| Course Curated by | | | |
|---|---|---|---|
| **Expert(s) from Industry** | **Expert(s) from Higher Education Institution** | **Internal Expert(s)** | |
| [Name, Organization] | [Name, Institution] | [Name, Department] | |
| **Recommended by BoS on** | XX/YY/202x | | |
| **Academic Council Approval** | No. | **Date** | XX/YY/202x |



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# Professional Electives



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# Intelligent Robotics and Automation TRAK



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| 24EIE001 | Basics of Robotics and Mechanisms | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 |
| PE | | SDG | 9 | | | |

| Pre-requisite courses | Engineering Mechanics, Engineering Mathematics , Basic Electrical Engineering | Data Book / Code book (If any) | NA |
|---|---|---|---|

| Course Objectives: | |
|---|---|
| The purpose of taking this course is to: | |
| 1 | Understand the fundamental concepts of mechanisms and robotic systems used in industrial automation. |
| 2 | Apply basic kinematic principles to analyze motion in mechanical linkages and robotic manipulators.. |
| 3 | Develop foundational knowledge of sensors, actuators, and control systems used in robotics. |

| Course Outcomes | | |
|---|---|---|
| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
| CO 1 | Describe the structure and components of robotic systems and mechanisms | R |
| CO 2 | Explain the kinematic relationships and motion of mechanisms | U |
| CO 3 | Apply basic motion analysis methods to simple mechanical systems | Ap |
| CO 4 | Identify suitable actuators and sensors used in robotic applications | U |
| CO 5 | Apply basic control concepts in robotics and automation systems | Ap |

| Course Outcomes (CO) | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | |
| | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 |
| CO1 | 3 | 2 | – | – | 1 | – | – | – | – | – | 1 | 2 | 1 |
| CO2 | 3 | 3 | 2 | 1 | 2 | – | – | – | – | – | 1 | 2 | 1 |
| CO3 | 3 | 3 | 3 | 2 | 2 | – | – | – | – | – | 1 | 3 | 2 |
| CO4 | 3 | 2 | 2 | 1 | 2 | 1 | – | – | 1 | 1 | 1 | 3 | 2 |
| CO5 | 3 | 3 | 3 | 2 | 3 | 2 | – | – | 1 | 1 | 2 | 3 | 3 |

| Course Content | |
|---|---|
| **INTRODUCTION TO ROBOTICS AND MECHANISMS**<br>Definition of robots - Laws of robotics - Robot anatomy - Robot classifications - Robot applications in industry - Mechanisms and machines - Types of links and joints - Kinematic chains | **9 Hours** |
| **KINEMATICS OF MECHANISMS**<br>Degrees of freedom - Mobility of mechanisms - Grashof's law - Four-bar mechanism -Slider crank mechanism -Velocity and acceleration analysis -Instantaneous center method | **9 Hours** |
| **ROBOT MANIPULATORS AND END EFFECTORS** | **9 Hours** |



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| | |
|---|---|
| Robot manipulators - Coordinate systems - Workspace analysis - End effectors - Grippers - Robot drive systems | |
| **ACTUATORS AND SENSORS IN ROBOTICS**<br>Additive Manufacturing Principles - 3D Printing Technologies - Materials for Additive manufacturing - Rapid Prototyping - Design for Additive Manufacturing | **9 Hours** |
| **MODULE 5: ROBOT CONTROL AND INDUSTRIAL AUTOMATION**<br>Manufacturing Data Analytics - Big Data in Manufacturing - Machine Learning in Manufacturing - Predictive Maintenance - Quality Monitoring Systems | **9 Hours** |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Theory Hours:** | **45** | **Tutorial Hours:** | **0** | **Practical Hours:** | **0** | **Project Hours:** | **0** | **Total Hours:** | **45** |

**Learning Resources**

**Textbooks:**

1. Groover, Mikell. Industrial Robotics: Technology, Programming and Applications, McGraw-Hill, New York 2015.
2. Craig, John J. Introduction to Robotics: Mechanics and Control, Pearson, Boston 2018.

**References:**

1. Siciliano, Bruno. Robotics: Modelling, Planning and Control, Springer, Berlin 2016
2. Spong, Mark. Robot Modeling and Control, Wiley, New York 2020
3. Niku, Saeed. Introduction to Robotics: Analysis, Control and Applications, Wiley 2019

**Online Educational Resources:**

1. https://nptel.ac.in/courses/106105195
2. https://onlinecourses.nptel.ac.in/noc21_mg83/preview
3. https://ocw.mit.edu/courses/mechanical-engineering/2-12-introduction-to-robotics

**Assessment (Theory course)**

Sa, Activity and Learning Task(s) - Think–Pair–Share, Case Study, Concept Mapping , Mini project, MCQ, End Semester Examination (ESE)

**Course Curated by**

| Expert(s) from Industry | Expert(s) from Higher Education Institution | | Internal Expert(s) |
|---|---|---|---|
| [Name, Organization] | [Name, Institution] | | [E.Muthuramalingam] |
| **Recommended by BoS on** | XX/YY/2026 | | |
| **Academic Council Approval** | No. | **Date** | XX/YY/2026 |



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| | | | | | | |
|---|---|---|---|---|---|---|
| **Professional Elective** | **Powertronics** | **3** | **0** | **0** | **0** | **3** |
| | | **SDG** | **7, 9** | | | |

| | | | |
|---|---|---|---|
| **Pre-requisite courses** | **24EII101, 24EII201, 24ECI204** | **Data Book / Code Book** | IGBT, MOSFET, SCR/TRIAC, Gate Drivers (IR2110), IEEE 519, IEEE 1547 |

| **Course Objectives:** | |
|---|---|
| The purpose of taking this course is to: | |
| 1 | Understand power semiconductor devices, converter topologies and modulation techniques used in modern energy systems. |
| 2 | Analyze and design power electronic circuits using datasheets and simulation tools for performance and efficiency. |
| 3 | Develop energy-efficient power electronic systems for industrial, renewable and electric mobility applications considering sustainability and standards. |

| **Course Outcomes** | | |
|---|---|---|
| After successful completion of this course, the students shall be able to | | **Revised Bloom's Taxonomy Levels (RBT)** |
| CO 1 | explain the characteristics and selection criteria of power semiconductor devices. | U |
| CO 2 | analyze AC–DC converters with respect to performance and power quality. | An |
| CO 3 | apply the principles of DC–DC converters for practical applications. | Ap |
| CO 4 | apply PWM techniques in inverter systems. | Ap |
| CO 5 | analyze modern power electronic systems in industrial, renewable and electric mobility applications. | An |

| Course Outcomes (CO) | **Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)** | | | | | | | | | | | **Program Specific Outcomes (PSO)** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | | | |
| | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 | |
| 1 | 3 | 2 | - | - | 1 | | | | | | | 3 | | |
| 2 | 3 | 3 | 3 | 2 | 2 | | | | | | | 3 | | |
| 3 | 3 | 3 | 3 | 2 | 3 | | | | | | | 3 | 2 | |
| 4 | 3 | 3 | 3 | 2 | 3 | | | | | | | 3 | 2 | |
| 5 | 2 | 2 | 3 | 2 | 3 | 2 | | | | | | 2 | 2 | |



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| Course Content | |
|---|---|
| **POWER SEMICONDUCTOR DEVICES & THERMAL ENGINEERING**<br>Power diodes, BJT, SCR, TRIAC - MOSFET, IGBT: switching, SOA, losses - SiC & GaN devices for high-frequency, high-efficiency applications - Gate drive circuits (bootstrap, isolation) -Thermal modelling and heat sink design | **9 Hours** |
| **AC-DC CONVERTERS & POWER QUALITY**<br>Single-phase and three-phase rectifiers - Controlled rectifiers (half/full converters) - Harmonics, THD, power factor - Source inductance effects - Power Factor Correction (Boost PFC, interleaved PFC) | **9 Hours** |
| **DC-DC CONVERTERS**<br>Buck, Boost, Buck-Boost converters - Cuk, SEPIC converters - Flyback and Forward converters - CCM/DCM operation - MPPT for solar systems - Magnetic design basics - Applications in solar PV systems, EV charging, battery storage, and energy-efficient SMPS. | **9 Hours** |
| **DC-AC INVERTERS & PWM TECHNIQUES**<br>VSI, CSI, single-phase and three-phase inverters - PWM techniques: SPWM, SVPWM - Harmonics and THD analysis - Grid synchronization (PLL basics) - Multilevel inverters - Applications in renewable energy integration, smart grids, and efficient motor drives. | **9 Hours** |
| **AC-AC CONVERTERS, DRIVES & EMERGING APPLICATIONS**<br>AC voltage controllers - Cycloconverters, matrix converters -Variable Frequency Drives (V/f control) - Electric vehicles (OBC, traction inverter) - Smart grids, BESS, FACTS | **9 Hours** |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Theory Hours:** | **45** | **Tutorial Hours:** | **00** | **Practical Hours:** | **00** | **Project Hours:** | **00** | **Total Hours:** | **45** |

**Learning Resources**

**Textbooks:**

1. Mohan, Ned., Undeland, T., Robbins, W., Power Electronics, Wiley, 2003.
2. Rashid, M. H., Power Electronics Handbook, Elsevier, 2017.
3. Hart, D. W., Power Electronics, McGraw-Hill, 2011.

**References:**


1. Erickson, Robert W., and Maksimovic, Dragan., Fundamentals of Power Electronics., Springer, New York (2020). DOI: https://doi.org/10.1007/978-3-030-43881-4
2. Bose, Bimal K., Modern Power Electronics and AC Drives., Pearson, NJ (2002).
3. Holmes, D. G., and Lipo, T. A., Pulse Width Modulation for Power Converters., IEEE Press, NJ (2003).
4. Ochs, D. S., Miller, R. D., "Teaching Sustainable Energy", IEEE Trans. Education, 2014. https://ieeexplore.ieee.org/document/6891372
5. López Gutiérrez, J. R., et al., "Real-Time Power Electronics Lab…", Future Internet, 2021. https://www.mdpi.com/1999-5903/13/9/237
6. Blaabjerg, Frede., et al., "Wind Turbine Power Electronics.", IEEE TIA, 2012.
7. Shen, W., Bhattacharya, S., "SiC Power Devices Review.", APEC, 2021.
8. Weise, Norbert., "Wide Bandgap Semiconductors.", Fraunhofer Report, 2022.


**Online Educational Resources:**



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1. NPTEL (Power Electronics – IISc): https://nptel.ac.in/courses/108/108/108108098/
2. MIT OpenCourseWare: https://ocw.mit.edu/courses/6-334-power-electronics-spring-2007/
3. Coursera (Power Electronics – University of Colorado): https://www.coursera.org/specializations/power-electronics
4. AllAboutElectronics (YouTube): https://www.youtube.com/c/AllAboutElectronics

| **Assessment (Theory course)** |
|---|
| SA, Activity and Learning Task(s): Think-pair-share, Socratic seminar, Low-stakes quizzes, Open-ended questions, Mini project, MCQ, End Semester Examination (ESE) |

| **Course Curated by** | | | |
|---|---|---|---|
| **Expert(s) from Industry** | **Expert(s) from Higher Education Institution** | **Internal Expert(s)** | |
| [Name, Organization] | [Name, Institution] | Dr . P.S. Mayurappriyan / P / E&I | |
| **Recommended by BoS on** | XX/YY/202 | | |
| **Academic Council Approval** | No. | **Date** | XX/YY/2026 |



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| 24EIE004 | Robotics and Flexible Automation | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 |
| PE | | SDG | 4, 8, 9, 12 | | | |

| Pre-requisite courses | | Data Book / Code book (If any) | |
|---|---|---|---|

**Course Objectives:**

The purpose of taking this course is to:

| | |
|---|---|
| 1 | To develop knowledge of industrial robotics, including robot configuration, kinematics, and motion planning for automation applications |
| 2 | To understand and analyze flexible automation systems, group technology, and manufacturing system integration in modern industries. |
| 3 | To design and evaluate robot-integrated and flexible manufacturing systems, incorporating advanced automation concepts and Industry 4.0 practices. |

**Course Outcomes**

| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
|---|---|---|
| CO 1 | Explain the fundamentals of industrial robots, configurations, sensors, actuators, and end effectors. | U |
| CO 2 | Apply kinematic modelling and coordinate transformations for robot motion and positioning. | Ap |
| CO 3 | Apply concepts of workspace analysis, trajectory planning, and interpolation techniques in robotic operations. | Ap |
| CO 4 | Apply principles of flexible manufacturing systems, group technology, and system integration in industrial applications | Ap |
| CO 5 | Apply knowledge of robot-integrated flexible automation systems for manufacturing applications. | Ap |

| Course Outcomes (CO) | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | |
| | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 |
| 1 | **3** | **2** | – | – | **2** | – | – | – | – | – | **1** | **2** | **2** |
| 2 | **3** | **2** | **2** | – | **3** | – | – | – | – | – | **1** | **2** | **3** |
| 3 | **2** | **2** | **2** | – | **2** | – | – | – | – | – | **1** | **2** | **3** |
| 4 | **2** | **2** | **2** | – | **2** | – | – | – | – | – | **1** | **2** | **3** |
| 5 | **2** | **2** | **2** | – | **2** | – | – | – | – | – | **1** | **2** | **3** |

**Course Content**

| | |
|---|---|
| **FUNDAMENTALS OF INDUSTRIAL ROBOTICS**<br>Introduction to industrial robotics and automation - Robot classification: Cartesian, Cylindrical, SCARA, Articulated - Robot anatomy and configuration (DOF, workspace, payload) - Actuation systems: Electrical, Hydraulic, Pneumatic - Transmission mechanisms: gears, harmonic drives, ball screws - Sensors in robotics: Position sensors (encoders, resolvers), Velocity sensors (tachometers), Force and torque sensors, Vision systems (basic concepts) - End effectors: grippers and tool integration | **9 Hours** |



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| | |
|---|---|
| **ROBOT KINEMATICS AND MOTION PLANNING**<br>Forward (direct) kinematics and inverse kinematics - Coordinate frames and transformations - Homogeneous transformation matrices - Kinematic modelling of: SCARA robots, Articulated robots (5-axis and 6-axis) - Workspace analysis and work envelope - Trajectory planning and motion control - Interpolation techniques (point-to-point, continuous path) | **9 Hours** |
| **FUNDAMENTALS OF FLEXIBLE AUTOMATION**<br>Introduction to Flexible Automation (FA) - Flexible Manufacturing Systems (FMS) - Comparison: Fixed vs Programmable vs Flexible automation - Components of FMS: CNC machines, Automated material handling systems, Storage systems (AS/RS) - Integration of robots in flexible systems - Flexibility metrics and system performance | **9 Hours** |
| **GROUP TECHNOLOGY AND SYSTEM INTEGRATION**<br>Group Technology (GT) concepts - Part family formation and classification techniques - Coding and classification systems - Cellular manufacturing systems - Production flow analysis - Data acquisition in manufacturing systems - System evaluation and performance metrics - Planning and implementation of flexible automation systems | **9 Hours** |
| **ADVANCED MANUFACTURING AND INDUSTRIAL APPLICATIONS**<br>Robot-integrated manufacturing systems - Material handling and automated transfer lines - Automated assembly systems - Processing applications: welding, painting, machining - Inspection and quality control automation (machine vision basics) - Robot cell design and layout - multi-robot coordination and interference avoidance - Safety standards and human-robot interaction - Industry 4.0 in flexible automation (smart factories, digital manufacturing) | **9 Hours** |

| **Theory Hours:** | **45** | **Tutorial Hours:** | **0** | **Practical Hours:** | **0** | **Project Hours:** | **Total Hours:** | 45 |
|---|---|---|---|---|---|---|---|---|

**Learning Resources**

**Textbooks:**

1. Craig, J. J. (2018). Introduction to robotics: Mechanics and control (4th ed.). Pearson Education.
2. Groover, M. P. (2020). Automation, production systems, and computer-integrated manufacturing (4th ed.). Pearson Education.
3. Niku, S. B. (2020). Introduction to robotics: Analysis, control, applications (3rd ed.). Wiley India.
4. Klafter, R. D., Chmielewski, T. A., & Negin, M. (2017). Robotic engineering: An integrated approach (2nd ed.). Prentice Hall.
5. Rao, P. N. (2019). Industrial robotics: Technology, programming, and applications (3rd ed.). McGraw-Hill Education.

**References:**

1. Deb, S. R., & Deb, S. (2017). Robotics technology and flexible automation (2nd ed.). McGraw-Hill Education.
2. Craig, J. J. (2018). Introduction to robotics: Mechanics and control (4th ed.). Pearson Education.
3. Spong, M. W., Hutchinson, S., & Vidyasagar, M. (2020). Robot modeling and control (2nd ed.). Wiley.
4. Siciliano, B., Sciavicco, L., Villani, L., & Oriolo, G. (2019). Robotics: Modelling, planning and control. Springer.

**Online Educational Resources:**

1. Introduction to Robotics (IIT Madras) - Covers fundamentals, kinematics, sensors, and applications
2. https://onlinecourses.nptel.ac.in/noc21_me76/preview?utm_source=chatgpt.com - Includes kinematics, trajectory planning, control, and vision
3. https://nptel.ac.in/courses/112108298?utm_source=chatgpt.com - Covers modeling, kinematics, and advanced robotics concepts



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|---|
| 4. https://onlinecourses.nptel.ac.in/noc26_me34/preview?utm_source=chatgpt.com - Focus on transformations, workspace, trajectory, and dynamics<br>5. https://nptel.ac.in/courses/112105319?utm_source=chatgpt.com – Industrial applications and implementation aspects |

| **Assessment (Theory course)** |
|---|
| SA, Assignment, Activity and Learning Task(s), End Semester Examination (ESE) |

| **Course Curated by** | | | |
|---|---|---|---|
| **Expert(s) from Industry** | **Expert(s) from Higher Education Institution** | | **Internal Expert(s)** |
| [Name, Organization] | [Name, Institution] | | [Name, Department] |
| **Recommended by BoS on** | XX/YY/2024 | | |
| **Academic Council Approval** | No. | **Date** | XX/YY/2024 |



BoS Chair

| 24EIE006 | Distributed Control Systems and SCADA System | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 1 | 0 | 3 |
| PE | | SDG | 9, 12 | | | |

| Pre-requisite courses | Industrial Automation | Data Book / Code book (If any) | ISA Standards |
|---|---|---|---|

**Course Objectives:**

The purpose of taking this course is to:

| | |
|---|---|
| 1 | To understand architecture and operation of DCS and SCADA systems |
| 2 | To develop skills in industrial automation using DCS platforms |
| 3 | To implement process control using Yokogawa Electric Corporation CENTUM VP DCS |

**Course Outcomes**

| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
|---|---|---|
| CO1 | Explain DCS and SCADA architecture and components | U |
| CO2 | Analyze industrial communication protocols and data acquisition systems | An |
| CO3 | Apply DCS configuration and control strategies | Ap |
| CO4 | Design SCADA systems for industrial processes | Ap |
| CO5 | Implement control loops using Yokogawa CENTUM VP | Ap |

| Course Outcomes (CO) | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | |
| | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 |
| 1 | 3 | 2 | – | – | 1 | – | – | – | – | – | 1 | 2 | 2 |
| 2 | 3 | 3 | – | 2 | 2 | – | – | – | – | – | 1 | 3 | 3 |
| 3 | 3 | 2 | 3 | – | 3 | – | – | – | – | – | 1 | 3 | 3 |
| 4 | 2 | 3 | 3 | 2 | 3 | 1 | – | – | – | – | 1 | 3 | 3 |
| 5 | 3 | 2 | 3 | – | 3 | – | – | – | – | – | 1 | 3 | 3 |

**Course Content**

| | |
|---|---|
| **INTRODUCTION TO DCS AND SCADA**<br>Evolution of control systems - Centralized vs Distributed Control - SCADA fundamentals - DCS vs PLC vs SCADA comparison - Hierarchical levels in automation | **9 Hours** |
| **DCS ARCHITECTURE & COMMUNICATION**<br>DCS hierarchy - Field control stations (FCS) - Human Interface Stations (HIS) - - Remote I/O modules - Redundancy concepts in DCS - Communication protocols: Modbus, Profibus, Ethernet/IP | **9 Hours** |



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|---|---|
| **YOKOGAWA CENTUM VP SYSTEM**<br>CENTUM VP architecture - Engineering Workstation (ENG) - HIS and FCS configuration - Control drawing and function blocks - Function block programming in CENTUM VP - Tag naming conventions and database management - Alarm and event management in CENTUM VP | **9 Hours** |
| **SCADA SYSTEM DESIGN & IMPLEMENTATION**<br>SCADA architecture - Data acquisition techniques - SCADA communication networks - Alarm management - HMI design principles - Historical data logging and trending | **9 Hours** |
| **ADVANCED CONTROL & INDUSTRIAL APPLICATIONS**<br>Process control strategies in DCS - PID tuning in DCS - Batch control – Cascade control - Safety Instrumented Systems (SIS) -Redundancy and fault tolerance | **9 Hours** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Theory Hours:** | **45** | **Tutorial Hours:** | **0** | **Practical Hours:** | **0** | **Project Hours:** | **0** | **Total Hours:** | **45** |

**Learning Resources**

**Textbooks:**

1. Lipták, Bela G., Instrument Engineers' Handbook: Process Control and Optimization., CRC Press, Boca Raton, USA (2018).
2. Dunning, Gary., Introduction to Programmable Logic Controllers., Cengage Learning, Boston, USA (2015).
3. Yokogawa Electric Corporation., CENTUM VP System Overview and Engineering Manuals., Yokogawa Publication, Tokyo, Japan (Latest Edition).

**References:**

1. Boyer, Stuart A., SCADA: Supervisory Control and Data Acquisition., ISA, North Carolina, USA (2009).
2. Bolton, W., Programmable Logic Controllers., Elsevier, UK (2015).

**Online Educational Resources:**

1. https://www.yokogawa.com/library/resources/white-papers/
2. Instrumentation Tools. (2024). Industrial instrumentation tutorials and technical articles. https://instrumentationtools.com
3. https://ocw.mit.edu/courses/mechanical-engineering/

**Assessment (Theory course)**

SAT, Activity and Learning Task(s)*, Mini project, MCQ, End Semester Examination (ESE)

**Course Curated by**

| Expert(s) from Industry | Expert(s) from Higher Education Institution | Internal Expert(s) |
|---|---|---|
| [Name, Organization] | [Name, Institution] | [Dr.M.Saravanabalaji] |

| | | | |
|---|---|---|---|
| **Recommended by BoS on** | XX/YY/2026 | | |
| **Academic Council Approval** | No. | **Date** | XX/YY/2026 |



BoS Chair

| 24EIE007 | Mobile Robotics | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 |
| PE | | SDG | 9,11,13 | | | |

| Pre-requisite courses | 24MA113, 24CSI103/24ECI103, 24EII303 | Data Book / Code book (If any) | Robotics Data Handbook |
|---|---|---|---|

| Course Objectives: | |
|---|---|
| The purpose of taking this course is to: | |
| 1 | understand the principles of mobile robot kinematics, sensing, and control in real-world environments. |
| 2 | develop skills in perception, localization, mapping, and navigation using modern robotic algorithms. |
| 3 | design and implement sustainable mobile robotic systems addressing industrial and societal challenges. |

| Course Outcomes | | |
|---|---|---|
| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
| CO 1 | Explain the principles of locomotion, kinematics, and mobile robot modelling | U |
| CO 2 | Apply control strategies and sensor integration techniques in mobile robots | Ap |
| CO 3 | Analyze perception systems and sensor fusion methods for mobile robots | An |
| CO 4 | Analyze localization and SLAM algorithms for autonomous navigation | An |
| CO 5 | Analyze path planning and navigation strategies in dynamic environments | An |

| Course Outcomes (CO) | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | PSO1 | PSO2 |
| | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 |
| 1 | 3 | 2 | 1 | - | 1 | - | - | - | - | - | - | 2 | 1 |
| 2 | 3 | 3 | 2 | 2 | 3 | - | - | - | - | - | - | 3 | 2 |
| 3 | 3 | 3 | 2 | 3 | 3 | 1 | - | - | - | - | - | 3 | 2 |
| 4 | 3 | 3 | 3 | 3 | 3 | 2 | - | - | - | - | - | 2 | 2 |
| 5 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 3 |



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| Course Content | |
|---|---|
| **INTRODUCTION & KINEMATICS**<br>• Mobile robot classifications (wheeled, legged, aerial)<br>• Sustainable robotics applications (smart cities, agriculture – SDG 11)<br>• Kinematic models, constraints, DOF<br>• Forward & inverse kinematics<br>**Practical Insight:** Simulation of differential drive robot | **9 Hours** |
| **CONTROL SYSTEMS**<br>Control basics (PID, feedback systems)--Stability, state-space models-- Energy-efficient control<br>**Practical Insight:** PID tuning in simulation | **9 Hours** |
| **PERCEPTION & SENSING**<br>Sensors: LiDAR, IMU, vision systems--Sensor fusion techniques--Environmental monitoring<br>**Practical Insight:** Sensor data fusion using ROS | **9 Hours** |
| **LOCALIZATION & SLAM**<br>Probabilistic localization -- Kalman Filter, Particle Filter --SLAM algorithms -- Smart infrastructure mapping<br>**Practical Insight:** Implement SLAM using ROS | **9 Hours** |
| **PATH PLANNING & NAVIGATION**<br>• Graph search (A*, D*)<br>• Potential field methods<br>• Multi-robot systems<br>• Autonomous transportation<br><br>**Practical Insight:** Path planning using Gazebo | **9 Hours** |

| Theory Hours: 45 | Tutorial Hours: 00 | Practical Hours: 00 | Project Hours: 00 | Total Hours: 45 |
|---|---|---|---|---|

| Learning Resources |
|---|
| **Textbooks:** |
| 1. Siegwart, Roland., Nourbakhsh, Illah R., Scaramuzza, Davide., *Introduction to Autonomous Mobile Robots.*, **2nd Edition**, MIT Press, Cambridge (2011). |
| **References:** |
| 1. Siciliano, Bruno., Sciavicco, Lorenzo., Villani, Luigi., Oriolo, Giuseppe., *Robotics: Modelling, Planning and Control.*, **2nd Edition**, Springer, London (2023).<br>2. Corke, Peter., *Robotics, Vision and Control: Fundamental Algorithms in MATLAB.*, **2nd Edition**, Springer, Cham (2017).<br>3. Thrun, Sebastian., Burgard, Wolfram., Fox, Dieter., *Probabilistic Robotics.*, MIT Press, Cambridge (Latest reprint 2022).<br>4. LaValle, Steven., *Planning Algorithms.*, Cambridge University Press, Cambridge (Latest digital edition 2020).<br>5. Fox, Dieter., "Monte Carlo Localization: Efficient Position Estimation for Mobile Robots.", *IEEE Transactions on Robotics and Automation*, Vol. 17 No. 2 (Latest indexed version): pp. 229–238, DOI: 10.1109/70.938381.<br>6. Cadena, Cesar., et al., "Past, Present, and Future of SLAM.", *IEEE Transactions on Robotics*, Vol. 32 No. 6 (Latest updated citation): pp. 1309–1332, DOI: 10.1109/TRO.2016.2624754. |
| **Online Educational Resources:** |



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1. NPTEL – Robotics & Control Courses
   https://nptel.ac.in/courses/106105171
2. SWAYAM – Robotics and AI Courses
   https://swayam.gov.in
3. MIT OpenCourseWare – Robotics
   https://ocw.mit.edu/courses/robotics
4. Coursera – Robotics Specialization (University of Pennsylvania)
   https://www.coursera.org/specializations/robotics
5. Control Tutorials for MATLAB & Simulink (CTMS)
   https://ctms.engin.umich.edu
6. ROS (Robot Operating System) Tutorials
   https://wiki.ros.org
7. Gazebo Simulation Platform
   https://gazebosim.org
8. Webots Robot Simulator
   https://cyberbotics.comSLAM Explained – YouTube
   https://www.youtube.com/watch?v=7C7sF6Kc6C0
9. Sensor Fusion in Robotics – YouTube
   https://www.youtube.com/watch?v=Fh7d9H6E5vM
10. Path Planning Algorithms – YouTube
    https://www.youtube.com/watch?v=5t8C7hQxV7A

| **Assessment (Theory course)** |
|---|
| SA, Activity and Learning Task(s), Mini project, MCQ, End Semester Examination (ESE) |

| **Course Curated by** | | | |
|---|---|---|---|
| **Expert(s) from Industry** | **Expert(s) from Higher Education Institution** | | **Internal Expert(s)** |
| [Name, Organization] | [Name, Institution] | | [Name, Department] |
| **Recommended by BoS on** | XX/YY/2024 | | |
| **Academic Council Approval** | No. | **Date** | XX/YY/2024 |



BoS Chair

| 24EIE008 | Autonomous Systems and Path Planning | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | | | | | |
| PE | | SDG | 9,11 | | | |

| Pre-requisite courses | | Data Book / Code book (If any) | • Robotics Toolbox Documentation<br>• ROS Documentation |
|---|---|---|---|

| Course Objectives: | |
|---|---|
| The purpose of taking this course is to: | |
| 1 | understand the fundamental concepts of autonomous systems, including robotics architecture, sensors, kinematics, path planning, localization, and AI techniques used in autonomous navigation. |
| 2 | apply analytical and problem-solving skills in modelling robotic systems, interpreting sensor data, and utilizing path planning and localization algorithms for autonomous navigation. |
| 3 | develop the ability to analyze and evaluate autonomous systems for real-world applications, ensuring efficient, reliable, and sustainable operation in engineering environments. |

| Course Outcomes | | |
|---|---|---|
| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
| CO 1 | explain fundamentals of autonomous systems and architectures | U |
| CO 2 | describe sensors and robot motion models | U |
| CO 3 | apply path planning algorithms for navigation problems | Ap |
| CO 4 | analyze localization and SLAM techniques | An |
| CO 5 | analyze AI techniques in autonomous systems | An |

| Course Outcomes (CO) | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | PSO1 | PSO2 |
| | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 |
| 1 | 3 | 2 | | | | | 1 | | 1 | | 2 | | |
| 2 | 3 | 3 | 2 | 2 | | | | | 1 | | 2 | | |
| 3 | 3 | 3 | 3 | 2 | | | | | 1 | | 2 | | |
| 4 | 3 | 3 | 2 | 3 | | | | | 1 | | 2 | | |
| 5 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 3 | | |

## Course Content

| INTRODUCTION TO AUTONOMOUS SYSTEMS | 09 Hours |
|---|---|
| Definition and classification of autonomous systems -- Evolution of robotics and automation -- Three Laws of Robotics and ethical considerations -- System | |



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| | |
|---|---|
| architecture of autonomous robots -- Applications in smart cities and infrastructure | |
| **SENSORS AND ACTUATION**<br>Proprioceptive sensors: encoders, gyroscopes -- Exteroceptive sensors: LiDAR, IR, ultrasonic --Sensor characteristics and uncertainty -- Sensor fusion concepts -- Sustainable sensing for smart infrastructure | **09 Hours** |
| **KINEMATICS AND DYNAMICS**<br>Forward and inverse kinematics -- Jacobian matrix and motion analysis-- Lagrangian dynamics-- Energy-efficient robot motion | **09 Hours** |
| **PATH AND MOTION PLANNING**<br>Classical algorithms: BFS, A*, Bug algorithms -- Configuration Space (C-space) -- Reactive methods: Potential fields-- Sampling-based planning: RRT, PRM -- Sustainable navigation for smart mobility | **09 Hours** |
| **LOCALIZATION, SLAM & AI**<br>Kalman Filter and Particle Filter -- Occupancy Grid Mapping—Graph SLAM-- Machine Learning and Reinforcement Learning -- AI for sustainable autonomous systems | **09 Hours** |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Theory Hours:** | **45** | **Tutorial Hours:** | **00** | **Practical Hours:** | **00** | **Project Hours:** | | **Total Hours:** | **45** |

**Learning Resources**

**Textbooks:**

1. R. Siegwart, I. R. Nourbakhsh, and D. Scaramuzza, *Introduction to Autonomous Mobile Robots*, 2nd ed., Cambridge, MA, USA: MIT Press, 2011.
2. S. Thrun, W. Burgard, and D. Fox, *Probabilistic Robotics*, Cambridge, MA, USA: MIT Press, 2005.

**References:**


1. LaValle, Steven M., *Planning Algorithms.*, Cambridge University Press, Cambridge (2006).
2. Siciliano, Bruno., *Robotics: Modelling, Planning and Control.*, Springer, London (2009).
3. Lynch, Kevin M., *Modern Robotics: Mechanics, Planning, and Control.*, Cambridge University Press, Cambridge (2017).
4. Russell, Stuart., *Artificial Intelligence: A Modern Approach.*, Pearson, Hoboken (2021).
5. Spong, Mark., *Robot Modeling and Control.*, Wiley, Hoboken (2020).
6. Murphy, Robin., *Introduction to AI Robotics.*, MIT Press, Cambridge (2019)
7. Thrun, Sebastian., "Robotic Mapping: A Survey.", Technical Report No. CMU-CS-02-111., Carnegie Mellon University, Pittsburgh, PA, USA, (2002)., DOI: 10.1184/R1/6609032
8. Fox, Dieter., "KLD-Sampling: Adaptive Particle Filters.", *Journal of Artificial Intelligence Research*, Vol. 22 No. 3 (2004): pp. 123–156, DOI: 10.1613/jair.1319, https://doi.org/10.1613/jair.1319
9. Karaman, Sertac., "Sampling-based Algorithms for Optimal Motion Planning.", Proceedings of IEEE International Conference on Robotics and Automation, Paper #: pp. 1238–1245, Shanghai, China, May 9–13, 2011., DOI: 10.1109/ICRA.2011.5980567., https://ieeexplore.ieee.org/document/5980567


**Online Educational Resources:**



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1. **NPTEL (AI & Robotics Courses)**
   https://nptel.ac.in/courses/106105171
2. **SWAYAM (Government of India MOOCs)**
   https://swayam.gov.in
3. **MIT OpenCourseWare – Robotics**
   https://ocw.mit.edu/courses/robotics/
4. **Coursera – Autonomous Systems & Robotics**
   https://www.coursera.org
5. **edX – Artificial Intelligence & Robotics Programs**
   https://www.edx.org
6. **ROS (Robot Operating System) Official Documentation**
   https://www.ros.org
7. **Gazebo Simulator Documentation**
   https://gazebosim.org
8. **OpenCV Documentation (Computer Vision)**
   https://docs.opencv.org
9. **MATLAB Robotics Toolbox**
   https://www.mathworks.com/products/robotics.html

| **Assessment (Theory course)** |
|---|
| SAT, Activity and Learning Task(s) , Mini project, MCQ, End Semester Examination (ESE) |

| **Course Curated by** | | | |
|---|---|---|---|
| **Expert(s) from Industry** | **Expert(s) from Higher Education Institution** | | **Internal Expert(s)** |
| [Name, Organization] | [Name, Institution] | | [Name, Department] |
| **Recommended by BoS on** | XX/YY/2024 | | |
| **Academic Council Approval** | No. | **Date** | XX/YY/2024 |



BoS Chair

| 24EIE009 | Digital Manufacturing | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 |
| Course Category – Professional Elective | | SDG | SDG 9, SDG 12 | | | |

| Pre-requisite courses | 24EII202,24EII203, 24EII306 | Data Book / Code book (If any) | ISO Digital Manufacturing and Industry 4.0 Standards |
|---|---|---|---|

| Course Objectives: | |
|---|---|
| The purpose of taking this course is to: | |
| 1 | To understand digital manufacturing and Industry 4.0 technologies used in modern industries. |
| 2 | To apply digital manufacturing tools such as IoT and additive manufacturing in production systems. |
| 3 | To utilize digital manufacturing concepts to improve productivity and sustainability in industrial operations. |

| Course Outcomes | | |
|---|---|---|
| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
| CO 1 | Explain the fundamentals of digital manufacturing and Industry 4.0 concepts | U |
| CO 2 | Describe the role of IoT and cyber-physical systems in smart manufacturing | U |
| CO 3 | Apply digital twin and simulation concepts in manufacturing systems | Ap |
| CO 4 | Explain additive manufacturing processes and technologies | U |
| CO 5 | Apply basic data analytics techniques used in smart manufacturing | Ap |

| Course Outcomes (CO) | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | |
| | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 |
| CO1 | 3 | 2 | – | – | – | 2 | – | – | 2 | – | 2 | 2 | 2 |
| CO2 | 3 | 3 | 2 | – | 2 | 2 | – | – | 2 | – | 2 | 2 | 3 |
| CO3 | 3 | 3 | 3 | 2 | 3 | 2 | – | – | 2 | – | 3 | 3 | 3 |
| CO4 | 3 | 2 | 2 | – | 2 | 2 | – | – | 2 | – | 2 | 2 | 2 |
| CO5 | 3 | 3 | 2 | 2 | 3 | 3 | – | 2 | 3 | 2 | 3 | 3 | 3 |

## Course Content

| | |
|---|---|
| **DIGITAL MANUFACTURING AND INDUSTRY 4.0**<br>Evolution of Manufacturing Systems -Digital Manufacturing Concepts -Industry 4.0 Architecture - Smart Factory Systems - Cyber-Physical Systems -Digital Transformation | **9 Hours** |
| **INDUSTRIAL INTERNET OF THINGS (IIOT)**<br>Industrial IoT Architecture -Sensors and Actuators Integration -Industrial Communication Protocols-Edge and Cloud Computing -Industrial Cybersecurity | **9 Hours** |



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| | |
|---|---|
| **DIGITAL TWIN AND SIMULATION**<br>Digital Twin Concept- Modelling and Simulation - Virtual Manufacturing -Predictive Maintenance - Smart System Monitoring | **9 Hours** |
| **MODULE 4: ADDITIVE MANUFACTURING**<br>Additive Manufacturing Principles - 3D Printing Technologies - Materials for Additive manufacturing - Rapid Prototyping - Design for Additive Manufacturing | **9 Hours** |
| **MODULE 5: DATA ANALYTICS AND SMART MANUFACTURING**<br>Manufacturing Data Analytics - Big Data in Manufacturing - Machine Learning in Manufacturing - Predictive Maintenance - Quality Monitoring Systems | **9 Hours** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Theory Hours:** | **45** | **Tutorial Hours:** | **0** | **Practical Hours:** | **0** | **Project Hours:** | **0** | **Total Hours:** | **45** |

**Learning Resources**

**Textbooks:**

1. M. P. Groover, Automation, Production Systems, and Computer-Integrated Manufacturing, 4th ed. Noida, India: Pearson Education, 2020.
2. A. Gilchrist, Industry 4.0: The Industrial Internet of Things. New York, NY, USA: Apress, 2019.

**References:**

1. F. Tao and A. Y. C. Nee, Digital Twin Driven Smart Manufacturing. London, U.K.: Academic Press, 2019.
2. G. Chryssolouris, Manufacturing Systems: Theory and Practice, 2nd ed. New York, NY, USA: Springer, 2006
3. J. Lee, B. Bagheri, and H. A. Kao, Industrial Artificial Intelligence. Cham, Switzerland: Springer, 2020
4. K. Schwab, The Fourth Industrial Revolution. Geneva, Switzerland: World Economic Forum, 2017.

**Online Educational Resources:**

1. https://nptel.ac.in/courses/106105195
2. https://onlinecourses.nptel.ac.in/noc21_mg83/preview
3. Coursera — Digital Manufacturing and Design

**Assessment (Theory course)**

SA, Activity and Learning Task(s) - Think–Pair–Share, Case Study, Concept Mapping , Mini project, MCQ, End Semester Examination (ESE)

**Course Curated by**

| Expert(s) from Industry | Expert(s) from Higher Education Institution | | Internal Expert(s) |
|---|---|---|---|
| [Name, Organization] | [Name, Institution] | | [E.Muthuramalingam] |
| **Recommended by BoS on** | XX/YY/2024 | | |
| **Academic Council Approval** | No. | **Date** | XX/YY/2024 |



BoS Chair

| 24EIE011 | Collaborative Robots (Cobots) | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 |
| PE | | SDG | 4, 8, 9, 12 | | | |

| Pre-requisite courses | | Data Book / Code book (If any) | |
|---|---|---|---|

**Course Objectives:**

The purpose of taking this course is to:

| | |
|---|---|
| 1 | To develop knowledge of collaborative robot systems, kinematics, control strategies, and safety standards for human-robot interaction. |
| 2 | To understand and implement cobot programming, sensor integration, and industrial communication for real-time automation applications. |
| 3 | To design and analyze collaborative robotic systems for industrial tasks, integrating Industry 4.0 concepts and productivity considerations. |

**Course Outcomes**

| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
|---|---|---|
| CO 1 | Explain the fundamentals of collaborative robots, architecture, sensors, actuators, and end effectors. | **Understand - K2** |
| CO 2 | Apply kinematic and control principles for motion and operation of collaborative robots. | **Apply - K3** |
| CO 3 | Apply concepts of human-robot interaction and safety standards for collaborative robotic systems. | **Apply - K3** |
| CO 4 | Implement cobot programming, communication, and integration with sensors and PLC systems. | **Apply - K3** |
| CO 5 | Apply collaborative robotic systems for industrial applications such as assembly, material handling, and inspection. | **Apply - K3** |

| Course Outcomes (CO) | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 Engineering Knowledge | 2 Problem Analysis | 3 Design/Development of Solutions | 4 Conduct Investigations of | 5 Engineering Tool Usage | 6 The Engineer and The World | 7 Ethics | 8 Individual and Collaborative Team | 9 Communication | 10 Project Management and Finance | 11 Life-Long Learning | PSO-1 | PSO-2 |
| 1 | **3** | **2** | **–** | **–** | **2** | **–** | **–** | **–** | **–** | **–** | **1** | **2** | **2** |
| 2 | **3** | **2** | **2** | **–** | **3** | **–** | **–** | **–** | **–** | **–** | **1** | **2** | **3** |
| 3 | **2** | **2** | **2** | **–** | **2** | **2** | **2** | **–** | **–** | **–** | **1** | **2** | **3** |
| 4 | **2** | **2** | **2** | **–** | **3** | **–** | **–** | **–** | **–** | **–** | **1** | **2** | **3** |
| 5 | **2** | **2** | **2** | **–** | **2** | **2** | **2** | **–** | **–** | **–** | **1** | **2** | **3** |

**Course Content**

| **Fundamentals of Collaborative Robotics** | **9 Hours** |
|---|---|
| Introduction to collaborative robots (Cobots) - Difference between industrial robots and cobots - Evolution of human-robot collaboration - Levels of collaboration: Coexistence, Sequential collaboration, Cooperation, Responsive | |



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|---|---|
| collaboration - Architecture and components of cobots - Degrees of freedom (DOF) and manipulators - Advantages and limitations of cobots | |
| **Kinematics and Control of Cobots**<br>Forward and inverse kinematics - Coordinate transformations and homogeneous matrices -Jacobian matrix and singularity analysis - Differential motion and velocity control - Robot dynamics (basic concepts) - Control strategies: PID control, Impedance and admittance control - Force control in collaborative robots | **9 Hours** |
| **Human-Robot Interaction (HRI) and Safety**<br>Fundamentals of Human-Robot Interaction (HRI) - Human intention and behaviour modelling - Safety in collaborative robotics - International standards: ISO 10218, ISO/TS 15066 - Risk assessment and hazard analysis - Safety modes: Power and force limiting, Speed and separation monitoring - Ergonomics and human factors | **9 Hours** |
| **Programming and Integration of Cobots**<br>Cobot programming methods: Teach pendant programming, Lead-through programming, Offline programming - Graphical and script-based programming - Integration with: PLC systems, Sensors and vision systems, End effectors - Communication protocols (Ethernet/IP, PROFINET, OPC-UA) - ROS/ROS2 basics for cobots - IIoT integration for collaborative systems | **9 Hours** |
| **Applications and Industrial Implementation**<br>Applications of cobots: Material handling, Machine tending, Assembly operations, Inspection and quality control - Robot cell design and layout - Multi-robot collaboration - Case studies of cobot deployment - Productivity and economic analysis - Future trends: AI in cobots, Smart factories and Industry 4.0 | **9 Hours** |

| **Theory Hours:** | **45** | **Tutorial Hours:** | **0** | **Practical Hours:** | **0** | **Project Hours:** | **Total Hours:** | 45 |
|---|---|---|---|---|---|---|---|---|

**Learning Resources**

**Textbooks:**

1. Siciliano, B., Sciavicco, L., Villani, L., & Oriolo, G. (2019). *Robotics: Modelling, planning and control*. Springer.
2. Craig, J. J. (2018). *Introduction to robotics: Mechanics and control* (4th ed.). Pearson Education.
3. Niku, S. B. (2020). *Introduction to robotics: Analysis, control, applications* (3rd ed.). Wiley India.

**References:**

1. Spong, M. W., Hutchinson, S., & Vidyasagar, M. (2020). *Robot modeling and control* (2nd ed.). Wiley.
2. Haddadin, S., & Croft, E. (2016). *Physical human–robot interaction*. Springer.
3. Matheson, E., Minto, R., Zampieri, E. G., Faccio, M., & Rosati, G. (2019). *Human–robot collaboration in manufacturing applications: A review*. Robotics and Computer-Integrated Manufacturing.
4. Groover, M. P. (2020). *Automation, production systems, and computer-integrated manufacturing* (4th ed.). Pearson Education.

**Online Educational Resources:**

1. https://onlinecourses.nptel.ac.in/noc25_me86/preview?utm_source=chatgpt.com - Covers safety, kinematics, force control, and applications
2. https://nptel.ac.in/courses/107106090?utm_source=chatgpt.com - Fundamentals of robotics, kinematics, and system components
3. https://onlinecourses.nptel.ac.in/noc21_me76/preview?utm_source=chatgpt.com - Covers robot structure, DOF, workspace, and industrial relevance



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|---|
| 4. https://nptel.ac.in/courses/112107289?utm_source=chatgpt.com - Focus on control systems and robotics applications |

| **Assessment (Theory course)** |
|---|
| SA, Activity and Learning Task(s) - Think–Pair–Share, Case Study, Concept Mapping , Mini project, MCQ, End Semester Examination (ESE) |

| **Course Curated by** | | | |
|---|---|---|---|
| **Expert(s) from Industry** | **Expert(s) from Higher Education Institution** | **Internal Expert(s)** | |
| [Name, Organization] | [Name, Institution] | [Name, Department] | |
| **Recommended by BoS on** | XX/YY/2024 | | |
| **Academic Council Approval** | No. | **Date** | XX/YY/2024 |



BoS Chair

| 24EII013 | SMART FARMING | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 |
| PE | | SDG | 12 ,6 | | | |

| Pre-requisite courses | Sensors, Basics of IOT | Data Book / Code book (If any) | - |
|---|---|---|---|

| Course Objectives: | |
|---|---|
| The purpose of taking this course is to: | |
| 1 | To know about the basics of sensing and control algorithm in farming. |
| 2 | To understand the efficiency of farming through technology |
| 3 | To explore image processing and Machine learning software tools for agriculture. |

| Course Outcomes | | |
|---|---|---|
| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
| CO 1 | Relate a farming with industrial problem and solving it. | An |
| CO 2 | Explain the process in growing a particular crop varieties and challenges associated with it. | U |
| CO 3 | Apply the knowledge to select suitable sensors and software for particular test case | Ap |
| CO 4 | Analyse anomaly and weather change beforehand. | An |
| CO 5 | Build an exclusive irrigation and harvest plan for a zone. | Ap |

| Course Outcomes (CO) | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | |
| | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 |
| 1 | 2 | 2 | 2 | 1 | 1 | - | - | - | - | - | - | - | - |
| 2 | 3 | 3 | 3 | 3 | 1 | - | - | - | - | - | - | - | 1 |
| 3 | 3 | 2 | 2 | 2 | 1 | - | - | - | - | - | - | 1 | 1 |
| 4 | 3 | 3 | 3 | 2 | 1 | - | - | - | - | - | - | 1 | 1 |
| 5 | 3 | 2 | 2 | 2 | 1 | - | - | - | - | - | - | 2 | 2 |

## Course Content

| INTRODUCTION | 9 Hours |
|---|---|
| History of Precision farming- Sensing Technology- Control Algorithm- Yield Monitoring- Soil Property Sensing- Acquisition through Remote Sensing- Crop Information- Farmland Data- Spatial Sensing- Temporal Sensing- Feedback Control | |



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|---|---|
| **MACHINE LEARNIG IN AGRICULTURE**<br>Machine Learning in Agriculture- Deep Learning in Agriculture- Yield prediction- Weed Detection-Irrigation Management- Discrimination between Weed and Crop- Forecasting stages. | **9 Hours** |
| **IOT IN AGRICULTURE**<br>Need of IoT- IoT in Agriculture- Case study: Protection of Agricultural land from Elephants- Irrigation and Water Quality Management- Monitoring- Farm-Soil- Aquaponics- Agricultural Machinery- Disease and Pest Control-Challenges and Issues. | **9 Hours** |
| **DRONE IN AGRICULTURE**<br>Drones in Agriculture- Agricultural Drones- Types of Drones and Classifications – Definitions and Terminologies- Study of Natural Resources and Vegetation- Mapping and Monitoring | **9 Hours** |
| **AGRICULTURE 5.0**<br>Introduction to Agriculture 4.0- Remote Sensing- Application of Nanotechnology in Agriculture- Role of Big data- Hurdles faced by Farmers in Adopting- Current Policy Trends and Regulation. | **9 Hours** |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Theory Hours:** | **45** | **Tutorial Hours:** | **0** | **Practical Hours:** | **0** | **Project Hours:** | **0** | **Total Hours:** | **45** |

**Learning Resources**

**Textbooks:**

1. 1.Latief Ahmad, Firasath Nabi, "Agriculture 5.0 – Artificial Intelligence, IoT and Machine learning", CRC Press, 2021.
2. Qin Zhang, "Precision Agriculture Technology for Crop Farming", CRC Press,2016

**References:**

1. Govind Singh Patel, "Smart Agriculture", CRC Press, 2021.
2. Ajith Abraham, Sujata Dash, Joel J.P.C.Rodrigues, "AI Edge and IoT based smart agriculture", 2021, Elsevier
3. Amitava Choudhury, Arindam Biswas, T.P.Singh, Santanu Kumar Ghosh, "Smart Agriculture Automation using Advanced Technologies", 2021, Springer

**Online Educational Resources:**

1. . https://onlinecourses.nptel.ac.in/noc22_bt25/preview
2. . https://www.intechopen.com/chapters/76652
3. . https://1lib.in/book/5402770/65c33e?dsource=recommend
4. . https://1lib.in/book/3581147/d6c544?dsource=recommend
5. . https://archive.nptel.ac.in/courses/126/104/126104002/

**Assessment (Theory course)**

SA, Activity and Learning Task(s)* , Mini project, MCQ, End Semester Examination (ESE)



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| Course Curated by | | | |
|---|---|---|---|
| **Expert(s) from Industry** | **Expert(s) from Higher Education Institution** | | **Internal Expert(s)** |
| [Name, Organization] | [Name, Institution] | | Mr. V. ATHAPPAN – AP-II/E&I |
| **Recommended by BoS on** | | | |
| **Academic Council Approval** | | **Date** | |



BoS Chair

# Healthcare Instrumentation



BoS Chair

BoS Chair

| 24EIE021 | Bio Sensors and Medical Instrumentation | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 |
| PE | | SDG | 3 , 9 | | | |

| Pre-requisite courses | | Data Book / Code book (If any) | - |
|---|---|---|---|

| Course Objectives: | |
|---|---|
| The purpose of taking this course is to: | |
| 1 | build literacy in bioelectric and biomagnetic phenomena underlying medical sensors. |
| 2 | develop competence in biopotential amplifiers, electrode systems, and noise mitigation. |
| 3 | introduce medical device electrical safety per IEC 60601 with sustainability framing. |

| Course Outcomes | | |
|---|---|---|
| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
| CO 1 | explain the origin of bioelectric and bio-magnetic signals (ECG, EEG, EMG, EOG). | U |
| CO 2 | design biopotential amplifier front-ends meeting CMRR and isolation requirements. | An |
| CO 3 | apply electrode selection criteria (Ag/AgCl, dry, capacitive) to clinical contexts. | Ap |
| CO 4 | configure instrumentation for non-electrical physiological measurements (BP, $SpO_2$, temp, respiration). | Ap |
| CO 5 | apply IEC 60601-1 electrical-safety classifications to device design | An |

| Course Outcomes (CO) | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | |
| | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 |
| 1 | 3 | 2 | - | - | - | - | - | - | - | - | 1 | 3 | 1 |
| 2 | 3 | 3 | 2 | - | 2 | - | - | - | - | - | 1 | 3 | 1 |
| 3 | 2 | 3 | 2 | - | 2 | - | - | - | - | - | 1 | 3 | 1 |
| 4 | 2 | 3 | 2 | - | 2 | 3 | 2 | - | - | - | 1 | 3 | 1 |
| 5 | 2 | 2 | 2 | - | - | 3 | 2 | - | - | - | 1 | 3 | 2 |

| Course Content | |
|---|---|
| **BIOELECTRIC ORIGINS AND PHYSIOLOGICAL SIGNALS**<br>Membrane potentials; action potential; cardiac cycle; ECG/EEG/EMG/EOG origins; signal characteristics, Brief introduction to wearable PPG and continuous-glucose-monitor signals<br>**Case Study**<br>• Wearable ECG and Continuous Glucose Monitoring System | **09 Hours** |



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|---|---|
| **ELECTRODES & BIOPOTENTIAL AMPLIFIERS**<br>Types of electrodes: Ag/AgCl electrodes; electrode-electrolyte interface; Signal acquisition systems -Noise and interference in biomedical signals instrumentation amplifiers; CMRR; isolation amplifiers; driven-right-leg; Dry and capacitive electrodes for wearables; INA819-class modern instrumentation amplifier ICs<br>**Case Study**<br>• ICU ECG Acquisition System using Instrumentation Amplifier | **09 Hours** |
| **NON-ELECTRICAL PHYSIOLOGICAL MEASUREMENTS**<br>Blood pressure measurement systems(oscillometric, auscultatory);$SpO_2$; Temperature; respiration; - blood-flow (Doppler basics);Cuffless BP awareness with accuracy caveats; multi-wavelength pulse oximetry<br>**Case Study**<br>• Smart Pulse Oximeter and Cuffless BP Monitoring | **09 Hours** |
| **PATIENT MONITORING SYSTEMS**<br>Multi-parameter monitors; alarms; trends; ICU and OT instrumentation; Networked monitors; HL7 / FHIR awareness;<br>**Case Study**<br>• Smart ICU Multi-Parameter Monitoring System | **09 Hours** |
| **ELECTRICAL SAFETY & SUSTAINABILITY**<br>Electrical safety in medical equipment - Macroshock and microshock; leakage currents; equipment classes (I, II); applied parts (B, BF, CF); IEC 60601-1 latest edition updates; sustainability — reusable vs. single-use trade-offs; reprocessing standards<br>**Case Study**<br>• IEC 60601-Based Electrical Safety Testing in Hospitals | **09 Hours** |

| Theory Hours: 45 | Tutorial Hours: 00 | Practical Hours: 00 | Project Hours: 00 | Total Hours: 45 |
|---|---|---|---|---|

**Learning Resources**

**Textbooks:**


1. R. S. Khandpur, *Handbook of Biomedical Instrumentation*, 4th ed., New Delhi, India: McGraw Hill Education, 2020.
2. J. G. Webster and J. W. Clark, *Medical Instrumentation: Application and Design*, 5th ed., Hoboken, NJ, USA: Wiley, 2018.


**References:**


1. J. Carr and J. Brown, *Introduction to Biomedical Equipment Technology*, 5th ed., London, U.K.: Pearson, 2021.
2. J. Enderle and S. Blanchard, *Introduction to Biomedical Engineering*, 3rd ed., Burlington, MA, USA: Elsevier, 2019.
3. A. Turner, "Biosensors: Fundamentals and Applications," *IEEE Sensors Journal*, vol. 21, no. 5, pp. 5678–5690, 2021.


**Online Educational Resources:**

NPTEL / SWAYAM Courses

- **Biomedical Instrumentation**
  https://nptel.ac.in/courses/108105101
- **Biosensors and Applications**
  https://swayam.gov.in/nd2_cec20_bt08/preview
- **Medical Devices and Healthcare Technology**
  https://nptel.ac.in/courses/102106065



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**MOOC Platforms**

1. **Digital Health and Wearable Technologies (Coursera)**
   https://www.coursera.org/learn/digital-health
2. **Introduction to Biomedical Engineering (Coursera)**
   https://www.coursera.org/learn/biomedical-engineering
3. **AI in Healthcare (edX)**
   https://www.edx.org/course/ai-for-healthcare

**IEEE & Research Resources**

1. **IEEE Xplore – Biosensors Collection**
   https://ieeexplore.ieee.org
2. **Nature Biomedical Engineering Journal**
   https://www.nature.com/natbiomedeng
3. **PubMed Central (Biomedical Articles)**
   https://www.ncbi.nlm.nih.gov/pmc

**Visual Learning (YouTube – Educational Channels)**

1. **Biomedical Instrumentation Lectures (NPTEL)**
   https://www.youtube.com/playlist?list=PLbMVogVj5nJQJqJkFvFzYw5dQkX9X2sFJ
2. **Biosensors Explained (Learn Engineering)**
   https://www.youtube.com/watch?v=QG2J0ZzZ1eE
3. **Medical Imaging Systems (MRI/CT Basics)**
   https://www.youtube.com/watch?v=6I3z2H9s0tM

**Simulation & Practical Learning Tools**

1. **NI Multisim (Circuit Simulation)**
   https://www.ni.com/en-in/shop/multisim.html
2. **MATLAB for Biomedical Signal Processing**
   https://www.mathworks.com/solutions/biomedical-engineering.html
3. **LabVIEW for Medical Instrumentation**
   https://www.ni.com/en-in/shop/labview.html

| **Assessment (Theory course)** |
|---|
| SA, Activity and Learning Task(s) , Mini project, MCQ, End Semester Examination (ESE) |

| **Course Curated by** | | | |
|---|---|---|---|
| **Expert(s) from Industry** | **Expert(s) from Higher Education Institution** | | **Internal Expert(s)** |
| [Name, Organization] | [Name, Institution] | | [Name, Department] |
| **Recommended by BoS on** | XX/YY/2026 | | |
| **Academic Council Approval** | No. | **Date** | XX/YY/2026 |



BoS Chair

| 24EIE022 | Bio Signal Processing | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 |
| PE | | SDG | 3, 9 | | | |

| Pre-requisite courses | 24EII204, 24EII202 | Data Book / Code book (If any) | • Biomedical Signal Standards (ECG/EEG Databases),<br>• IEEE Signal Processing Guidelines |
|---|---|---|---|

**Course Objectives:**

The purpose of taking this course is to:

| | |
|---|---|
| 1 | Acquire knowledge of bio-signals and acquisition techniques and analyze preprocessing methods for biomedical applications. |
| 2 | Apply digital signal processing techniques to analyze bio-signals and extract meaningful features. |
| 3 | Develop knowledge of biomedical signal interpretation to evaluate signal features for healthcare applications. |

**Course Outcomes**

| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
|---|---|---|
| CO1 | Explain the classification,origin and characteristics of bio signals (ECG, EEG, EMG)and identify noise sources and artifacts | U |
| CO2 | Describe bio signal acquisition and preprocessing techniques | U |
| CO3 | Apply digital signal processing( digital filtering) techniques for bio signal enhancement | Ap |
| CO4 | Analyse bio signals using time and frequency domain analysis methods | Ap |
| CO5 | Apply feature extraction techniques for biomedical signal interpretation | Ap |

| Course Outcomes (CO) | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | |
| | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 |
| CO1 | 3 | 2 | – | – | – | 2 | – | – | 2 | – | 2 | 3 | 2 |
| CO2 | 3 | 3 | 2 | – | 2 | 2 | – | – | 2 | – | 2 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 2 | 3 | 2 | – | – | 2 | – | 3 | 3 | 3 |
| CO4 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | – | 2 | – | 3 | 3 | 2 |
| CO5 | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 3 | 3 |

**Course Content**

| **INTRODUCTION TO BIOSIGNALS**<br>Classification of bio signals – Bioelectric, Bioacoustics and Biochemical signals – Origin of bioelectric signals – Characteristics of ECG, EEG and EMG – Noise sources and artifacts – Basics of biomedical instrumentation | **9 Hours** |
|---|---|



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| | |
|---|---|
| **BIOSIGNAL ACQUISITION & PREPROCESSING**<br>Electrode types and characteristics – Signal acquisition system – Instrumentation amplifiers – Noise and interference (power line, motion artifacts) – Analog filtering (LPF, HPF, BPF) – Sampling and quantizatio | **9 Hours** |
| **DIGITAL SIGNAL PROCESSING OF BIOSIGNALS**<br>Discrete-time bio signals – Digital filters (FIR, IIR) – Filter design for ECG/EEG – Signal averaging – Adaptive filtering – Noise cancellation techniques | **9 Hours** |
| **TIME & FREQUENCY DOMAIN ANALYSIS**<br>Time-domain analysis (mean, variance, RMS) – Frequency-domain analysis (FFT, PSD) – Short-time analysis – Introduction to wavelet transform – Time-frequency representation | **9 Hours** |
| **FEATURE EXTRACTION & APPLICATIONS**<br>Feature extraction techniques – ECG feature extraction (QRS detection) – EEG signal analysis – EMG interpretation – Biomedical signal classification basics – Healthcare monitoring systems | **9 Hours** |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Theory Hours:** | **45** | **Tutorial Hours:** | **0** | **Practical Hours:** | **0** | **Project Hours:** | **0** | **Total Hours:** | **45** |

**Learning Resources**

**Textbooks:**

1. R. M. Rangayyan, *Biomedical Signal Analysis: A Case-Study Approach*, 2nd ed., Hoboken, NJ, USA: Wiley-IEEE Press, 2015.
2. W. J. Tompkins, *Biomedical Digital Signal Processing: C-Language Examples and Laboratory Experiments for the IBM PC*, New Delhi, India: Prentice Hall of India, 2001.

**References:**

1. D. C. Reddy, *Biomedical Signal Processing: Principles and Techniques*, 2nd ed., New Delhi, India: McGraw Hill Education, 2019.
2. J. G. Webster, *Medical Instrumentation: Application and Design*, 4th ed., Hoboken, NJ, USA: Wiley, 2010.
3. L. Sörnmo and P. Laguna, *Bioelectrical Signal Processing in Cardiac and Neurological Applications*, Amsterdam, Netherlands: Elsevier Academic Press, 2005.

**Online Educational Resources:**

1. NPTEL – Biomedical Signal Processing
   a. https://nptel.ac.in/courses/108105101
2. Coursera – Digital Signal Processing Applications
3. PhysioNet – Open Biosignal Databases
   a. https://physionet.org/content/?topic=biosignal

**Assessment (Theory course)**

SA, Activity and Learning Task(s)*, Mini project, MCQ, End Semester Examination (ESE)

**Course Curated by**

| Expert(s) from Industry | Expert(s) from Higher Education Institution | Internal Expert(s) |
|---|---|---|
| [Name, Organization] | [Name, Institution] | |

| | | | |
|---|---|---|---|
| **Recommended by BoS on** | XX/YY/2026 | | |
| **Academic Council Approval** | No. | **Date** | XX/YY/2026 |



BoS Chair

| 24EII023 | Clinical Support and Laboratory Equipment | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 2 | 0 | 2 | 0 | 3 |
| PE | | SDG | 3 , 9 | | | |

| Pre-requisite courses | 24EIE021<br>24EIE201 | Data Book / Code book (If any) | IEC 60601 Standards Manual<br>NABL / NABH Guidelines Handbook<br>WHO Medical Device Technical Series |
|---|---|---|---|

**Course Objectives:**

The purpose of taking this course is to:

| | |
|---|---|
| 1 | Understand the principles and working of clinical support and laboratory equipment |
| 2 | Develop skills in operation and calibration of hospital equipment systems |
| 3 | Analyse the performance characteristics of fluid, gas, and laboratory equipment |
| 4 | Understand maintenance practices and operational issues in clinical equipment |
| 5 | Apply knowledge of safety procedures and standard practices in hospital environments |

**Course Outcomes**

| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
|---|---|---|
| CO 1 | Explain the principles of clinical support and laboratory equipment | U |
| CO 2 | Apply operational procedures for hospital support systems | Ap |
| CO 3 | Apply calibration techniques for clinical equipment | Ap |
| CO 4 | Analyse the performance of fluid, gas, and laboratory equipment | An |
| CO 5 | Analyse maintenance requirements and operational issues in hospital equipment | An |

| Course Outcomes (CO) | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | |
| | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 |
| 1 | 1 | 3 | 2 | - | - | 1 | - | - | - | - | - | - | 3 |
| 2 | 2 | 3 | 3 | 2 | 1 | 3 | - | - | - | 1 | - | - | 3 |
| 3 | 3 | 3 | 3 | 2 | 2 | 3 | - | - | - | 1 | - | - | 3 |
| 4 | 4 | 3 | 3 | 2 | 3 | 2 | - | - | - | - | - | - | 3 |
| 5 | 5 | 3 | 3 | 2 | 3 | 2 | - | - | - | 1 | 1 | 2 | 3 |

## Course Content

| | |
|---|---|
| **STERILIZATION & DISINFECTION EQUIPMENT**<br>Autoclave, hot air oven, ethylene oxide sterilizer, UV sterilization, sterilization cycles, infection control practices | **6 Hours** |
| **Practical**<br>• Autoclave operation and parameter setting<br>• Sterilization cycle validation (temperature & pressure study) | **6 Hour** |



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|---|---|
| **LABORATORY EQUIPMENT**<br>Centrifuge, spectrophotometer, blood analysers, microscopes, lab automation<br>**Practical:**<br>• Centrifuge speed calibration and separation study<br>• Spectrophotometer absorbance measurement | **6 Hours**<br><br><br>**6 Hours** |
| **FLUID DELIVERY & INFUSION SYSTEMS**<br>Infusion pumps, syringe pumps, dialysis machines, flow control, safety<br>**Practical (6 hrs):**<br>• Infusion pump flow rate calibration<br>• Syringe pump setup and testing | **6 Hours**<br><br><br>**6 Hours** |
| **SUCTION & GAS DELIVERY SYSTEMS**<br>Suction apparatus, oxygen delivery systems, anesthesia machines, gas pipelines<br>**Practical:**<br>• Suction apparatus performance testing<br>• Oxygen flow meter calibration | **6 Hours**<br><br><br>**6 Hours** |
| **HOSPITAL SUPPORT SYSTEMS & EQUIPMENT MANAGEMENT**<br>Hospital beds, incubators, phototherapy units, patient lifting systems, waste management, lifecycle, NABH & ISO<br>**Practical :**<br>• Infant incubator parameter testing<br>• Safety inspection and maintenance log preparation | **6 Hours**<br><br><br>**6 Hours** |

| **Theory Hours: 30** | **Tutorial Hours: 0** | **Practical Hours: 30** | **Project Hours: 0** | **Total Hours: 60** |
|---|---|---|---|---|

**Learning Resources**

**Textbooks:**


1. Khandpur, R.S., Biomedical Instrumentation, McGraw Hill Education, New Delhi (2014).
2. Cromwell, Leslie., Biomedical Instrumentation and Measurements, Pearson Education, New Delhi (2011).


**References:**


1. Bronzino, Joseph D., The Biomedical Engineering Handbook, CRC Press, Boca Raton (2015).
2. Carr, Joseph J., and Brown, John M., Introduction to Biomedical Equipment Technology, Pearson Education, New Delhi (2014).
3. Webster, John G., Medical Instrumentation: Application and Design, Wiley India, New Delhi (2014).
4. World Health Organization (WHO), Medical Device Technical Series, WHO Press, Geneva (2017).
5. International Electrotechnical Commission (IEC), IEC 60601 – Medical Electrical Equipment Standards, IEC, Geneva (Latest Edition).
6. National Accreditation Board for Hospitals (NABH), Accreditation Standards for Hospitals, Quality Council of India, New Delhi (Latest Edition).




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**Online Educational Resources:**

1. National Programme on Technology Enhanced Learning (NPTEL), Biomedical Instrumentation, https://nptel.ac.in/courses/108105101
2. SWAYAM, Healthcare Technology and Medical Devices, https://swayam.gov.in
3. World Health Organization – Medical Device Technical Resources, https://www.who.int/health-topics/medical-devices
4. International Electrotechnical Commission – Medical Equipment Standards (IEC 60601), https://www.iec.ch
5. National Accreditation Board for Hospitals & Healthcare Providers – NABH Standards and Guidelines, https://nabh.co
6. Coursera, Medical Device and Healthcare Technology Courses, https://www.coursera.org

| **Assessment (Theory course)** |
|---|
| SAT, Activity and Learning Task(s), Mini project, MCQ, End Semester Examination (ESE) |

**Course Curated by**

| **Expert(s) from Industry** | **Expert(s) from Higher Education Institution** | **Internal Expert(s)** |
|---|---|---|
| [Name, Organization] | [Name, Institution] | Dr.I.Jeya Daisy., Assistant Professor-II./EIE., |
| **Recommended by BoS on** | XX/YY/2024 | |
| **Academic Council Approval** | No. | **Date** XX/YY/2024 |



BoS Chair

| 24EIE025 | Bio-MEMS and Lab-on-Chip Systems | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 |
| PE | | SDG | 3, 9 | | | |

| Pre-requisite courses | 24EII202 | Data Book / Code book (If any) | • IEEE MEMS and Sensors Chapter |
|---|---|---|---|

| Course Objectives: | |
|---|---|
| The purpose of taking this course is to: | |
| 1 | Acquire knowledge of Bio-MEMS fabrication techniques and materials used in biomedical systems. |
| 2 | Analyze microfluidic systems and understand fluid transport at microscale. |
| 3 | Develop skills in simulation, fabrication, and testing of Bio-MEMS devices. |

| Course Outcomes | | |
|---|---|---|
| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
| CO1 | Explain Bio-MEMS concepts, materials and fabrication techniques | U |
| CO2 | Analyze microfluidic behavior in lab-on-chip systems | An |
| CO3 | Design Bio-MEMS devices for biomedical applications | C |
| CO4 | Apply lab-on-chip technologies for diagnostics and sensing | Ap |
| CO5 | Evaluate performance of Bio-MEMS systems and interpret results | E |

| Course Outcomes (CO) | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | |
| | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 |
| CO1 | 3 | 2 | – | – | 1 | – | – | – | – | – | – | 2 | – |
| CO2 | 2 | 3 | 1 | 2 | 2 | – | – | – | – | – | – | 3 | – |
| CO3 | 2 | 2 | 3 | 2 | 3 | – | – | – | – | 1 | – | 3 | 2 |
| CO4 | 2 | 2 | 2 | 3 | 3 | 1 | – | – | – | – | – | 3 | 2 |
| CO5 | 3 | 3 | 2 | 3 | 2 | – | – | – | – | – | 2 | 2 | 3 |

| Course Content | |
|---|---|
| **INTRODUCTION TO BIO-MEMS AND MICROFABRICATION TECHNIQUES**<br>MEMS fundamentals – Scaling laws – Overview of Bio-MEMS – Applications in healthcare – Materials used in Bio-MEMS – Biocompatibility issues. Photolithography – Etching (wet & dry) – Thin film deposition – Soft lithography – PDMS fabrication – Cleanroom processes | **9 Hours** |
| **MICROFLUIDICS**<br>Laminar flow – Reynolds number – Fluid transport in microchannels – Mixing techniques – Droplet microfluidics | **9 Hours** |



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| | |
|---|---|
| **BIOSENSORS & MICROACTUATORS**<br>Electrochemical sensors – Optical biosensors – Piezoelectric sensors – Microactuators – Signal transduction | **9 Hours** |
| **FEATURE EXTRACTION & APPLICATIONS**<br>LOC architecture – Point-of-care devices – DNA microarrays – Integration of sensors and microfluidics – Organ-on-chip | **9 Hours** |
| **APPLICATIONS & FUTURE TRENDS**<br>Drug delivery systems – Cancer detection – Micro-robotics – AI in BioMEMS – Future healthcare technologies | **9 Hours** |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Theory Hours:** | **45** | **Tutorial Hours:** | **0** | **Practical Hours:** | **0** | **Project Hours:** | **0** | **Total Hours:** | **45** |

**Learning Resources**

**Textbooks:**

1. Madou, Marc., *Fundamentals of Microfabrication*, CRC Press (2018)
2. Nguyen, Nam-Trung., *Microfluidics and Lab-on-a-Chip*, Artech House (2019)

**References:**

1. Kovacs, G., *Micromachined Transducers Sourcebook*
2. Whitesides, G., Microfluidics research papers
3. IEEE BioMEMS Journals

**Online Educational Resources:**

1. NPTEL – BioMEMS
   https://nptel.ac.in
2. Coursera – Microfluidics

**Assessment (Theory course)**

SA, Activity and Learning Task(s)*, Mini project, MCQ, End Semester Examination (ESE)

**Course Curated by**

| Expert(s) from Industry | Expert(s) from Higher Education Institution | Internal Expert(s) |
|---|---|---|
| | | Dr.V.Manimekalai |

| | | | |
|---|---|---|---|
| **Recommended by BoS on** | XX/YY/2026 | | |
| **Academic Council Approval** | No. | **Date** | XX/YY/2026 |



BoS Chair

| 24EIE026 | SMART BIOMEDICAL IMAGING ANALYTICS | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 |
| PE | | SDG | 3, 9,11 | | | |

| Pre-requisite courses | 24EII204, | Data Book / Code book (If any) | DICOM Standard |
|---|---|---|---|

| Course Objectives: | |
|---|---|
| The purpose of taking this course is to: | |
| 1 | Acquire knowledge of biomedical imaging modalities, DICOM standards, sensing systems, and global bio-imaging ecosystems. |
| 2 | Develop skills in enhancement, segmentation, feature extraction, and deep learning using Python, ImageJ, and AI frameworks. |
| 3 | Design sustainable, ethical, AI-enabled biomedical imaging systems for healthcare and environmental applications. |

| Course Outcomes | | |
|---|---|---|
| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
| CO 1 | explain biomedical imaging systems as data sensing and instrumentation systems | U |
| CO 2 | apply image enhancement and restoration techniques for improving biomedical data quality | Ap |
| CO 3 | analyze segmentation and feature extraction methods for biomedical decision-making systems | An |
| CO 4 | analyze and compare AI-based biomedical image processing algorithms for diagnostic applications | An |
| CO 5 | apply principles of sustainable and intelligent imaging systems in healthcare and environmental applications | Ap |

| Course Outcomes (CO) | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | PSO1 | PSO2 |
| | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 |
| 1 | 3 | 2 | – | – | 1 | – | 1 | 1 | – | 1 | – | | |
| 2 | 3 | 3 | 1 | – | 3 | – | 1 | – | – | 1 | – | | |
| 3 | 2 | 3 | 2 | 3 | 2 | – | 1 | – | 1 | 1 | – | | |
| 4 | 2 | 3 | 2 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | – | | |
| 5 | 1 | 2 | 2 | – | 2 | 3 | 3 | 2 | 1 | 1 | 2 | | |



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| Course Content | |
|---|---|
| **FOUNDATIONS & IMAGING AS DATA SENSING SYSTEMS**<br>Imaging modalities (MRI, CT, PET, microscopy); Sensors: CD/CMOS, noise; Image acquisition & DICOM; Open-source ecosystems; Sustainability: low-energy imaging, equitable access | **09 Hours** |
| **IMAGE ENHANCEMENT & PREPROCESSING**<br>Histogram equalization, CLAHE; Spatial & frequency filtering; Noise models (Gaussian, Poisson); Morphological operations; Sustainability: reduce repeat scans | **09 Hours** |
| **SEGMENTATION & FEATURE EXTRACTION**<br>Thresholding (Otsu, adaptive; Edge detection (Canny, Sobel); Watershed; U-Net (intro); Feature extraction (GLCM, shape); SDG: affordable diagnostics | **09 Hours** |
| **AI & DEEP LEARNING FOR BIO-IMAGING**<br>CNN architecture; U-Net variants; Transfer learning; GANs; Explainable AI (Grad-CAM); Sustainable AI (model efficiency) | **09 Hours** |
| **ADVANCED APPLICATIONS & SUSTAINABILITY**<br>Whole Slide Imaging (WSI) ;3D/4D imaging; Environmental imaging; Federated learning; Ethics, bias, fairness; SDG: global healthcare + sustainability | **09 Hours** |

| Theory Hours: | 45 | Tutorial Hours: | 0 | Practical Hours: | 0 | Project Hours: | 0 | Total Hours: | 45 |
|---|---|---|---|---|---|---|---|---|---|

**Learning Resources**

**Textbooks:**


1. Gonzalez, R. C., Woods, R. E., *Digital Image Processing*, Pearson, New York (2018).
2. Szeliski, R., *Computer Vision: Algorithms and Applications*, Springer, Cham (2022).


**References:**


1. Russ, J. C.,*The Image Processing Handbook*, **7th ed.**, CRC Press, Boca Raton, FL (2016).
2. Deserno, T. M.,"Biomedical Image Processing.", in *Biomedical Image Processing*, Springer, Berlin, Germany (2011): pp. 1–25.
3. Shen, D., Wu, G., Suk, H.-I.,"Deep Learning in Medical Image Analysis.", *Annual Review of Biomedical Engineering*, Vol. 19 (2017): pp. 221–248.DOI: 10.1146/annurev-bioeng-071516-044442
4. World Health Organization (WHO),"Medical Imaging and Radiation Safety.", Technical Report, WHO, Geneva, Switzerland (2020).
5. Litjens, G., Kooi, T., Bejnordi, B. E., et al.,"A Survey on Deep Learning in Medical Image Analysis.", *Medical Image Analysis*, Vol. 42 (2017): pp. 60–88. DOI: 10.1016/j.media.2017.07.005
6. Ronneberger, O., Fischer, P., Brox, T., "U-Net: Convolutional Networks for Biomedical Image Segmentation.", in *Proc. Int. Conf. Medical Image Computing and Computer-Assisted Intervention (MICCAI)*,Munich, Germany, Oct. 2015, pp. 234–241.
7. DOI: 10.1007/978-3-319-24574-4

**optional**

8. Isensee, F., Jaeger, P. F., Kohl, S. A. A., Petersen, J., Maier-Hein, K. H., "nnU-Net: A Self-configuring Method for Deep Learning-based Biomedical Image Segmentation.", *Nature Methods*, Vol. 18, No. 2 (2021): pp. 203–211. DOI: 10.1038/s41592-020-01008-z




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9. Kirillov, A., Mintun, E., Ravi, N., et al.,"Segment Anything.", IEEE/CVF International Conference on Computer Vision (ICCV), 2023. DOI: 10.48550/arXiv.2304.02643

**Online Educational Resources:**

**1. Core MOOCs / Structured Courses**

- **NPTEL – Medical Image Analysis**
  https://nptel.ac.in/courses/117105135
  Covers fundamentals + Indian academic alignment
- **SWAYAM – AI & Image Processing Courses**
  https://swayam.gov.in
  Government-certified courses
- **Coursera – Medical Imaging & Deep Learning**
  https://www.coursera.org/learn/medical-imaging
  Industry-oriented content
- **fast.ai – Practical Deep Learning**
  https://course.fast.ai
  Hands-on learning using real datasets

## 2. Research & Academic Platforms

- **IEEE Xplore Digital Library**
  https://ieeexplore.ieee.org
  Latest biomedical imaging research papers
- **arXiv (Computer Vision & Medical Imaging)**
  https://arxiv.org/list/cs.CV/recent
  Preprints (U-Net, AI imaging, etc.)
- **PubMed (Biomedical Research)**
  https://pubmed.ncbi.nlm.nih.gov
  Clinical and medical imaging papers
- **Papers With Code**
  https://paperswithcode.com/task/medical-image-segmentation
  Benchmarks + code implementations

## 3. Visualization & Concept Learning (VERY IMPORTANT)

- **3Blue1Brown (YouTube – Math & AI Intuition)**
  https://www.youtube.com/@3blue1brown
  Fourier transform, neural networks visualization
- **Stanford CS231n (YouTube – Deep Learning)**
  https://www.youtube.com/results?search_query=cs231n
  CNN fundamentals
- **MIT OpenCourseWare – AI & Health**
  https://ocw.mit.edu
  AI applications in healthcare
- **MicroscopyU (Nikon Educational Portal)**
  https://www.microscopyu.com
  Visual understanding of microscopy

# 4. Bio-Imaging & Domain-Specific Platforms

- **ImageJ / Fiji Documentation**
  https://imagej.net
  Biomedical image processing
- **CellProfiler Tutorials**
  https://cellprofiler.org/examples
  Cell-level image analysis



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- **BioImage Model Zoo**
  https://bioimage.io
  Pre-trained biomedical models
- **MONAI (Medical Open Network for AI)**
  https://monai.io
  Healthcare AI framework

## 5. Tools & Interactive Learning Platforms

- **Scikit-Image Gallery (Interactive Examples)**
  https://scikit-image.org/docs/stable/auto_examples/
  Step-by-step visualization
- **OpenCV Documentation**
  https://docs.opencv.org
  Computer vision implementations
- **Google Colab (Free GPU Notebooks)**
  https://colab.research.google.com
  Run AI models in browser
- **Kaggle Learn & Datasets**
  https://www.kaggle.com
  Real biomedical datasets

## 6. Standards, Ethics & Sustainability Resources

- **DICOM Standard**
  https://www.dicomstandard.org
  Medical imaging standards
- **WHO Digital Health**
  https://www.who.int/health-topics/digital-health
  SDG 3 healthcare systems
- **UN SDG Portal**
  https://sdgs.un.org
  Sustainability integration
- **EU AI Act Overview**
  https://artificialintelligenceact.eu
  AI ethics & regulation

| **Assessment (Theory course)** |
|---|
| SA, Activity and Learning Task(s)*, Mini project, MCQ, End Semester Examination (ESE) |

| **Course Curated by** | | | |
|---|---|---|---|
| **Expert(s) from Industry** | **Expert(s) from Higher Education Institution** | | **Internal Expert(s)** |
| [Name, Organization] | [Name, Institution] | | [Name, Department] |
| **Recommended by BoS on** | XX/YY/2024 | | |
| **Academic Council Approval** | No. | **Date** | XX/YY/2024 |



BoS Chair

| 24EIE027 | AI in Healthcare | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 |
| PE | | SDG | 3 , 9 | | | |

| Pre-requisite courses | 24EIE021<br>24CSI103<br>24EII204 | Data Book / Code book (If any) | IEC 60601 Standards Manual<br>NABL / NABH Guidelines Handbook<br>WHO Medical Device Technical Series |
|---|---|---|---|

**Course Objectives:**

The purpose of taking this course is to:

| | |
|---|---|
| 1 | Understand the fundamentals of artificial intelligence in healthcare |
| 2 | Apply machine learning techniques for medical data analysis |
| 3 | Analyse AI-based healthcare systems and applications |
| 4 | Understand healthcare data processing and clinical decision systems |
| 5 | Analyze ethical, legal, and regulatory aspects of AI in healthcare |

**Course Outcomes**

| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
|---|---|---|
| CO 1 | Explain the fundamentals of AI in healthcare systems | U |
| CO 2 | Apply machine learning techniques for healthcare data analysis | Ap |
| CO 3 | Apply AI models for medical diagnosis and prediction | Ap |
| CO 4 | Analyse healthcare data processing and AI system performance | An |
| CO 5 | Analyse ethical, legal, and regulatory issues in AI healthcare systems | An |

| Course Outcomes (CO) | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | |
| | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 |
| 1 | 3 | 2 | - | - | 2 | - | - | - | - | - | - | 2 | - |
| 2 | 3 | 3 | 2 | 2 | 3 | - | - | - | 1 | - | - | 2 | - |
| 3 | 3 | 3 | 2 | 2 | 3 | -- | - | - | 1 | - | - | 2 | - |
| 4 | 3 | 3 | 2 | 3 | 2 | -- | - | - | - | - | - | 2 | - |
| 5 | 3 | 3 | 2 | 3 | 2 | 2 | 1 | 3 | 1 | 1 | 2 | 2 | - |
| 6 | | | | | | | | | | | | | |

**Course Content**

| **INTRODUCTION TO AI IN HEALTHCARE**<br>Artificial Intelligence concepts, types of AI, role of AI in healthcare, AI vs traditional systems, applications in diagnosis, treatment, and monitoring | **9 Hours** |
|---|---|



BoS Chair

| | |
|---|---|
| **MACHINE LEARNING IN HEALTHCARE**<br>Supervised and unsupervised learning, classification and regression models, training datasets, feature extraction, applications in disease<br>**Self-study:**<br>**Case studies on AI-based diagnosis** | **9 Hours** |
| **AI IN MEDICAL IMAGING & DIAGNOSIS**<br>Image processing basics, AI in radiology (X-ray, CT, MRI), pattern recognition, computer-aided diagnosis systems | **9 Hours** |
| **HEALTHCARE DATA ANALYTICS & DECISION SYSTEMS**<br>Electronic health records (EHR), big data in healthcare, predictive analytics, clinical decision support systems (CDSS), performance evaluation | **9 Hours** |
| **ETHICS, REGULATIONS & FUTURE TRENDS**<br>AI ethics, data privacy, bias in AI models, regulatory frameworks, tele-AI systems, future trends in smart healthcare | **3 Hours** |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Theory Hours:** | **45** | **Tutorial Hours:** | **0** | **Practical Hours:** | **0** | **Project Hours:** | **0** | **Total Hours:** | **45** |

**Learning Resources**

**Textbooks:**

1. Jiang, Fei., Artificial Intelligence in Healthcare, Academic Press, Elsevier, London (2021).
2. Russell, Stuart., and Norvig, Peter., Artificial Intelligence: A Modern Approach, Pearson Education, New Delhi (2020).

**References:**

1. Topol, Eric., Deep Medicine: How Artificial Intelligence Can Make Healthcare Human Again, Basic Books, New York (2019).
2. Bronzino, Joseph D., Biomedical Engineering Handbook, CRC Press, Boca Raton (2015)
3. WHO, Ethics and Governance of Artificial Intelligence for Health, WHO Press, Geneva (2021).

**Online Educational Resources:**

1. National Programme on Technology Enhanced NPTEL – AI Courses: https://nptel.ac.in
2. SWAYAM, AI Programs: https://swayam.gov.in
3. World Health Organization AI in Health Resources: https://www.who.int
4. Institute of Electrical and Electronics Engineers – IEEE AI & Healthcare Papers: https://ieeexplore.ieee.org

**Assessment (Theory course)**

SAT, Activity and Learning Task(s), Mini project, MCQ, End Semester Examination (ESE)

**Course Curated by**

| Expert(s) from Industry | Expert(s) from Higher Education Institution | Internal Expert(s) |
|---|---|---|
| [Name, Organization] | [Name, Institution] | Dr.I.Jeya Daisy., Assistant Professor-II., Department of EIE., Kumaraguru college of Technology |
| **Recommended by BoS on** | XX/YY/2024 | |
| **Academic Council Approval** | No. | **Date** XX/YY/2024 |



BoS Chair

| 24EIE028 | Smart Healthcare Systems and Telemedicine | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 |
| PE | | SDG | SDG 3<br>SDG 9 | | | |

| Pre-requisite courses | 24EIE021,<br>24EII302<br>24EIT309 | Data Book / Code book (If any) | IEC 60601 Standards Manual<br>NABL / NABH Guidelines Handbook<br>WHO Medical Device Technical Series |
|---|---|---|---|

**Course Objectives:**

The purpose of taking this course is to:

| | |
|---|---|
| 1 | Understand the concepts of smart healthcare systems and telemedicine |
| 2 | Apply IoT technologies for healthcare monitoring |
| 3 | Analyze communication methods used in telemedicine systems |
| 4 | Understand healthcare data management and security practices |
| 5 | Analyze system integration and real-world healthcare applications. |

**Course Outcomes**

| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
|---|---|---|
| CO 1 | Explain the architecture and components of smart healthcare systems | U |
| CO 2 | Apply IoT technologies for remote patient monitoring | Ap |
| CO 3 | Apply communication protocols in telemedicine systems | Ap |
| CO 4 | Analyze healthcare data management and security mechanisms | An |
| CO 5 | Analyze integration and performance of smart healthcare systems | An |

| Course Outcomes (CO) | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | | |
| | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 | PSO-3 |
| 1 | 3 | 2 | - | - | 2 | - | - | - | - | - | - | 2 | - | |
| 2 | 3 | 3 | 2 | 2 | 3 | - | - | - | 1 | - | - | 2 | - | |
| 3 | 3 | 3 | 2 | 2 | 3 | -- | - | - | 1 | - | - | 2 | - | |
| 4 | 3 | 3 | 2 | 3 | 2 | -- | - | - | - | - | - | 2 | - | |
| 5 | 3 | 3 | 2 | 3 | 2 | - | - | - | 1 | 1 | 2 | 2 | - | |

**Course Content**

| | |
|---|---|
| **IRODUCTION TO SMART HEALTHCARE SYSTEMS**<br>Smart healthcare concepts, digital health ecosystem, architecture of smart healthcare systems, components (sensors, networks, cloud), wearable devices, applications in modern healthcare | **9 Hours** |



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| | |
|---|---|
| **IoT IN HEALTHCARE SYSTEMS**<br>IoT architecture, biomedical sensors (ECG, $SpO_2$, temperature), data acquisition, remote patient monitoring systems, wireless body area networks (WBAN) | **9 Hours** |
| **TELEMEDICINE SYSTEMS & COMMUNICATION**<br>Telemedicine concepts, teleconsultation, telemonitoring, communication protocols (Bluetooth, Wi-Fi, ZigBee), data transmission techniques, tele-ICU systems<br>**Self-study :** Tele-ICU system design and communication protocols analysis | **9 Hours** |
| **HEALTHCARE DATA MANAGEMENT & SECURITY**<br>Defibrillators, infusion pumps, ventilators – calibration methods, safety checks, performance | **9 Hours** |
| **SYSTEM INTEGRATION & APPLICATIONS**<br>Integration of IoT and telemedicine systems, interoperability (HL7 basics), smart hospitals, AI in healthcare overview, performance analysis and challenges | **9 Hours** |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Theory Hours:** | **45** | **Tutorial Hours:** | **0** | **Practical Hours:** | **0** | **Project Hours:** | **0** | **Total Hours:** | **60** |

**Learning Resources**

**Textbooks:**

1. Hemanth, D. Jude., *Intelligent IoT Systems in Healthcare*, Springer, Cham (2021)
2. Webster, John G., *Medical Instrumentation: Application and Design*, Wiley India Pvt. Ltd., New Delhi (2014).

**References:**

1. Bronzino, Joseph D., *The Biomedical Engineering Handbook*, CRC Press, Boca Raton (2015).
2. IEEE, *Journal of Biomedical and Health Informatics*, IEEE Publications (Recent Issues).
3. World Health Organization, *Digital Health and Telemedicine Guidelines*, WHO Press, Geneva (2019).

**Online Educational Resources:**

1. NPTEL – IoT and Applications: https://nptel.ac.in
2. SWAYAM – Digital Health Courses: https://swayam.gov.in
3. World Health Organization – Digital Health Resources: https://www.who.int
4. Institute of Electrical and Electronics Engineers – IEEE Xplore Digital Library: https://ieeexplore.ieee.org

**Assessment (Theory course)**

SAT, Activity and Learning Task(s), Mini project, MCQ, End Semester Examination (ESE)

**Course Curated by**

| Expert(s) from Industry | Expert(s) from Higher Education Institution | Internal Expert(s) |
|---|---|---|
| [Name, Organization] | [Name, Institution] | Dr.I.JEYA DAISY<br>Assistant Professor-II,EIE |
| **Recommended by BoS on** | XX/YY/2026 | |
| **Academic Council Approval** | No. | **Date** XX/YY/2026 |



BoS Chair

| 24EIE029 | ROBOTICS FOR SURGERY AND REHABILITATION | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 |
| PE | | SDG | 3,9,10 | | | |

| Pre-requisite courses | 24CSI103,24EII204, 24EII303 | Data Book / Code book (If any) | • ISO 13485, IEC 60601<br>• FDA 21 CFR Part 820<br>• IEEE Robotics Standards<br>• ROS2 Documentation |
|---|---|---|---|

| Course Objectives: | |
|---|---|
| The purpose of taking this course is to: | |
| 1 | Understand the principles of surgical and rehabilitation robotics, including kinematics, sensing, control systems, AI integration, and regulatory frameworks in healthcare. |
| 2 | Apply modeling, simulation, biomedical signal processing, and AI techniques to analyze and develop robotic systems for surgical and rehabilitation applications. |
| 3 | Design and evaluate sustainable, ethical, and inclusive robotic healthcare solutions addressing global challenges, safety standards, and SDG goals. |

| Course Outcomes | | |
|---|---|---|
| After successful completion of this course, the students shall be able to | | Revised Bloom's Taxonomy Levels (RBT) |
| CO 1 | Explain fundamentals, classifications, and regulatory frameworks of medical robotics | U |
| CO 2 | Apply kinematics, dynamics, and mechanism design in surgical robotics | Ap |
| CO 3 | Apply sensing techniques and biomedical signal processing in robotic healthcare systems | Ap |
| CO 4 | Analyze control strategies and AI techniques used in surgical and rehabilitation robotics | An |
| CO 5 | Analyze robotic healthcare systems with respect to sustainability, safety, and inclusivity | An |

| Course Outcomes (CO) | Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1) | | | | | | | | | | | Program Specific Outcomes (PSO) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | PSO1 | PSO2 |
| | Engineering Knowledge | Problem Analysis | Design/Development of Solutions | Conduct Investigations of Complex Problems | Engineering Tool Usage | The Engineer and The World | Ethics | Individual and Collaborative Team work | Communication | Project Management and Finance | Life-Long Learning | PSO-1 | PSO-2 |
| 1 | 3 | 2 | – | – | 1 | 2 | 1 | 1 | – | – | 1 | 2 | 1 |
| 2 | 3 | 3 | 2 | 2 | 3 | 1 | – | – | 1 | – | 1 | 3 | 2 |
| 3 | 2 | 3 | 2 | 2 | 3 | 1 | – | – | 1 | – | 1 | 3 | 2 |
| 4 | 2 | 3 | 2 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 2 | 2 | 3 |
| 5 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 3 |



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| Course Content | |
|---|---|
| **FOUNDATIONS OF MEDICAL ROBOTICS**<br>Evolution: ROBODOC → da Vinci → AI-assisted surgery - Classification of medical robots -Surgical workflow integration - Regulatory frameworks (FDA, ISO, IEC) - Ethical and sustainable healthcare systems | **9 Hours** |
| **KINEMATICS & MECHANISM DESIGN**<br>DH parameters, forward/inverse kinematics - Jacobian and singularity - RCM mechanisms - Continuum robots - Sustainable robotic design | **9 Hours** |
| **SENSING & HUMAN–ROBOT INTERACTION**<br>Sensors: vision, force, EMG, EEG - Haptics and teleoperation - Sensor fusion - AI-based perception - Affordable healthcare robotics | **9 Hours** |
| **CONTROL SYSTEMS & AI**<br>PID, impedance, admittance control - MPC and robust control - Reinforcement learning - Safe AI systems - Sustainable automation | **9 Hours** |
| **REHABILITATION ROBOTICS & PROSTHETICS**<br>Exoskeletons and prosthetics - Neurorehabilitation and BCI - Gait analysis - Frugal innovation | **9 Hours** |

| Theory | Tutorial | Practical | Project | Total |
|---|---|---|---|---|
| **Hours: 45** | **Hours: 00** | **Hours: 00** | **Hours: 00** | **Hours:45** |

**Learning Resources**

**Textbooks:**


1. Siciliano, Bruno., Sciavicco, Lorenzo., Villani, Luigi., Oriolo, Giuseppe., *Robotics: Modelling, Planning and Control.*, **2nd ed.**, Springer, Cham, Switzerland (2023).
2. Corke, Peter., *Robotics, Vision and Control: Fundamental Algorithms in MATLAB.*, **2nd ed.**, Springer, Cham, Switzerland (2017). *(Still globally standard for robotics labs & simulation)*
3. Taylor, Russell H., Menciassi, Arianna., Fichtinger, Gábor., Dario, Paolo., "Medical Robotics and Computer-Integrated Surgery.", *Springer Handbook of Robotics.*, **2nd ed.**, Springer, Cham (2016).


**References:**


1. Craig, John J., *Introduction to Robotics: Mechanics and Control.*, **4th ed.**, Pearson, USA (2018).
2. Murray, Richard M., Li, Zexiang., Sastry, S. Shankar., *A Mathematical Introduction to Robotic Manipulation.*, CRC Press, Boca Raton (Updated reprint, 2017).
3. Netter, Frank H., *Atlas of Human Anatomy.*, **8th ed.**, Elsevier, Philadelphia (2022).
4. Hogan, Neville., "Impedance Control: An Approach to Manipulation.", *Journal of Dynamic Systems*, Vol.107 (1985): pp.1–24. DOI:10.1115/1.3140702 *(Foundational – still current)*
5. Yang, Guang-Zhong., "Medical Robotics—Regulatory and Ethical Challenges.", *IEEE Transactions on Robotics*, Vol.36 No.4 (2020): pp.1025–1035. DOI:10.1109/TRO.2020.2981234
6. Krishnan, Sanjay., et al., "Surgical Robot Learning and Automation.", *Annual Review of Control, Robotics, and Autonomous Systems*, Vol. 5 (2022): pp. 421–445. DOI:10.1146/annurev-control-042920-092819
7. FDA., "Artificial Intelligence/Machine Learning-Based Software as a Medical Device (SaMD) Action Plan.", U.S. FDA, USA (2021).
8. WHO., "Global Report on Assistive Technology.", World Health Organization, Geneva (2022).




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9. ISO., *ISO 13485: Medical Devices – Quality Management Systems.*, ISO, Geneva (2016, latest enforced standard).

**Online Educational Resources:**

1. IEEE Xplore – https://ieeexplore.ieee.org
2. PubMed Central – https://www.ncbi.nlm.nih.gov/pmc/
3. ROS2 Documentation – https://docs.ros.org/en/humble/
4. MIT OpenCourseWare – https://ocw.mit.edu
5. WHO Assistive Technology – https://www.who.int
6. PhysioNet – https://physionet.org
7. Coursera – Modern Robotics (Northwestern, updated)

| **Assessment (Theory course)** |
|---|
| SA, Activity and Learning Task(s) , Mini project, MCQ, End Semester Examination (ESE) |

| **Course Curated by** | | | |
|---|---|---|---|
| **Expert(s) from Industry** | **Expert(s) from Higher Education Institution** | **Internal Expert(s)** | |
| [Name, Organization] | [Name, Institution] | Umesh M V<br>Associate Professor, EIE | |
| **Recommended by BoS on** | XX/YY/2026 | | |
| **Academic Council Approval** | No. | **Date** | XX/YY/2026 |



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